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**Karnafuly Dry Dock Special Economic Zone Ltd.**

944/A, Strand Road, Majhirghat,  
Chittagong-4000.

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**Revised Environmental Impact Assessment Report of  
Karnafuly Dry Dock Special Economic Zone Ltd.,  
Chittagong, Bangladesh**



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**Prepared by:**

**Shahidul Consultant**

66/D, Indira Road,

Dhaka-1215, Bangladesh

<http://www.shahidulconsultantbd.com/>



## *Disclaimer*

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## ***List of Abbreviations and Symbols***

<b>AAQ</b>	Ambient Air Quality
<b>ADPC</b>	Asian Disaster and Preparedness Center
<b>ADRC</b>	Asian Disaster Reduction Center
<b>AECL</b>	Adroit Environment Consultants Limited
<b>AEZ</b>	Agro Ecological Zone
<b>AMSL</b>	Above Mean Sea Level
<b>AP</b>	Action Plan
<b>AS</b>	Aquatic Survey
<b>BDT</b>	Bangladesh Taka
<b>BERC</b>	Bangladesh Energy Regulatory Commission
<b>BFD</b>	Bangladesh Forest Department
<b>BIWTA</b>	Bangladesh Inland Water Transport Authority
<b>BM</b>	Benchmark
<b>BMD</b>	Bangladesh Meteorological Department
<b>BNAAQs</b>	Bangladesh's National Ambient Air Quality Standard
<b>BOD</b>	Biological Oxygen Demand
<b>BOI</b>	Board of Investment
<b>Bq/l</b>	Becquerel Per Litre
<b>BRAC</b>	Bangladesh Rural Advancement Committee
<b>BRTC</b>	Bureau of Research Testing and Consultation
<b>BUET</b>	Bangladesh University of Engineering and Technology
<b>BWDB</b>	Bangladesh Water Development Board
<b>CAA</b>	Civil Aviation Authority
<b>CAMS</b>	Continuous Air Monitoring Station
<b>CDDL</b>	Chittagong Dry Dock Limited
<b>CEC</b>	Cation Exchange Capacity
<b>CF &amp; AO</b>	Chief Finance & Accounting Officer
<b>CFC</b>	Chlorofluorocarbons
<b>CFS</b>	Container Freight Station
<b>cmol/kg</b>	centimoles of charge per kilogram of soil
<b>CNG</b>	Compressed natural Gas
<b>CO</b>	Carbon Monoxide
<b>COD</b>	Chemical Oxygen Demand
<b>CPA</b>	Chittagong Port Authority
<b>CRC</b>	Convention on the Rights of the Child
<b>CSD</b>	Cutter Suction Dredgers
<b>CSR</b>	Corporate Social Responsibilities
<b>CUFL</b>	Chittagong Urea Fertilizer Limited
<b>cum</b>	Cubic Meter
<b>DAFOR</b>	Dominant Abundant Frequent Occasional Rare
<b>DAPFCL</b>	Di-Ammonium Phosphate Fertilizer Company Limited



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<b>dba</b>	Decibel-A Scale
<b>DC</b>	Deputy Commissioner
<b>DG</b>	Diesel Generator
<b>DGM</b>	Deputy General Manager
<b>DGPS</b>	Differential Deo Positioning System
<b>DMB</b>	Disaster Management Board
<b>DO</b>	Dissolved Oxygen
<b>DoE</b>	Department of Environment
<b>DWT</b>	Dead Weight Tonnage
<b>EA</b>	Environmental Assessment
<b>EC</b>	Electrical Conductivity
<b>ECA</b>	Environment Conservation Act
<b>ECC</b>	Environmental Clearance Certificate
<b>ECNWRC</b>	Executive Committee of the National Water Resources Council
<b>ECR</b>	Environment Conservation Rules
<b>EHS</b>	Environmental Health and Safety
<b>EPFI</b>	Equator Principles Financial Institutions
<b>ESAP</b>	Environmental and Social Action Plan
<b>ESIA</b>	Environmental and Social Impact Assessment
<b>ESMMP</b>	Environmental and Social Management and Monitoring Plan
<b>ESMS</b>	Environmental and Social Management System
<b>ETP</b>	Effluent Treatment Plant
<b>FEI</b>	Food Energy Intake
<b>FI</b>	Financial Intermediary
<b>GHG</b>	Greenhouse Gas
<b>GIIP</b>	Good International Industry Practice
<b>GM</b>	General Manager
<b>GOB</b>	Government of Bangladesh
<b>GRC</b>	Grievance Redress Committee
<b>GRM</b>	Grievance Redressal Mechanism
<b>GSB</b>	Geological Survey of Bangladesh
<b>HAP</b>	Hazardous Air Pollutants
<b>HFC</b>	Hydrofluorocarbons
<b>HR</b>	Human Resources
<b>ICD</b>	Inland Container Depot
<b>IEE</b>	Initial Environment Examination
<b>IFC</b>	International Finance Corporation
<b>ILO</b>	International Labor Organization
<b>IMO</b>	International Maritime Organization
<b>ISLWL</b>	Indian Spring Low Water Level
<b>IUCN</b>	International Union for the Conservation of Nature
<b>KAFCO</b>	Karnafuly Fertilizer Company
<b>KDDL</b>	Karnafuly Dry Dock Limited
<b>KEPZ</b>	Korean Export Processing Zone
<b>kg</b>	Kilogram
<b>KL</b>	Kilolitres

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<b>KLD</b>	kilolitres per day
<b>KSBL</b>	Karnafuly Ship Builders (Pvt.) Limited
<b>kVA</b>	Kilo volt ampere
<b>LC</b>	Least Concern
<b>LCC</b>	Location Clearance Certificate
<b>Leq</b>	Time-Weighted Average Noise Level
<b>lpcd</b>	Litres Per Capita Per Day
<b>LPG</b>	Liquefied Petroleum Gas
<b>LULC</b>	Land Use Land Cover
<b>m/s</b>	Metre Per Second
<b>MBT</b>	Main Boundary Thrust
<b>µg/m<sup>3</sup></b>	Microgram Per Cubic Meter
<b>µs/cm</b>	Micro Seconds Per Centimetre
<b>MEA</b>	Multilateral Environmental Agreements
<b>mg/l</b>	Milligram Per Liter
<b>MIS</b>	Management Information System
<b>mm</b>	Millimeter
<b>MoEF</b>	Ministry of Environment and Forests
<b>MOFL</b>	Ministry of Fisheries and Livestock
<b>MOLE</b>	Ministry of Labor and Employment
<b>MOS</b>	Ministry of Shipping
<b>MPN</b>	Most Probable Number
<b>MSDS</b>	Material Safety Data Sheet
<b>MW</b>	Mega Watt
<b>NGO</b>	Non-Governmental Organizations
<b>NOC</b>	No Objection Certificate
<b>NOx</b>	Nitrogen Oxides
<b>NPK</b>	Nitrogen Phosphorus Potassium
<b>NQ</b>	Noise Quality
<b>NT</b>	Not Threatened
<b>NTU</b>	Nephelometric Turbidity Unit
<b>NWMP</b>	National Water Management Plan
<b>NWRC</b>	National Water Resources Council
<b>NWRD</b>	National Water Resources Database
<b>OM</b>	Organic Matter
<b>OP</b>	Operational Policies
<b>ORP</b>	Oil Recovery Pump
<b>OWS</b>	Oil Water Separator
<b>PAH</b>	Polycyclic Aromatic Hydrocarbon/ Project Affected Households
<b>PCB</b>	Polychlorinated Biphenyls
<b>PCU</b>	Passenger Car Units
<b>PFC</b>	Perfluorocarbons
<b>PM</b>	Particulate Matter
<b>ppb</b>	Parts Per Billion
<b>PPE</b>	Personnel Protective Equipment
<b>ppm</b>	Parts Per Million

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<b>PS</b>	Performance Standard
<b>PSI</b>	Pound-force Per Square Inch
<b>PSMP</b>	Power System Master Plan
<b>QA</b>	Quality Assurance
<b>QC</b>	Quality Control
<b>RTM</b>	River Traffic Monitoring
<b>SBR</b>	Sequencing Batch Reactor
<b>SEP</b>	Stakeholder Engagement Plan
<b>SeQ</b>	Sediment Quality
<b>SMS</b>	Safety Management System
<b>SO<sub>2</sub></b>	Sulphur Dioxide
<b>SoQ</b>	Soil Quality
<b>SPL</b>	Sound Pressure Levels
<b>SPM</b>	Suspended Particulate Matter
<b>SRDI</b>	Soil Resource Development Institute
<b>SSW-NNE</b>	South Souht West - North North East
<b>STD</b>	Sexually Transmitted Disease
<b>STP</b>	Sewage treatment plant
<b>TBT</b>	Tributyltin
<b>TDS</b>	Total Dissolved Solids
<b>TOR</b>	Terms of Reference
<b>TSS</b>	Total Suspended Solids
<b>UHP</b>	Ultra High Pressure
<b>UN</b>	United Nations
<b>UNCED</b>	United Nations Conference on Environment and Development
<b>UNEP</b>	United Nations Environment Programme
<b>UP</b>	Union Parishad
<b>USD</b>	United States Dollar
<b>USEPA</b>	United States Environmental Protection Agency
<b>UTM</b>	Universal Transverse Mercator
<b>VOC</b>	Volatile Organic Carbon
<b>WARPO</b>	Water Resources and Planning Organisation
<b>WB</b>	World Bank
<b>WRE</b>	Department of Water Resources Engineering

## Chapter 1

### INTRODUCTION

#### 1. Introduction

Karnafuly Ship Builders (Pvt.) Limited (herein after referred to as 'KSBL') is one of the leading ship building companies in Bangladesh, established in Chittagong in the year 1994, for repair and construction of ships. KSBL functions in the areas of designing, drawing and building of Dredger, Tug, Barge, Cargo Ship, Fishing Trawler, Passenger Vessel, Patrol & Pilot Vessel, Crew Boat, Naval Craft, etc. KSBL currently owns the largest privately owned shipyard in the country, situated on the southern bank of Karnafuly River, having capacity to dock 2 vessels upto 350 feet in length at a time. KSBL has repaired and renovated about 450 vessels and built 62 new vessels of various types since the past 18 years of operations.

KSBL has also formed a Joint Venture Consortium in 2009 with VOSTA LMG BV, a world renowned Dutch-German Company in dredger technology. Under this joint venture, the company has manufactured 450mm of Cutter Suction Dredgers (CSD) for the first time in Bangladesh.

KSBL now intends to set up a Special Economic Zone name Karnafuly Dry Dock Special Econmoic Zone (KDDSEZL) and two dolphin jetties on the River Karnafuly in Bangladesh (herein after referred as the 'Project'). Karnafuly Dry Dock Limited (herein after referred as 'KDDL'), a fully owned subsidiary of KSBL, will own the project and supervise the activities associated with the construction and operation of the project.

#### 1.1. Project overview

The Project will be located within the administrative limit of the Chittagong Port Authority in Anwara Upzilla, Chittagong district, Bangladesh. The project site is located in Badalpura village on the eastern bank of Karnafuly River at an aerial distance of 6km from the Chittagong Port and about 3 nautical miles (5.56 km) from the Bay of Bengal. An indicative location of the project site is presented in the following Figure. The Karnafuly Dry Dock Special Econmoic Zone (KDDSEZL) will facilitate ship repairing, ship building, and dry docking of ocean going vessels up to 100,000 tons dead weight tonnage (DWT). The two dolphin jetties will provide support to ships on their arrival in its berth. An approach trestle is also planned that will connect the jetty to the shore and will accommodate a roadway, pedestrian walkway and utilities corridor. The Chittagong Port, being the principal seaport of Bangladesh, faces huge river traffic due to arrival of a good number of ocean going ships. Despite the increasing traffic in and around Chittagong Port, there is no modern dry docking facility except the existing Chittagong Dry Dock which provides limited dry docking facilities for vessels up to 20,000 tons DWT only. Therefore, the proposed KDDSEZL will have

immense business potential and viability as the only dry dock special economic zone in Bangladesh with all the necessary facilities to repair small, medium and big ships up to 100,000 tons DWT. The Feasibility Report on Conceptual Design and Cost Estimation for the project has been prepared by BMT Asia Pacific.

As per the procedure, an Initial Environment Examination (IEE) Report for development of on-site and off-site facilities along with proposed Terms of Reference (ToR) was submitted to Department of Environment (DOE) on 26.09.2017. Approved ToR was granted by DoE vide Memo No. 22.02.0000.018.72.57.17.490 dated 10th October, 2017. Copy of the approved ToR by DoE Bangladesh is attached as **Annex XXII**. The EIA study for the development of proposed KDDSEZL has been carried out as per the ToR issued by DoE.

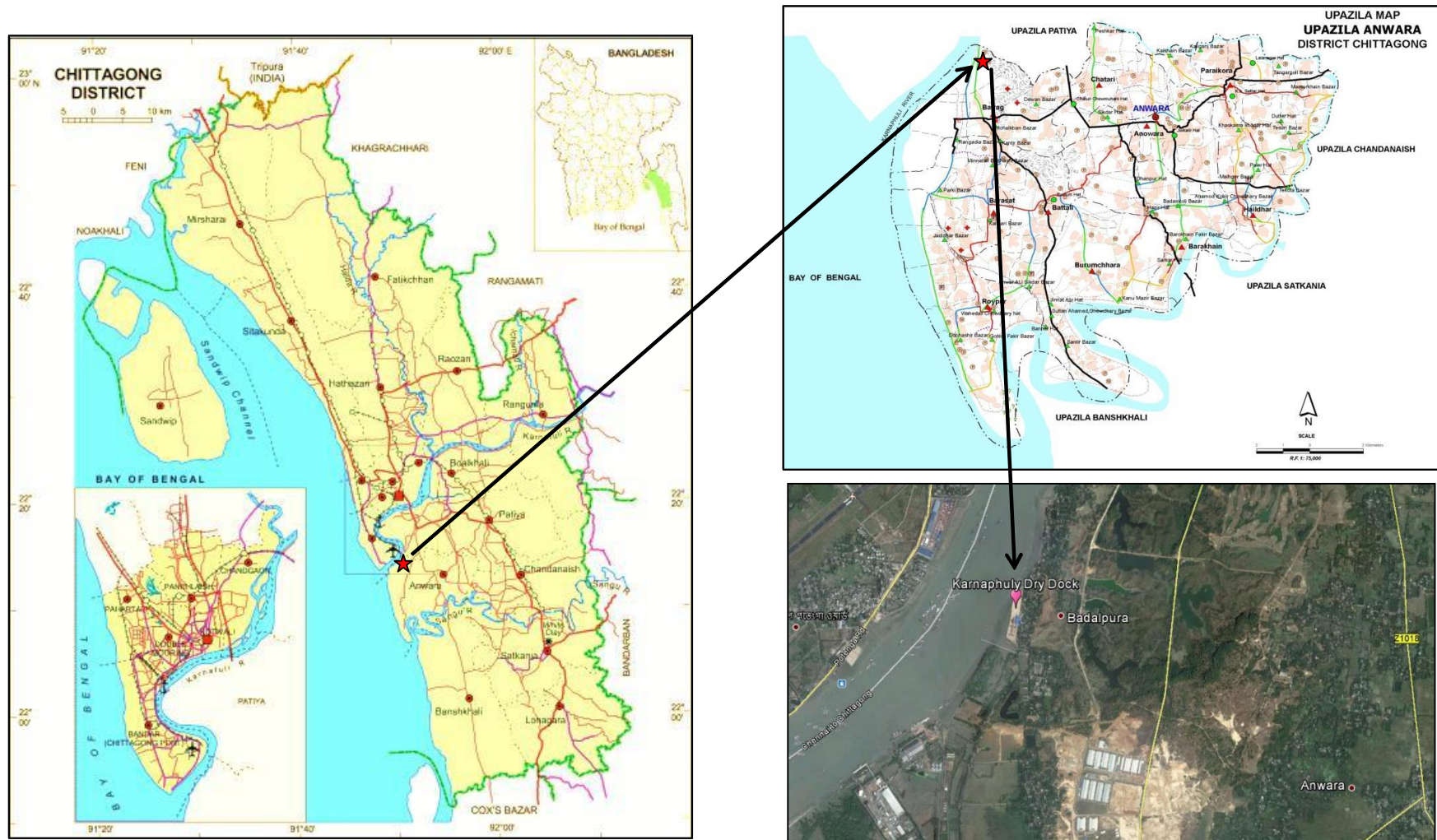


Figure 1: Indicative location of the project site



## 1.2. Need for study

KDDSEZL, through IDLC Finance Limited, has sought financial assistance from the World Bank for the proposed project. KDDSEZL has also sought partial financing from the Asian Development Bank (ADB). As part of the funding requirement, KSBL is required to address the social and environmental issues related to the project.

The proposed project being a KDDSEZL which will facilitate ship repairing, ship building, and dry docking of ocean going vessels up to 100,000 DWT falls under the Red category as classified under Schedule-I of the Environment Conservation Rules, 1997. KDDSEZL needs to obtain Location Clearance Certificate (LCC) and Environmental Clearance Certificate (ECC) from the Department of Environment (DoE), Bangladesh. The Initial Environment Examination (IEE) of the project has been completed by Adroit Environmental Consultants Limited. The project has submitted the IEE and application with DoE for receiving the specific Terms of Reference (TOR) for conducting EIA study in order to obtain the ECC.

In lieu of this, Shahidul Consultant which is fastest growing research oriented environmental consultancy firm has been appointed by KDDSEZL to carry out an Environmental and Social Impact Assessment (ESIA) Study for the proposed project as per the requirements of World Bank Operational Policies (OP 4.01 and others as applicable), EHS (Environmental Health and Safety) guidelines and ADB Safeguard Policy Statement, 2009 as well as Environment Conservation Rules, 1997 of Governments of the People's Republic of Bangladesh. The ESIA study has also been undertaken for the purpose of obtaining environmental clearance from the Department of Environment (DoE), Bangladesh.

The environmental and social assessment has been carried out against the following reference framework:

- Applicable national and local regulatory requirements;
- Applicable World Bank Operational Policies
- Environmental Assessment (OP 4.01), Natural Habitats (OP 4.04) and Pest Management (OP 4.09)
- ADB Safeguard Policy Statement, June 2009
- World Bank Group's General EHS Guidelines
- World Bank Group's EHS Guidelines for Ports, Harbors and Terminals
- World Bank Group's EHS Guidelines for Shipping
- Equator Principles, June 2013

## 1.3. Scope of work

The scope of the project comprises of:

- Reconnaissance survey and primary field surveys to assess the existing environmental conditions in the project area, including the identification of the environment and social receptors;

- Consultations with local community and other key stakeholders of the project to understand public perception and their expectations from project;
- Collection of additional secondary environmental, social and demographic information;
- Collection of information on forestry, flora and fauna, and natural habitats and species of special conservation/scientific interest through primary ecological survey of the study area;
- Identification and review of the applicable standards and identification of key issues;
- Evaluation of potential social impacts of the Project and its components (including associated facilities as per the details available);
- Preparation of Environmental and Social Management Plan (ESMP) based on the findings of the ESIA and develop procedures for mitigation and monitoring of environment and social impacts on an on-going basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the ESIA.
- Suggest appropriate institutional arrangement and capacity building needs for proper implementation of environmental and social management plan during the pre-construction, construction and operation phase.
- Support KDDSEZL in obtaining EIA approval and Environmental Clearance from DOE.

#### **1.4. Approach and methodology**

The Environment and Social Impact Assessment study for the project has been carried out as per the requirements of the Environment Conservation Rules, 1997, World Bank Operational Policies and ADB Safeguard Policies related to environment and social. The environmental impact assessment study considers an area of 5 km around the project site as study area. For assessment of the socio-economic impacts of the project, a study area of 2km radius has been considered, as detailed in Section 4.4.2.

Reconnaissance surveys were conducted to identify environmental and social issues in the project area. A detailed desk based literature survey was also undertaken and relevant information was collected for environmental and social baseline assessment.

Primary baseline monitoring was carried out by Adroit Environment Consultants Limited (herein after referred to as 'AECL'), Bangladesh for eight weeks, i.e., two months starting from mid-July to mid-August, 2014 for meteorology, air, water, noise and soil quality. Traffic survey for assessing the traffic volume in Karnafuly River and major roads in the project area was also undertaken. A primary ecological survey was also carried out for the entire study area to assess biodiversity, species richness and abundance. In addition, land use pattern study was carried out using latest satellite imagery.

Social surveys were also conducted by Shahidul Consultant and AECL and the project affected village was visited to collect information on the socio-economic and cultural aspects of the local community. Various government departments and other agencies were contacted to gather information relevant to the project or the project area. Based on the baseline and proposed activities, an impact analysis was carried out where potential direct and indirect impacts of the project activities have been considered. A detailed

Environmental and Social Management and Monitoring Plan (ESMMP) has been formulated for the Project where measures are proposed to mitigate adverse impacts along with recommended good practices. Following plans have been developed for the project:

- Construction Labour Management Plan;
- Waste Management Plan;
- Occupational Health and Safety Plan;
- Emergency Response Plan
- Stakeholder Engagement Plan
- Grievance Redressal Mechanism;
- Environment and Social Monitoring Plan

### **1.5. Agencies contacted**

The following agencies were contacted during the course of the study:

- Chittagong Port Authority
- Shahidul Consultant
- Karnafuly Ship Builders Limited
- Adroit Environmental Consultants Limited
- Chittagong Dry Dock Limited
- Local Forest Department
- Bangladesh Rural Advancement Committee (BRAC)
- Bangladesh University of Engineering and Technology (BUET)
- Bangladesh Meteorological Department (BMD)
- Chittagong City Corporation
- Chittagong Development Authority
- Bangladesh Inland Water Transport Authority
- Bangladesh Inland Water Transport Corporation
- Department of Environment
- Bangladesh Forest Research Institute
- Bangladesh Water Development Board
- Bangladesh Marine Academy
- Bangladesh Marine Fisheries Academy
- Badalpura Primary School

### **1.6. Limitations**

The impact assessment study for the proposed project is largely based on the project information from client, discussion with local community and other stakeholders and observations from various surveys and investigations undertaken in the project area. Professional judgement and subjective interpretation of facts has been applied for this study. Any change in project location, orientation, proposed plant components, proposed project activities is likely to result in variation of the impacts. It is to be noted that any technological advances during the course of construction and execution of the project will alter the extent and severity of impacts on the surroundings.

This report has been prepared by Shahidul Consultant in accordance with the agreed upon scope of work and generally accepted scientific practice in effect at the time of Shahidul Consultant's assessment of the subject property. The statements, conclusions, and opinions contained in this report are only intended to give approximations of the environmental and social condition of the site. Moreover, there are several major limitations that are inherent in the conduct of this, or any other, environmental and social assessment.

- First, it is difficult to predict which, if any of the potential environmental and social issues identified will become actual problems in the future, environmental regulations continually change, as do the enforcement priorities of the applicable governmental agencies involved.
- Second, even for problems currently identified, it is often difficult and sometimes impossible to accurately estimate the liabilities that may be involved in mitigating the problem(s), for the legal and technological standards for evaluating, mitigating, and allocating liability for environmental issues are in a constant state of change. Moreover, the liability for mitigating environmental problems tends to be highly dependent upon agency negotiations and the sometimes arbitrary and unpredictable nature of agency officials charged with such negotiations.

This report was prepared by Shahidul Consultant for the benefit of its client, KDDSEZL. Shahidul Consultant's client may release the information to third parties, who may use and rely upon the information at their own discretion. However, any use of or reliance upon the information by a party other than specifically named above shall be solely at the risk of such third party and without legal recourse against Shahidul Consultant, its subsidiaries and respective employees, officers, or directors; regardless of whether the action in which recovery of damages is sought is based upon contract, tort, statute, or otherwise. This information shall not be used or relied upon by a party that does not agree to be bound by the above statement. Any information provided in the present report shall not be considered or construed as legal advice.

### **1.7. Layout of the report**

The layout of the report is as provided below:

**Chapter 1:** Introduction

**Chapter 2:** Describes Policy, Legal and Administrative Framework

**Chapter 3:** Description of the Proposed Project and its Area of Influence

**Chapter 4:** Details Description of the Environmental and Social Baseline of Project Area

**Chapter 5:** Provides details on the Stakeholder Analysis, Consultation, Public Awareness, Disclosure and Grievance Redress.

**Chapter 6:** Provides an Analysis of Alternatives

**Chapter 7:** Presents Impact Assessment and Mitigation Measures

**Chapter 8:** Provides Environmental and Social Management and Monitoring Plan (ESMMP)

**Chapter 9:** Presents the Conclusion and Categorization of Project

**Following annexures have been attached to the report,**

**Annexure I:** All Legal Documents

**Annexure II:** Proposed dredging layout

**Annexure III:** River cross sections around the project site

**Annexure IV:** Social Survey Questionnaire

**Annexure V:** Details of Land and Titleholders

**Annexure VI:** Topographic and bathymetric contour map

**Annexure VII:** List of Attendees

**Annexure VIII:** Construction Labour Management Plan

**Annexure IX:** Waste Management Plan

**Annexure X:** Occupational health and safety plan

**Annexure XI:** Emergency Preparedness and Response Plan

**Annexure XII:** Construction Dust Management Plan

**Annexure XIII:** Traffic Safety Management Plan

**Annexure XIV:** Stakeholder Engagement Plan

**Annexure XV:** Grievance Redressal Mechanism

**Annexure XVI:** Terms of Reference for EHS Manager

**Annexure XVII:** Year Wise Market Price List for Lands of Badalpura (2008-15)

**Annexure XVIII:** Checklist for Social Audit

**Annexure XIX:** Newspaper Notices for Public Hearing

**Annexure XX:** Chemical Management Plan

**Annexure XXI:** Master Plan

**Annexure XXII:** Approved TOR

## Chapter 2

### DESCRIPTION OF THE PROJECT

#### 2. Description of the proposed project

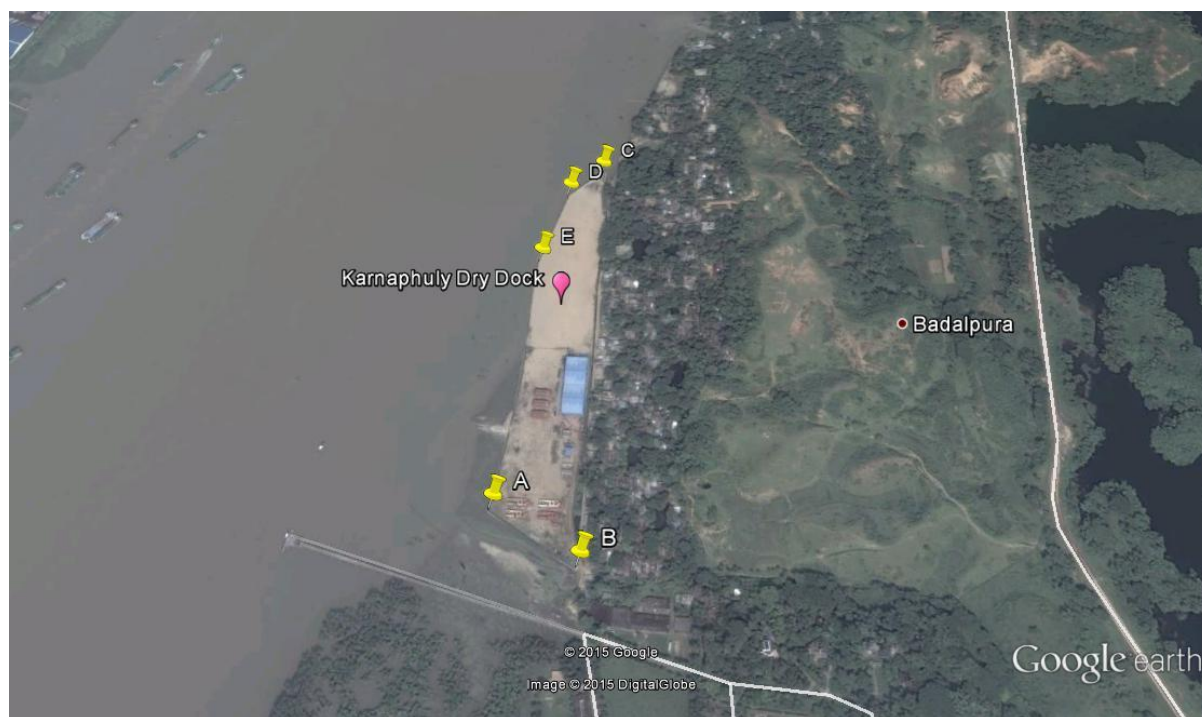
This section of the report provides the details about the project location, site settings and details pertaining to procurement of land. It also provides a description of project components along with associated facilities. The resource requirements and pollution control systems proposed have also been discussed.

##### 2.1. Project location

The proposed project site is located at Badalpura Mouza in Anwara Upazila of Chittagong Division, Bangladesh. The geographical coordinates of the site are as given below in the following Table and Figure, respectively.

**Table 1: Geographical Coordinates of Site**

Points	Coordinates
A	22°14'44.19"N, 91°50'8.04" E
B	22°14'41.89"N, 91°50'11.35"E
C	22°14'59.10"N, 91°50'13.02"E
D	22°14'58.06"N, 91°50'11.48"E
E	22°14'54.83"N, 91°50'10.12"E



**Figure 2: Geographical Coordinates of Proposed Project Site**

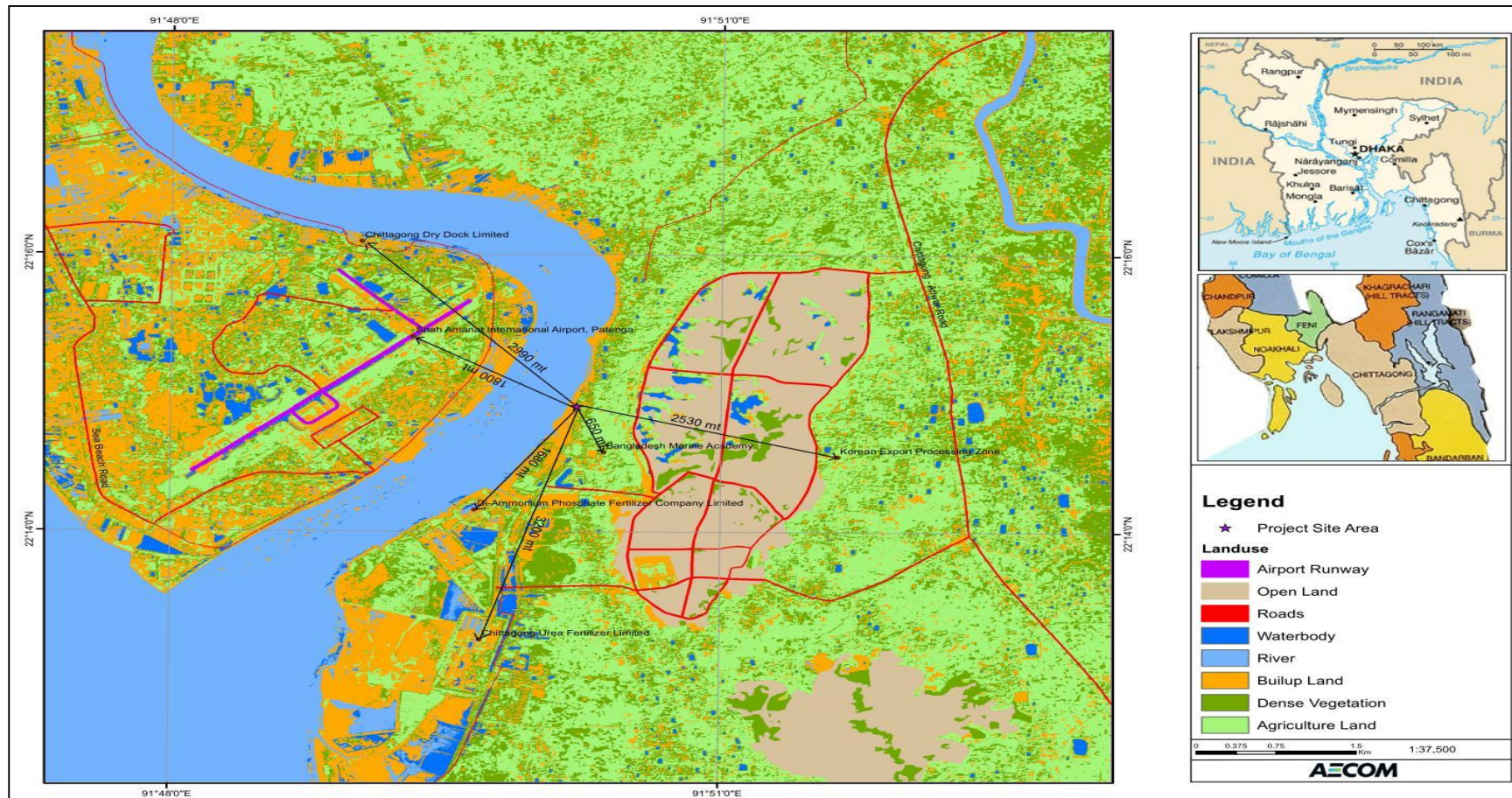
The project site is situated on the eastern bank of the River Karnaphuly just opposite to Shah Amanat International Airport, Patenga. The airport is at an aerial distance of 2 km west to the project site. The Chittagong Port is located at an aerial distance of 6 km from the site



towards north-west. The existing dry dock of the Chittagong Port, operated by Chittagong Dry Dock Limited, is situated at about 3 km from the project site. The Karnafuly tunnel is about 2.7 km South-West from the project site. The Bangladesh Marine Academy is situated adjacent to the project site in south-east direction. The Academy has an existing jetty, just south of the project site, and currently KDDSEZL also has permission to use the jetty. A detailed location map showing the adjacent details is given in the following Figure.

The project site is also situated close to three fertilizer industries viz. Chittagong Urea Fertilizer Limited (CUFL), Di-Ammonium Phosphate Fertilizer Company Limited (DAPFCL) and Karnafuly Fertilizer Company (KAFCO) within range of 1 – 3.5 km south-west of the project site. The site is in close proximity (1 km) to the upcoming Korean Export Processing Zone (KPEZ) towards the east. The site surrounding area of the project are as follows,

Sides	Objects	GPS Coordinates	Distance
<b>North</b>	Chittagong Port, Chittagong Dry Dock Limited.	22°18'36.22"N 91°48'01.62"E	3-6 km away from the project site
<b>South</b>	Bangladesh Marine Academy, Chittagong Urea Fertilizer Limited (CUFL), Karnafuly Fertilizer Company (KAFCO), Karnafuly Tunnel	22°14'34.61"N 91°50'21.80"E	1-3.5 km SW of the project site
<b>East</b>	Badalpura Village, Korean Export Processing Zone (KPEZ)	22°14'33.20"N 91°51'38.18"E	Approximately 1 km from the KDDSEZL
<b>West</b>	The Shah Amanat International Airport	22°14'42.48"N 91°48'55.54"E	2 km west from the project site



Source: ESIA Study of Karnafuly Dry Dock by AECOM

The project fact sheet has been given in the following Table.

**Table 2: Project fact sheet**

Sl. No.	Particulars	Details
1.	Project Location	Badalpura Mouza in Anwara Upazila of Chittagong Division, Bangladesh
2.	Type of project	Karnafuly Dry Dock Special Economic Zone
3.	Maximum Capacity of	100,000 tons dead weight tonnage (DWT) Vessels to be docked
4.	Capacity of New vessels to be docked	15,000 tons DWT be built
5.	Environmental categorization	Red category as classified under Schedule-I of the Environment Categorisation
6.	Area	18.23 acres
<b>Construction Phase</b>		
7.	Construction Period	35 Months
8.	Labour Requirement	250-300 Nos.
9.	Water Requirement	25 KLD of fresh water for construction works
10.	Source	Local ponds
11.	Domestic water	8-10 KLD per day requirement
12.	Source	Packaged water
13.	Waste water management	Treated in a temporary package type sewage treatment plant and discharged to Karnafuly River in compliance with the discharge norms
14.	Power Requirement	1 X 500 kVA DG set
<b>Operational Phase</b>		
15.	Power Requirement	1.5 – 2.0 MW/h
16.	Power Backup	3 X 500 kVA, 1 X 250 kVA DG sets
17.	Water Requirement	250 KLD
18.	Domestic water	75 KLD requirement
19.	Domestic waste water	60 KLD generated
20.	Manpower Requirement	1500 Nos.
21.	Pollution Control Measures	Sewage Treatment Plant (STP) of capacity 80 KLD Sequencing Batch Reactor (SBR) Technology
22.	Project Cost	USD 105.2 Million

## 2.2. Functioning of dry dock

In dry docking, a ship/vessel is removed from the water to perform repair works on the exterior part of the ship. A dry dock is a narrow basin that can be flooded with water to allow a ship/vessel to be floated in and then drained (pumped) in order to allow the vessel to come to rest on a dry platform. Dry docks are normally used for construction, maintenance, and repair of ships, boats, and other vessels. The entire docking operation is supervised by a qualified dock master.

To prepare the dry dock, keel blocks and side blocks are first set into position. Keel and side blocks are concrete or steel structures with timber capping that support the weight of the vessel inside the dock. The keel blocks are provided with electromagnetic signal switch to sense whether the vessel has been appropriately placed within the dock. The point of keel touchdown can be monitored and controlled in a central control room. The heights of the keel blocks may be adjusted as per the positioning of the vessel. In some dry docks, the block



arrangement is reconfigured using fork lifts. The centre keel block arrangement is always the same in a dry dock. However, the rest of the keel blocks are arranged according to the ships' structure based on the ships' construction design.



**Figure 4: View of Basin Type Dry Dock and Associated Facilities**

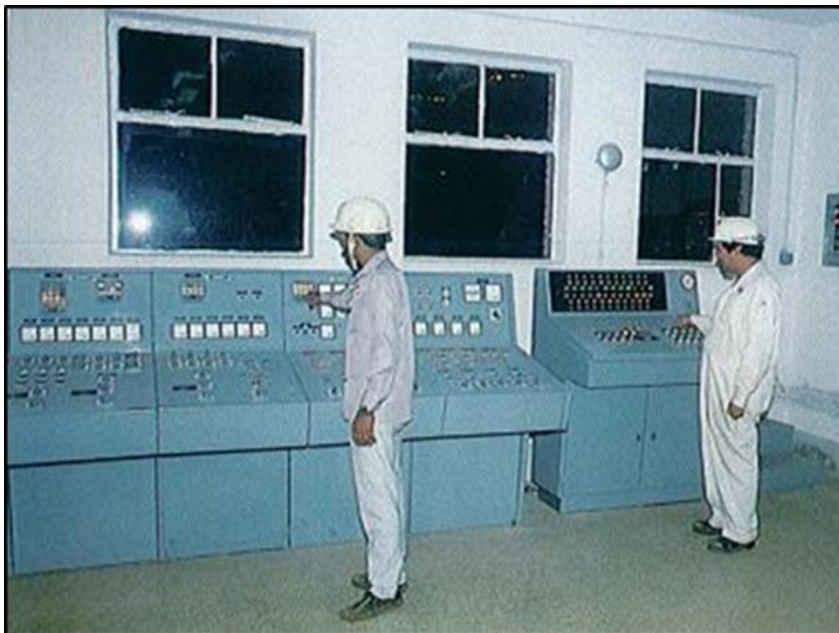
*Source:* Chittagong Dry Dock Limited.

Prior to entering the dock, the draught of the vessel is noted so as to estimate the tide at which the vessel should enter the dock. The dry dock is provided with gates (may be flap type, floating caisson type, intermediate type, mitre gates, etc.) which have ducts through which water is allowed to enter in order to flood the basin. Once the dock is flooded, the dock gates are opened and the ship/ vessel, with propeller shut off, is hauled into the dock basin with the help of haul-in winches. Two winches are secured at the aft end and two at the forward end of the ship. The gates are then closed and water is pumped out of the dock with the help of high capacity dewatering pumps. Silt depositions in the apron area are cleared by silt pumps. Fire hydrants, safety signs and gangways are attached to the vessel. Prior to docking of a vessel, the dock master ensures that the docking crew is prepared with tools, spares, paints, chemicals, gas, lubricants, etc. The cabin crew of the ship/vessel is shifted from the vessel and accommodated in quarters provided within the dry dock facility. The ballast water from the ballast tanks of the vessel and oily bilge water is pumped out before carrying out any repair/ maintenance activities.



**Figure 5: View of a Docked Vessel**

The activities such as maintenance of main and auxiliary engines, pumps, hydraulic system, valves, pipes, motors, etc. for the docked vessel are then undertaken by the repair and maintenance crew. The external hull of the vessel is also cleaned through sand blasting or hydro blasting and repainted. Mobile dockside cranes are installed on rails alongside the dock basin and are used for undertaking the maintenance activities. Works related to marking, cutting, welding and fabrication of steel plates, pipes, rewinding of motors and transformers, machining operations, etc. are performed in the workshop complex within the facility. The workshops are also equipped with inspection and testing equipment such as ultrasonic flaw detector, magnetic crack tester, gas detection equipment, radiographic equipment, etc.



**Figure 6: Dry Dock Control Room**

After all the repair and maintenance activities for the ship/vessel are completed, the docking crew are engaged in activities to make the vessel ready for sailing. Various tests and inspections of the hull and other parts of the ship are carried out by personnel in order to detect any fault, leaks, etc. An Authority to Flood Certificate is obtained from the authorized officer of the dock, stating that the docking specifications are satisfactorily completed and that the ship is in seaworthy condition.

The ship's anchor and cables are heaved up and adequate supplies of fresh water, fuel and lubricating oil are stocked on board to suit the ship's movement needs. The gangway is lifted by means of crane once the dock personnel have cleared the ship and the cabin crew has boarded. The ship's ballast tank is filled with water to adjust the draught. The sea water is pumped into the dock basin, also referred to as ballasting the dock. The amount of water being pumped is controlled from the pump room. The forward and aft ends of the ship are attached to shore based mooring lines which are controlled by winches, to ensure that the ship leaves the dock smoothly.

When the level of seawater in the dry dock reaches the sea level, the dock gates are opened. The ship is pulled backwards out of the dock with the help of tug lines attached to tug boats at the aft end of the ship and are guided by the mooring lines. When the ship has cleared the dock gates, the mooring lines are detached and the tug boats turn the ship around. Finally, the tug lines are detached and the ship's propeller is started. The dock gates are closed and the dock basin is again dewatered with the help of pumps.

### **2.3. Project components**

KDDSEZL proposes to construct graving or basin type dry dock, with dimensions of 255 m x 48 m x 15 m, for repairing vessels having capacity upto 100,000 tons DWT. Initially the facility

will be designed for the purpose of ship repair and maintenance only, with future plans of including building of new vessels with maximum capacity of 15,000 tons DWT. In addition to the above, two dolphin jetties, with jetty berths, will also be constructed for the purpose of loading and unloading cargo and floating repairs.

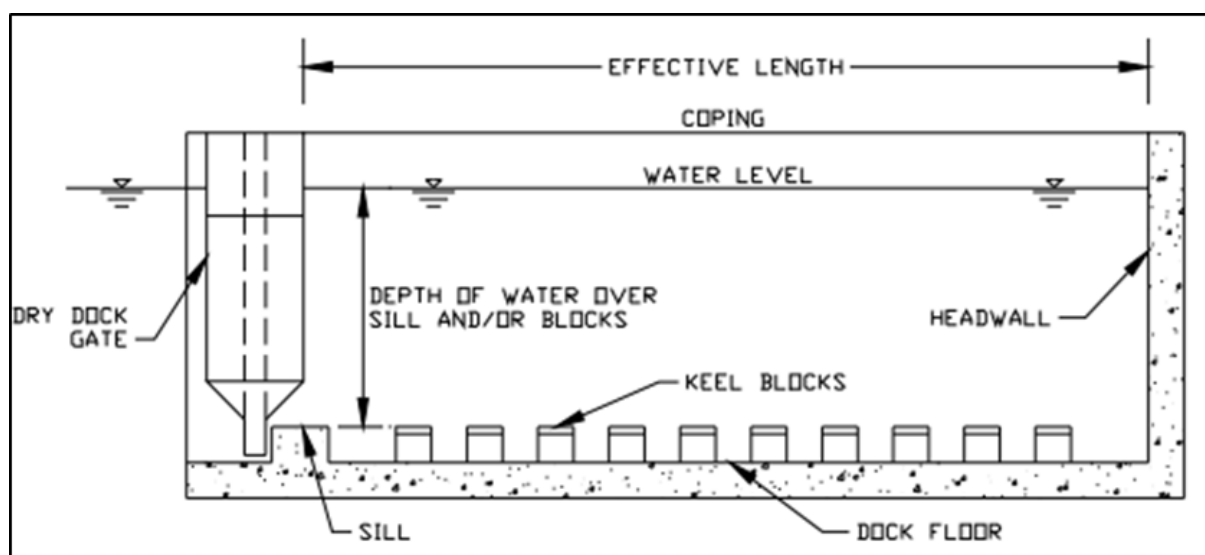
The details of the various components of the project have been presented below. It is to be noted that the detailed designing of the facility and associated components has not yet been initiated by KDDSEZL. The description of project components in this section is based on the details provided in the preliminary Feasibility Report on Conceptual Design and Cost Estimation by BMT Asia Pacific.

**Table 3: Basic Project Information**

Component	Details
Type of Dock	Partially Relieved Graving Type
Length of Dock	255.00 m
Width of Dock (excluding rubbing strips)	48.00 m
Depth of floor (immediately adjacent to sill)	14.50 m
Dock floor gradient	1:200
Keel blocks dimensions with timber capping	1.5m x 0.9m x 1.8m (HxWxL)
Dock Centre Line Orientation	North westerly
General level of the dockyard	7.00 m above ISLWL
Cope level of dock	7.00 m above ISLWL
Level at dock entrance (Sill)	6.00 below ISLWL
Mean Sea Level	1.673 m above ISLWL
Mean High Water Spring	5.50 m above ISLWL
Total Land Area	18.23 acres
Maximum Capacity of Vessels to be docked	100,000 tons DWT
Capacity of New vessels to be built	15,000 tons DWT

Source: Feasibility Report on Conceptual Design and Cost Estimation by BMT Asia Pacific

Following Figure may be referred for understanding the various levels considered for the purpose of dry dock designing.



**Figure 7: Levels considered for Dry Dock**



### 2.3.1. Dry dock basin and associated facilities

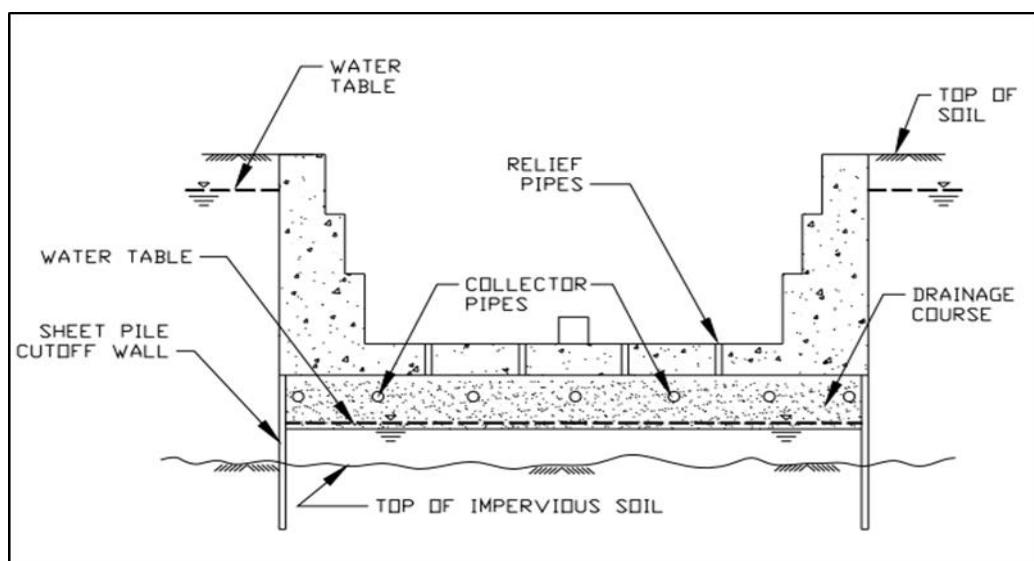
#### Basin

The dry dock will be graving or basin type and will have dimensions of 255m in length, 48m in width and 15m in depth. Basin or graving docks are large, fixed basins built into the ground at water's edge, separated from the water by a dock gate.

The dry dock will have foundation depth of 10m below ISLWL (or about 13m below existing ground level). The soils at this depth are likely to be either medium-dense to very dense sand, or very stiff to very hard silt. These soils are expected to have adequate bearing capacity to support the dry dock loads, and as such, a raft (or mat) foundation is considered appropriate.

The proposed dry dock will be designed as “partially relieved” type of dock, based on the hydraulic pressure surrounding the structure. A partially relieved dock uses a drainage system under the dock floor to eliminate the hydrostatic pressure on the floor only. The walls resist the full hydrostatic head. A cutoff wall will be installed at the edge of the foundation to reduce seepage, and a drainage system will be provided under the foundation to collect any water that does seep in, thereby eliminating the build-up of hydrostatic pressures. Collector pipes and relief pipes may be provided to allow water to seep through and collect in the pumping chamber.

The dock floor will be designed to allow “of-center-line” docking of smaller vessels. Vessel types include most types of cargo vessels (tankers, bulkers, and container ships), offshore supply vessels, tugs and ferries. The dock center line is to be approximately north-westerly (to be fixed in final design) to take advantage of the port maintained channel.



**Figure 8: Partially Relieved Basin Dock (Cross Sectional View)**

**Source:** Hedger Dry Dock Inc. (2005), 'Dockmaster Training Manual', ESIA Study of Karnafuly Dry Dock by AECOM

### **Keel Blocks**

The dock basin will also be provided with piles to support the dock and vessel weights if the allowable pressure on the soil is not adequate. In this case, keel and side blocks having dimensions of 1.5m x 0.9m x 1.8m will be placed over the piles. The blocks will be made of concrete or steel, and provided with timber capping. These piles can also be used in tension as anchor piles to resist hydrostatic uplift if required.

### **Flap Gates**

All basin docks have an entrance closure that keeps water out of the dock once the ship is in and retracts out of the way for docking and undocking operations. In this case, the proposed dock will be provided with box type flap gates.

Flap gates consist of a rigid one-piece gate hinged at the bottom that swings downward and outward. Flap gates are opened by lowering the hinges down into the water so they lie on the seabed below the sill. Flap gates are usually provided with buoyancy tanks to minimise the operating load on the winches or hydraulic rams. Flap gates can be designed to either span an entrance (up to around 80m) or are cantilevered or propped off the sill.

The flap gate will also comprise of roadway (about 4 to 5 meter wide), on top of the gate in order to allow forklifts and light trucks to move from one side of the dock to the other without having to circumnavigate around the dock head.

KDDSEZL proposes to install prefabricated gates, with plates pre-blasted before fabrication and finally coated with epoxy paint. Zinc anodes or impressed current may be used for further protection against corrosion.

### **Apron Flushing**

The flap gate recess outside dock entrance, known as apron area, is often prone to siltation. In order to mitigate this, the detailed design will incorporate jetting pipes in sill, connected to dewatering pump discharge pipe. Each time dock is dewatered, jetting pipes will discharge water under pressure to clear silt from the gate recess. For large silt depositions, dedicated silt pump will be required to be installed.



**Figure 9: Typical Flap Type Gate**

*Source:* Royal Haskoning DHV, ESIA Study of Karnafuly Dry Dock by AECOM

### **Dock Dewatering**

For the purpose of dock dewatering, low tension (400 volts) submersible pumps will be considered. This is to mitigate the considerable risk of flooding in the motor room due to the exceptionally high tidal levels prevailing in the river and the possibility of river overflowing.

### **Pump House**

Two pump houses, each to house 3 to 4 pumps, will be incorporated in the detailed design of the facility. The pumps will be submersible type and seated at the bottom of the pump wells. The water in the dock will flow into the sump below the wells and will be lifted to the level of the weirs where it will flow over into a culvert connecting to the river.



**Figure 10: Dock De-watering pumps**

*Source:* Chittagong Dry Dock Limited, ESIA Study of Karnafuly Dry Dock by AECOM

### Winches and Cherry Pickers

To facilitate docking of large vessels hauling-in system, with haul in winches of capacity 50 tons pull, is proposed to be constructed along each side of the dock wall. High reach cherry pickers will be used for hull cleaning and painting. Cherry pickers may be lowered to dock floor by crane.



**Figure 11: Haul-in Winch**

*Source:* Chittagong Dry Dock Limited, ESIA Study of Karnafuly Dry Dock by AECOM

### Cranes

Installation of dockside cranes, with capacity not exceeding 50 tons and radius of 35m, is proposed on either side of the dock. This capacity will be sufficient to cater lifting of most hatch covers, machinery equipment, propellers and rudders of heavy vessels. The crane beams will run from the entrance to the head of the dock on rails. There shall be storm anchors and jack up points for maintenance purposes along the crane track as well as buffers at each end.

Two jetty cranes, each with 30 ton capacity and 30 m radius, are also proposed to be installed. A 50-ton gantry crane is also proposed to support the new building berth.

### Gangway Access Towers

Two access towers, each sixteen (16) meters in height, will be provided on each side of the dock. The access towers will provide the access to the gangway linking the vessel on the dock.

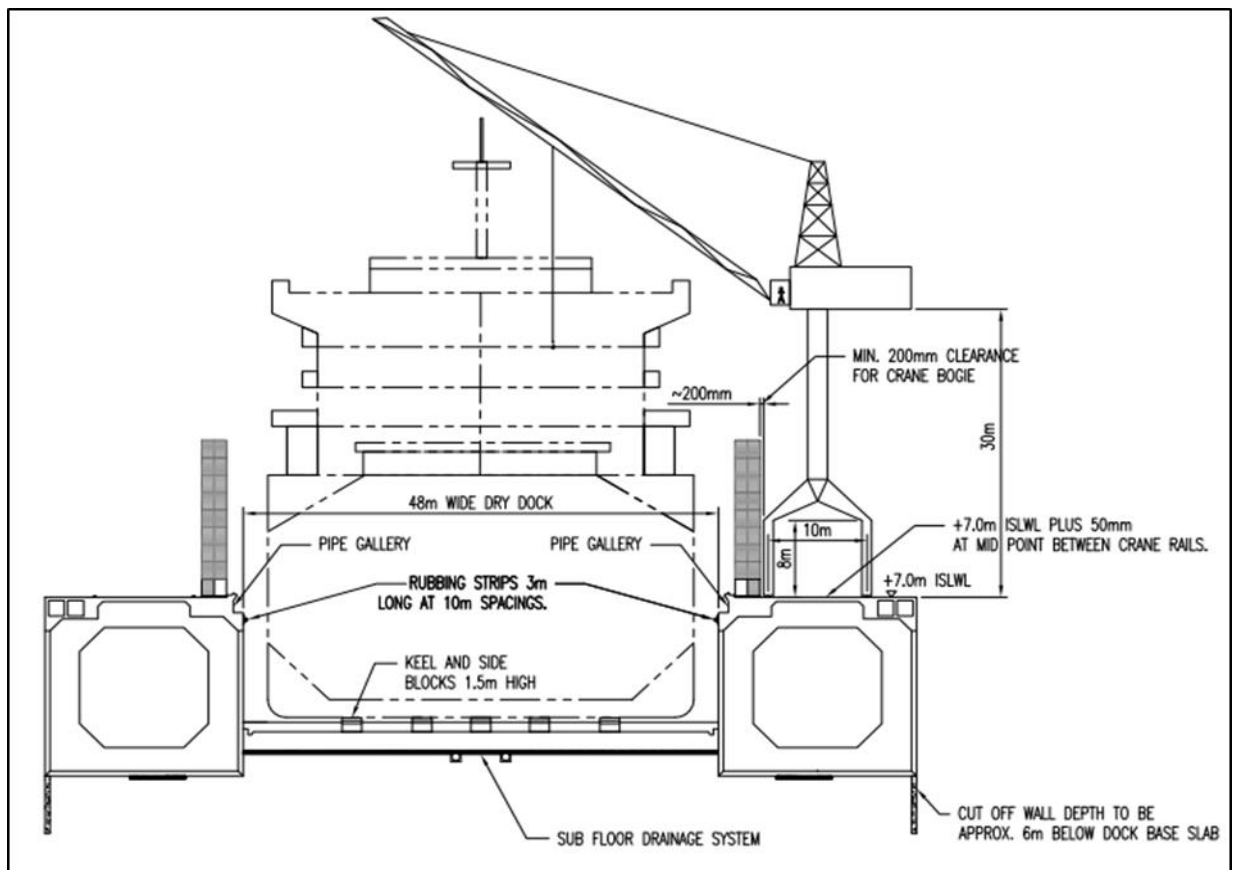
### Other Equipment

Apart from the above mentioned components, following equipment are also proposed for the dry dock.

**Table 4: Details of the proposed equipments**

Equipment	No./Capacity
Low Bed Transporter	1 x 50 tons
Heavy truck	1 x 5 tons
Light truck	1 x 2 tons
Mobile crawler cranes	1 x 50 tons
Car	3

A typical cross section of the proposed KDDSEZL has been provided in the following Figure.


**Figure 12: Typical cross section of the proposed KDDSEZL**

Source: Feasibility Study for Dry Dock Project by AECOM, Conceptual Design and Cost Estimation, BMT Asia Pacific, April 2014

### 2.3.2. Civil structures

The KDDSEZL facility will comprise of office building, workshop, generator and substation shed, foundry shop, winches shed, workers shed, store room, pump house, boundary wall, internal road and other civil structures.

#### Workshops

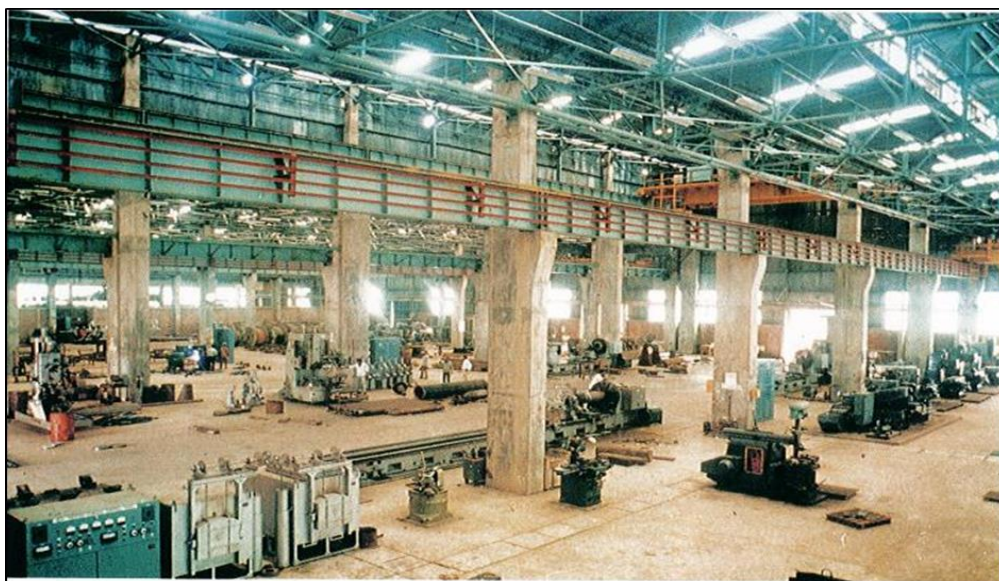
Four workshops viz. plate shop, pipe shop, electrical/instrumentation shop and machine shop are proposed to be constructed in the centre of the facility. The workshops will cater to marking, cutting, welding and fabrication of steel plates, pipes, rewinding of motors and transformers, machining operations, etc. The dimensions and other details of the workshops are as given below in the following Table.



**Table 5: Details of the proposed equipments**

Type of Workshop	Dimension	Purpose	Number and capacity of Overhead Cranes
Electrical and	80 m x25 m x 8 m	Rewinding of motors and sections	5 tons (1 no.) instrumentation transformers, balancing of
Machine shop	80 m x 25 m x 12 m	All machining operations	30 tons (1 no.) (turning, milling, drilling,
Plate shop	80 m x 25 m x 12 m	Marking, cutting, welding,	30 tons (1 no.) fabrication of steel plates and
Pipe shop	80 m x25 m x 8 m	Marking, cutting, welding,	10 tons (1 no.)

The machine shop will be equipped with steam and chemical cleaning facilities for degreasing of machine parts. Contaminated water will be removed periodically from the shop and will be sent for treatment. The waste materials from the plate, pipe and electrical workshops such as steel debris, plate and pipe cut-offs, old wires and cables, motor windings, etc. will be sold to authorized scrap dealers.


**Figure 13: Partial View of Machine Shop**

Source: Chittagong Dry Dock Limited, ESIA Study of Karnafuly Dry Dock by AECOM

### Storage Areas

Following storage areas are proposed as part of the facility.

Scaffolding laydown and storage area - A triangular area near the dock entrance will be demarcated as the scaffolding storage area and will comprise of a small shed of 6m x 6m dimension for storage and testing of chain blocks and slings.

Equipment pipe and plate laydown area – It is estimated that the facility will store about 200 tons of various inventories of plates and pipes of common dimensions and thicknesses. An area to the south of the entrance gate will be allocated for this purpose in order to facilitate transfer through delivery trucks.

### **Warehouse**

A warehouse is proposed near the facility entrance for storing of ship parts such as pipe fittings, cables, stainless steel sheets, accommodation building materials, electrical components, consumables such as welding electrodes, paints, etc. The existing workshop will be utilized in case more warehousing space is required during operations.

### **Roads and Lay Down Area**

Heavy duty Macadam type internal roads, designed to hold heavy payloads with minimum of 50 tons capacity, will be constructed within the facility. The internal roads will have width of around 10m with surface drains on both sides for rainwater and surface runoff. The facility will also be provided with lay down areas for the temporary lay down of items unloaded from ships or to be boarded on ships.

### **Workers Resting Area**

The facility will employ large number of workers such as painters, dockers, riggers and general workers apart from front line supervisors and managers. A resting area and area for maintenance of their equipment (high pressure pumps, spray guns, hoses, slings) will be provided for the workers. It is proposed that the existing workshop at site will be converted for this purpose.

### **Administrative Building**

An administrative building will be constructed adjacent (north) to the facility entrance. The building will house senior management and non-production staff, with departments such as human resources, accounting, marketing, engineering, procurement. The lower floor of this building will house the shop managers and ship repair managers. The admin building will also have private offices for top management, shower facilities, lockers and common pantry area.

### **Workers Amenities**

It is estimated that the facility will employ about 1500 workers and staff during peak operations. Considering this, it is proposed that a worker's amenities building be constructed which will cater about 800 workers at a time. The building will be provided with following facilities:

- Personal lockers;
- Shower rooms to cater 30 persons at one time;
- Toilets;
- Clinic with full time nurse and first aid facilities;
- Canteen with sufficient seating capacity;
- HSE Office;
- Payroll Office;
- Training room with seating capacity for 50 workers; and
- Recreation room



### 2.3.3. Island jetty

Jetties (also known as piers) are structures that extend from shore into a body of water in order to accommodate the corresponding vessels to be berthed or moored and are connected to land by trestle and/or causeway. They are primarily used for loading/unloading of cargo and embarking/ disembarking of passengers and vehicles from vessels. Jetties are designed and constructed based on the loading requirement, design life and the underlying strata.

Dolphins are isolated structures designed primarily to guide, berth or moor the vessels approaching into the ports, docks or jetties. Mooring dolphins are designed strictly to secure a vessel's mooring lines while berthing (or breasting) dolphins are structures that absorb the impact of vessels berthing at the jetty.



**Figure 14: View of a Dolphin structure**

*Source:* ESIA Study of Karnafuly Dry Dock by AECOM, NSCC International

Two island jetties consisting of a loading / unloading platform, breasting dolphins, and two mooring dolphins are proposed to be constructed as part of the project for the purpose of floating repair. The jetty will be connected to the shore by an approach trestle of 70m length, which will also accommodate a roadway, pedestrian walkway and utilities corridor. Following Figure shows layout of the proposed jetties.

The loading platform deck will be of reinforced concrete and will accommodate jib crane, bollards and fenders. The plan dimensions of the loading platform shall be 30m x 15m. Two pairs of breasting dolphins are required on either side of loading platform at each jetty to safely berth the range of the vessels. The mooring dolphins will be sized approximately 14m x 14m as per preliminary design and will be located on either side of the loading platform. The mooring dolphins will house bollards and access ladders.

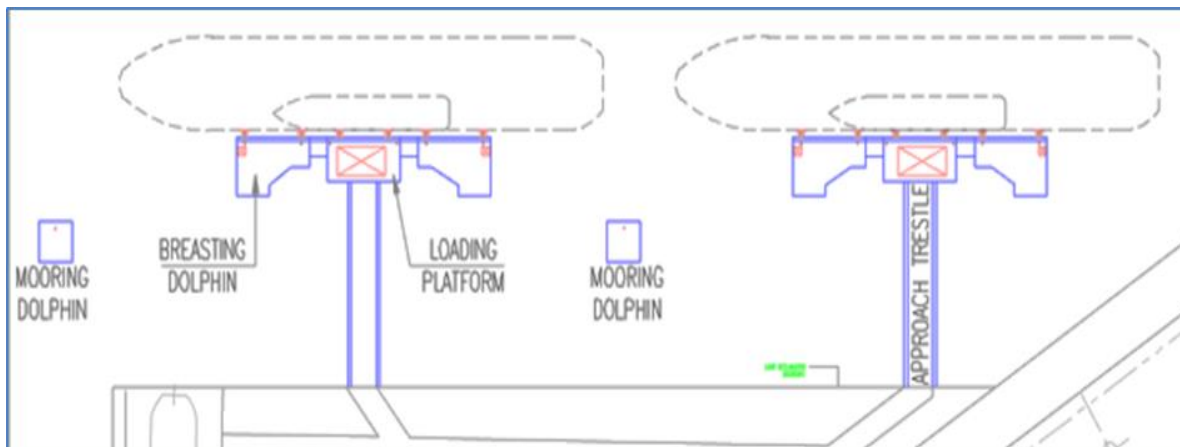


Figure 15: Island Jetty Layout

#### 2.3.4. New ship building area

The facility will have provision for building of new vessels up to 15,000 tons DWT at the south end of the site. New vessels will be built on a simple slip and launching is proposed to be carried out with rubber bags. For launching, a temporary ramp will be constructed with one end at the top of the reclaimed land and the other into the river as is the current practice. In future a launch way of 1:20 gradient might be constructed with a simple gate to stop high water from reaching the work area.

#### 2.3.5. Gas supply station

Ship building and ship repair activities make widespread use of oxygen and other fuel gases for welding, cutting, gouging, brazing and heating processes. It is proposed that liquid oxygen will be delivered to the facility where it will be stored in oxygen storage tanks. The liquid oxygen will then be gasified and piped to the dockside, quayside, new building area and workshops. Other gases such as acetylene, liquefied petroleum gas (LPG), argon and helium will be delivered in small quantities in gas cylinders.

The liquid oxygen storage tank is proposed to be located on the left hand side of the main gate. Inert gases (argon, helium) may also be stored centrally in this location while inflammable gases (e.g. acetylene, LPG) will be kept away from the oxygen tank. An acetylene battery is proposed to be erected between the Plate Shop and New Building area. From this point the acetylene will be piped to workshops, dock and quaysides.

#### 2.3.6. Sand and hydro blasting

KDDSEZL proposes to use sand and hydro blasting techniques for the purpose of cleaning the hull of ships under repair/ maintenance, and removing various paint coatings, rust and corrosion, sea growth and slime.

Sand blasting generally involves propelling very fine bits of abrasive material (such as sand, steel grit, copper slag, walnut shells, powdered abrasives, bits of coconut shell) at high-velocity to clean or etch a surface. A sand blasting setup usually consists of three different

parts: the abrasive itself, an air compressor, and a blaster nozzle. The sand blasting process may be dry, whereby the surface is cleaned with abrasive and compressed air. When both sand and water are used in a compressed air blast, it is termed as wet sand blasting.

Hydro Blasting is the technology of using water jets at very high pressure for effective cleaning of the contaminated surfaces. Water jets with Ultra High Pressure (UHP) Pump units, operating at pressure up to 40,000 PSI (2,800 bar pressure) at flow rate of 27 liters/min are generally used for hydro blasting.

The process of sand/hydro blasting constitutes substantial health and safety hazards for the workers involved. These issues have been dealt with in detail in the Occupational Health and Safety Plan. Other impacts associated with the blasting procedures have been covered in the Chapter 7 Impacts and Mitigation Measures.

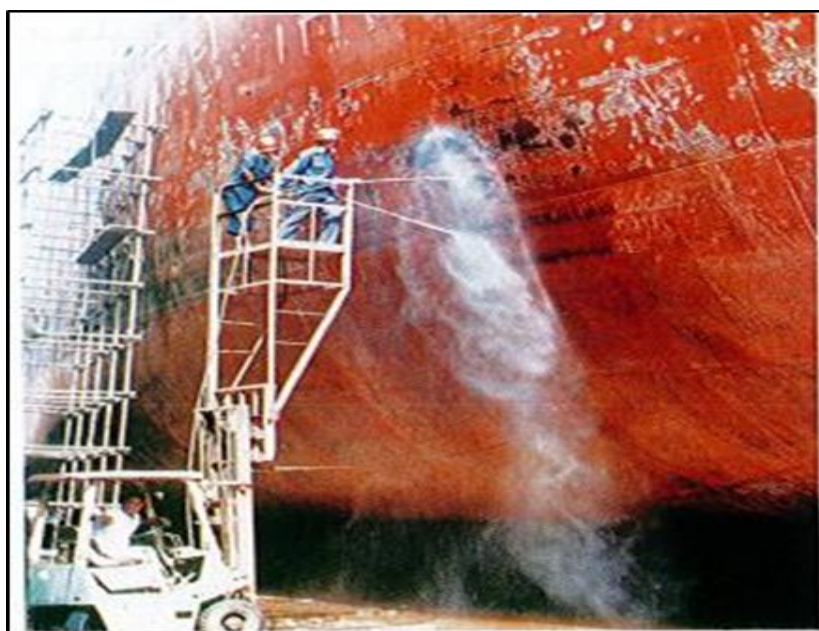


Figure 16: Hydro Blasting

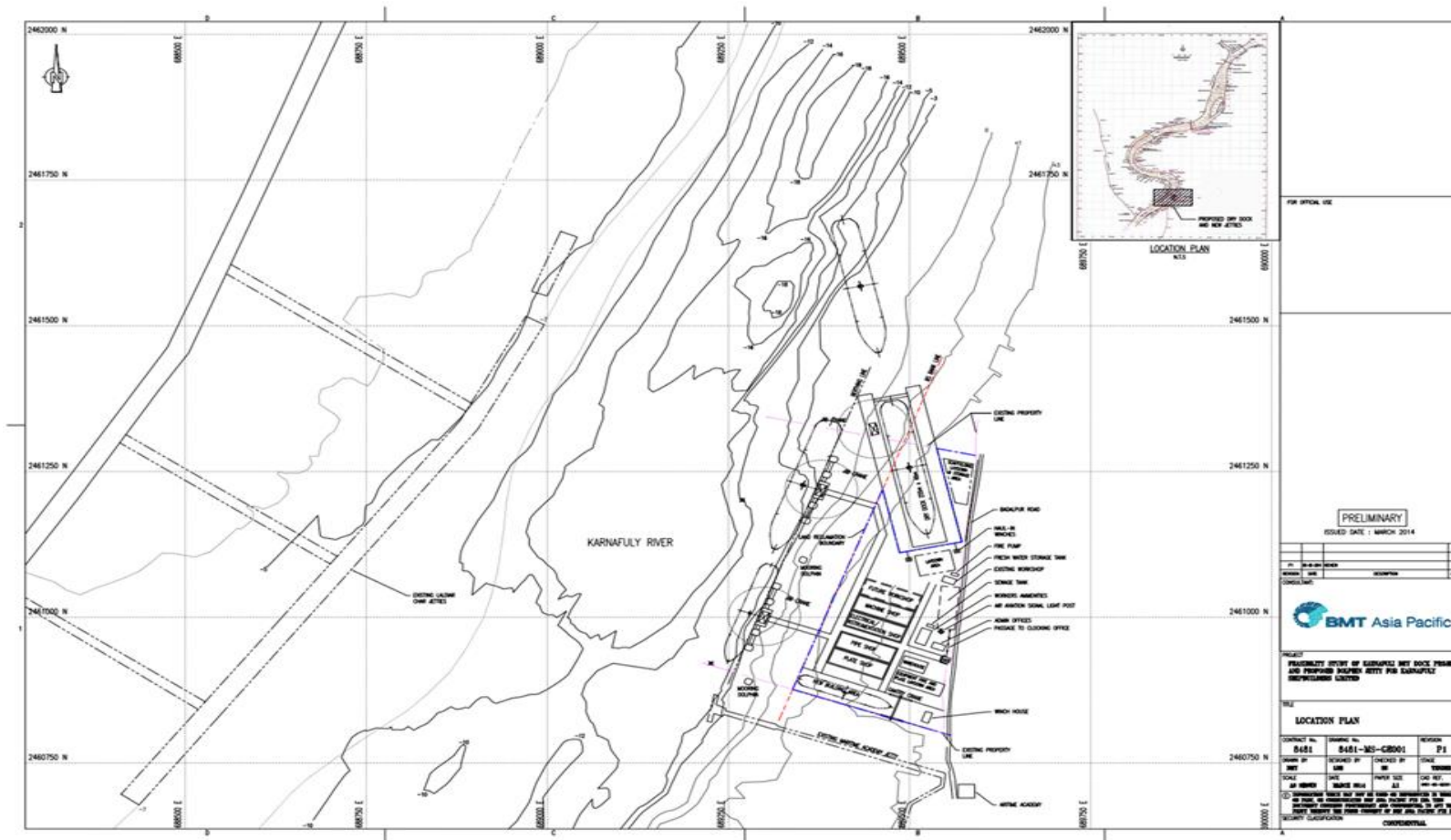
## 2.4. Project utilities

Apart from the components as described above, following utilities will also be part of the dry dock facility:

- Pipes carrying freshwater, firefighting water, ballast water, compressed air, oxygen and acetylene
- Fire Pump for firefighting purposes
- Mobile air compressors (each about 10 to 15 cu m capacity at 7.5 bars)
- Mobile crawler cranes (1 no. of 50 ton)

## 2.5. Proposed facility layout

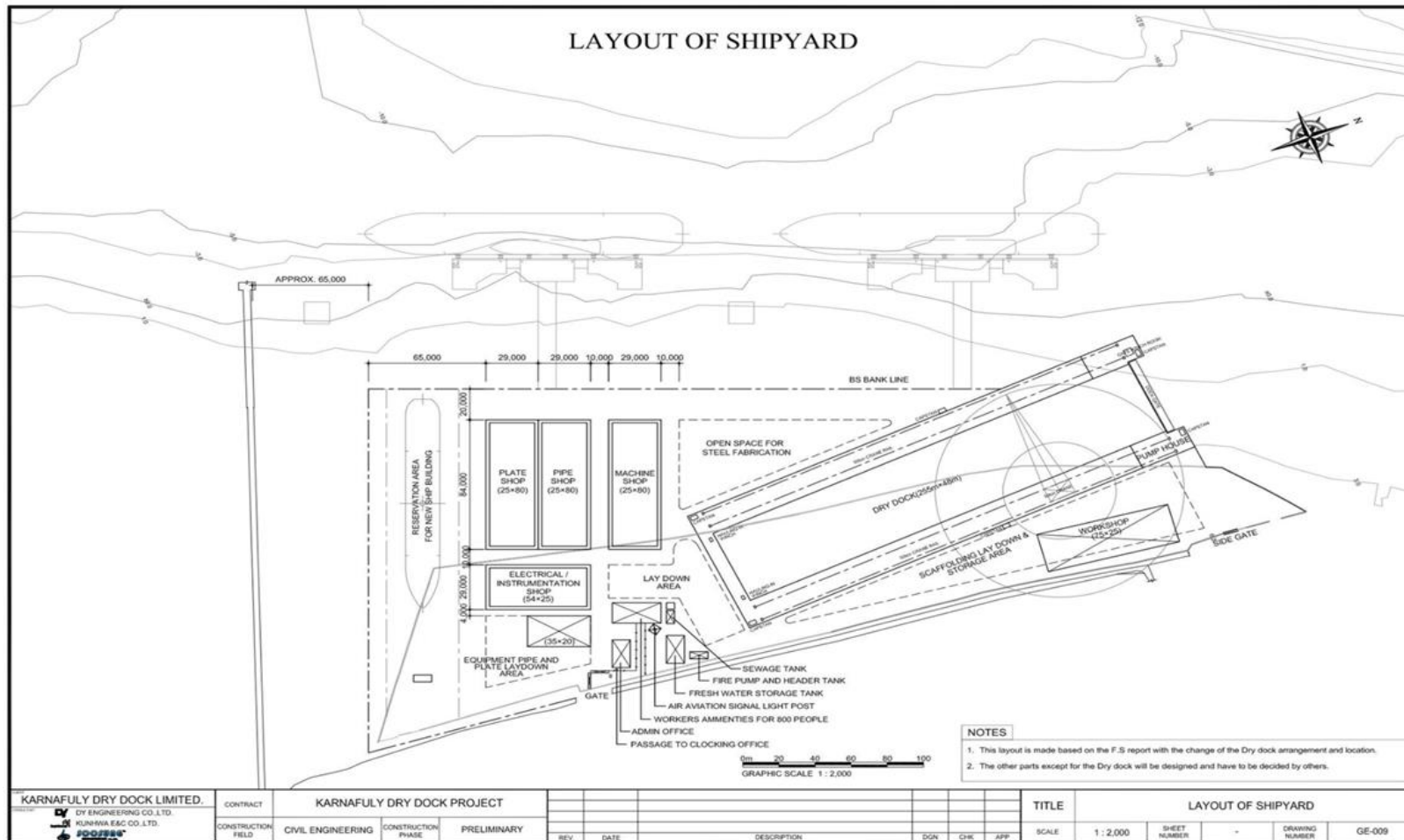
The proposed layout of the dry dock and dolphin jetty is provided in the following Figures.



**Figure 17: Proposed Preliminary Layout of the Dry Dock and Dolphin Jetty with respect to Karnafuly River of the project**

**Source:** Feasibility Study for Dry Dock Project by AECOM, Conceptual Design and Cost Estimation, BMT Asia Pacific, April 2014





**Figure 18:** Proposed Preliminary Layout of the Components within the KDDSEZL

**Source:** ESIA Study of Karnafuly Dry Dock Limited by AECOM

## 2.6. Project development –construction phase

The construction phase of the proposed Project will involve procurement of raw materials and equipments, component delivery, construction foundations, construction of berths, installation of berth furniture, civil works for associated buildings, construction of roads and drainage structures, welding/cutting onsite, installation of heavy machinery, pumps and mechanical and electrical installations. The construction works will also entail dredging and reclamation works and soil improvement works.

This sub section describes the various aspects involved in the construction phase of the project, along with the project development schedule.

### 2.6.1. Project schedule

The project is scheduled to be completed in about 51 months, starting from the initiation of detailed designing of project components in July 2014. KDDSEZL plans to complete all activities including the detailed designing and construction of the dry dock, jetty and ancillary buildings by end of March 2019. The work plan of implementation (Implementation Schedule) is provided in Table below.

**Table 6: Project Implementation Schedule**

Sl. No.	Activity	Expected Date of Completion
1.	Detailed Engineering Design and Obtaining Approvals for the Project from Relevant Authorities	January 2015 the Project from Relevant Authorities
2.	Award of contract for construction and mobilization of work	January 2016
3.	Construction of Break water, Dock gate, Cofferdam	April 2017
4.	Construction of Jetties and Ancillary Buildings	September 2017
5.	Construction of Basin	May 2018
6.	Construction of KDDSEZL and Handover to authority	March 2019

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### 2.6.2. Labour

During construction phase, the labour requirement will be about 250 workers during normal construction period and is expected to increase up to 300 during for peak activities. There will be a significant influx of migrant labour during the construction phase. The migrant workers and staff will be accommodated in rented houses in surrounding villages such as Badalpura, Anwara and Daulatpura. The project does not require setting up of labour camps during the construction phase of the project.

**Table 7: Project Implementation Schedule**

Sl.No.	RCC work	Quantity Nos.	Total Nos.
<b>RCC Work</b>			
1	M/C Operator	25	25
2	Concrete Worker	30	80
3	Steel Worker	25	25
<b>Excavation/Reclamation Works</b>			
1	Excavator Operator	15	15
2	Helper	30	75

Sl.No.	RCC work	Quantity Nos.	Total Nos.
3	Earth Transporter	30	30
<b>Dock Preparation</b>			
1	Steel Worker	25	25
2	Concrete Workers	50	50
3	Dock Gate Workers	15	15
4	Electricians	5	145
5	Welder	20	20
6	Helper	20	20
7	Mechanic	10	10
	Total	300	300

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### 2.6.3. Waste generation

The construction activities will lead to generation of wastes such as construction debris, waste from packaging and crafting material for project components. The movement of heavy machinery for site clearance, earth moving, transportation and erection will generate waste oil, hydraulic oil, lubricants, paints, degreasers and gearbox oil. Waste oil is classified as a hazardous waste and will be disposed-off through a DoE approved vendor.

### 2.6.4. Dredging and reclamation

Prior to start of construction activities, the project site will be filled or reclaimed to a minimum elevation of 7m above Indian Spring Low Water Level (ISLWL). At present, the eastern part of the site has already been reclaimed upto 6m above ISLWL and will further be raised by another 1m to achieve the required minimum elevation. The western part of the site has ground elevations of between 3m and 3.5m above ISLWL and will need to be raised by 3.5m to 4m to achieve the required minimum elevation.

It is estimated that about 366,000 m<sup>3</sup> of material will be dredged from the Karnafuly River bed/ sub-littoral area, out of which about 174,800 m<sup>3</sup> would be used for reclamation of the site. The berthing pockets of the jetties will be dredged to 7m below ISLWL, while the apron at the entrance to the dry dock will be dredged to 13 m below ISLWL. Dredging will be carried out using a cutter suction dredger (CSD) which is a stationary or self-propelled vessel that uses a rotating cutter head to loosen the material/ soil in the bed. The cut soil will be sucked in by dredge pumps and the excess dredged material after reclamation will be transported to the low lying areas where filling is required. KDDSEZL is required to consult with local residents and identify low lying areas for dumping of remaining dredged material, if required apart from filling the site itself.

KDDSEZL will also undertake maintenance dredging at the site on annual basis. The volume of dredged material that will be generated during maintenance dredging is estimated to be about 74,000 m<sup>3</sup> per annum. The dredged material will be used for filling low lying areas.





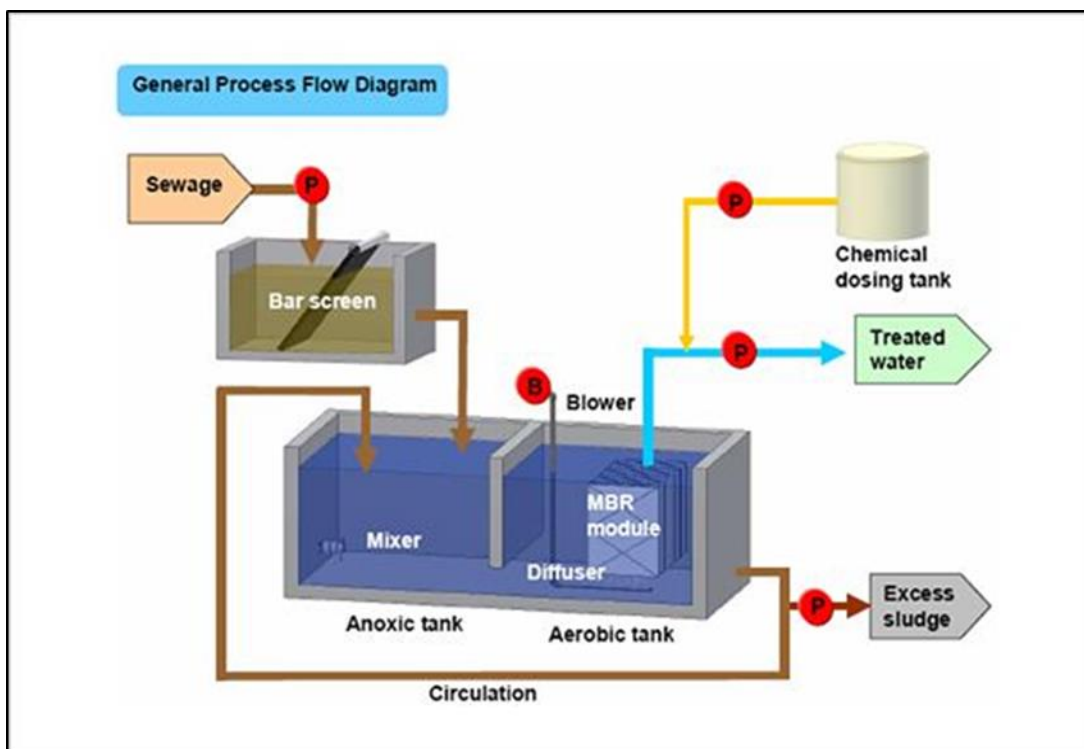
Figure 19: View of cutter suction dredger

#### 2.6.5. Water and wastewater

The water demand for the construction works will be limited mostly to construction of civil structures and domestic purposes. Approximately, 25 KLD of fresh water will be required for construction activities. The fresh water for construction will be sourced from local water ponds using tanker services. The domestic water requirement for 250-300 workers will be about 8-10 KL per day. Packaged drinking water for workers will be procured from authorized suppliers.

Domestic wastewater of about 6-8 KLD will be generated during construction phase. The domestic wastewater generated will be treated in a temporary package type sewage treatment plant (10 KLD capacity) and discharged to Karnafuly River in compliance with the discharge norms. The package type STP will be based on membrane bio-reactor (MBR) technology. Membrane bio-reactors use a perm-selective membrane as the filter (ultra / micro filtration process), which is integrated with a biological process such as activated sludge process. The filter rejects the solid materials which are developed by the biological process, resulting in a clarified and disinfected effluent. The MBR process is used in place of the secondary sedimentation tank and sand filter used for tertiary treatment in the conventional activated sludge process.

The general process diagram of MBR is shown below.



**Figure 20: Process flow diagram- Membrane Bioreactor (MBR)**

Source: [www.hitachi-aqt.com/products/membrane.html](http://www.hitachi-aqt.com/products/membrane.html)

The package type MBR integrates all the components into a self-contained, covered, single piece packaged treatment system for onsite wastewater treatment. The package type MBR will be configured to achieve BOD reduction, suspended solids reduction, total nitrogen reduction and phosphorus reduction.

#### **2.6.6. Power requirement**

The power requirement during development of the KDDSEZL will be limited to activities such as cutting, welding, fabrication, forging, grinding, drilling, etc. At present the site has an existing workshop which is supplied with power sourced from the Bangladesh Power Development Board (BPDB). It is estimated that the current power supply will be sufficient for the proposed construction activities, however in case additional power is required, KDDSEZL will apply for the same from the Board. In case of power failure, back up will be provided through diesel generator set of 500kVA capacity.

#### **2.6.7. Activities during operation of the KDDSEZL**

The general activities that are undertaken during repairing of a ship in a dry dock have been enumerated below:

**Material Handling:** Movements of materials and parts from and to workshops and vice versa will be undertaken during ongoing repair works of ship docked;

**Burning and Cutting:** These operations are required to modify a part of the ship under repair works;

**Fabrication:** Metal fabrication of different parts of ship is undertaken by cutting, bending, and assembling processes;

**High Pressure Water Jetting:** This technique is used for the purpose of cleaning the hull of ships under repair/ maintenance, and removing various paint coatings, rust and corrosion, sea growth and slime.

**Degasing:** When inserting empty tanks that are gas free, for a dry docking, inert gas should be introduced through the distribution system while venting the air in the tank to the atmosphere. This operation should continue until the oxygen content throughout the tank is not more than 8% by volume.

**Unloading and Waste Water cleaning operations:** Different type of waste waters like Ballast water, Bilge water, used lube oil, fuel oil residues, sewage etc. needs to be pumped out from the ship under repair works and appropriate treatment is provided. Remaining ship fuel is also removed

**Cleaning/washing:** Different parts of the ship like Hull, Deck, rudder, cargo tanks, service tanks, oil tanks, holds, hatches, structural steel work needs to be cleaned before further application of paints or any other repair works;

**Dry Abrasive Blasting:** Blasting is achieved by propelling copper slag/ grit with compressed air and as many sets as needed can be mobilized around the ship. Portable air compressors and blasting pots are required. Blower may be needed for tank internal blasting and painting.

**Painting:** Painting of parts like Hull, Deck, rudder, cargo tanks, service tanks, holds, hatches, structural steel work is undertaken by applying prepared coating and sprayers. Clean up of the area is then carried out with transportation of waste into drums.

**Mechanical/hot Repairs:** Deck, hull, rudder, cargo tanks, service tanks, holds hatches, structural steel work, Engine, boiler & steering gear works, Pipe-works, anchors and cables

**Electrical and Electronic Repairs:** Electrical, electronic, cathodic protection and navigation systems repairs of the ships is undertaken.

## **2.7. Resource requirements during operations**

### **2.7.1. Land**

The proposed KDDSEZL site is expected to be set up in an area of 18.23 acres in Badalpura village (Mouza) of Anwara Upazila. The total land purchased from private land owners is about 8.31 acres and comprises of waste land eroded by the Karnafuly River years back, due to the ebb and flow of the tides. As gathered from the consultations with land sellers, it was understood that the land has been procured on willing seller-willing buyer basis and individual negotiations were carried out by KDDSEZL with the land owners. The land was not being used for any economic activities by the community during the time of purchase.

Remaining land was leased to KDDSEZL by Government of Bangladesh, i.e. about 7.80 acres, while about 2.12 acres of land has been leased from Chittagong Port Authority.

### **2.7.2. Power**

About 1.5 – 2.0 MW/h of power will be required for the KDDSEZL operations. Power will be sourced from the grid through transformers and low tension (400/230 volts) power cables fitted around the dock and jetty. It is also proposed that three (3) diesel generator sets of capacity 500 kVA will be installed in the facility for catering to the backup power requirements at dockside, jetty, workshops and offices, while one (1) 250 kVA diesel generator set will be provided for ship supply during the time of repair.

### **2.7.3. Water and wastewater**

During operation phase, the routine (daily) requirement of water will be limited to cooking, drinking, washing and flushing purposes by the facility staff and workers. However, when a vessel will be docked in the facility and will be under maintenance/ repair, water will also be required for cleaning of vessel hull and inner compartments, hydro blasting, washing of dock floor prior to undocking, etc. It is estimated that about 250 KLD of water will be required for all activities during peaking operations, including 75 KLD for domestic purposes.

Two tube wells, having 150 m depth and 0.15 m (6 inch) diameter, will be installed at the site in order to meet the daily water requirement. However, one of the tube wells will be kept on standby for use during emergency periods only. A freshwater storage tank is proposed to be constructed near the existing workshop to store the groundwater. The groundwater will be appropriately treated prior to supplying for drinking purpose.

Approximately 60 KLD of domestic sewage will be generated during operations. About 16 KLD of waste water will also be generated from on board ships, which will be channelized to the STP. Other wastewater streams will be:

Water used for cleaning of dock floor contaminated with sand blast materials, paints, oils, fuels, lubricants, solvents or petroleum prior to undocking of vessel;

- Wash water from hydro blasting process used to remove layers of hull paint, sea growth and slime;
- Water from tank cleaning used to remove sludge or dirt;
- Oily bilge water; and
- Contaminated ballast water.

The detailed estimations of other wastewater streams have been provided in Waste Management Plan (Annexure IX).

The different water requirements and subsequent waste streams generated from the operations of KDDSEZL are provided in figure below.

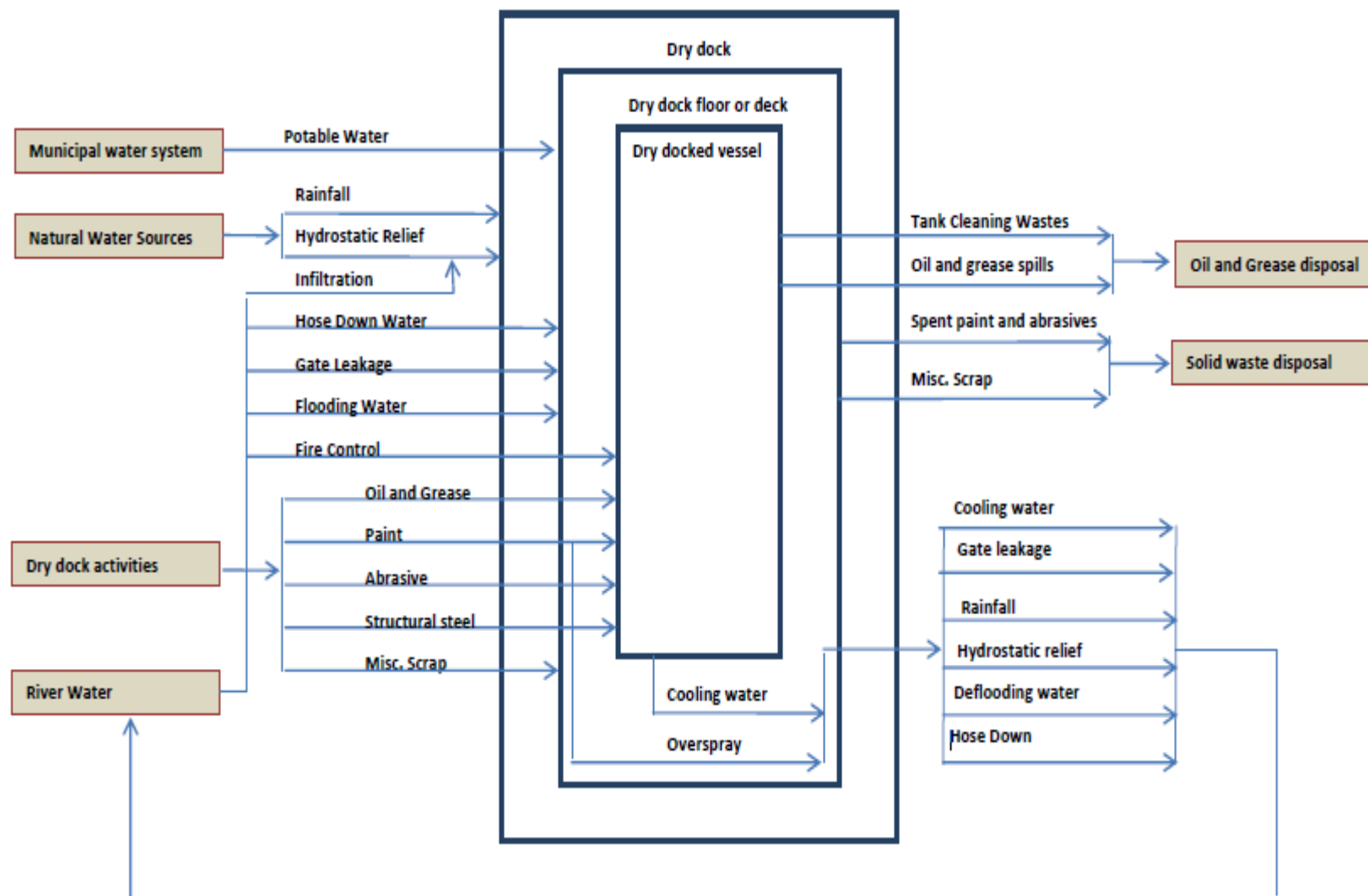


Figure 21: General waste water streams from dry dock (USEPA)

#### 2.7.4. Manpower

It is estimated that about 1500 people will be employed in the KDDSEZL during operation phase. As the duration of ship repair and maintenance works fluctuates considerably, the number of workers will vary during lean and peak working days. The staff will include senior management personnel, non-production staff (such as human resources, accounting, invoicing, marketing, engineering, procurement), shop managers, ship repair managers, supervisors, riggers, painters, dockers and other general workers.

**Table 8: Details of Operational Manpower Requirement**

Sl. No.	Trade	Dock Side	Jetty Side	New building Area
1.	Mooring Crew	10	20	10
2.	Cleaner	50	20	50
3.	De-scaler	50	20	50
4.	Cutter	40	20	40
5.	Welder	50	20	50
6.	Pipe fitter	20	20	20
7.	Painter	20	20	20
8.	Mechanic	50	30	50
9.	Electrician	20	20	20
10.	Crane Operator	10	10	10
11.	Pump Operator	10	-	10
12.	Trawley/Portable Equipment operator	20	20	20
13.	Wood Worker	20	20	20
14.	Fire Fighter	20	20	20
15.	General Labor	20	50	20
16.	Sub-Total (A, B, C)	410	290	400
17.	Machine Shop	50		
18.	Plate Shop	50		
19.	Pipe Shop	50		
20.	Electrical Shop	50		
21.	Maintenance General	50		
22.	General Fire Fighter	50		
23.	Overall Security	100		
24.	Sub-Total (D)	400		
25.	Total Manpower (A+B+C+D)	1500		

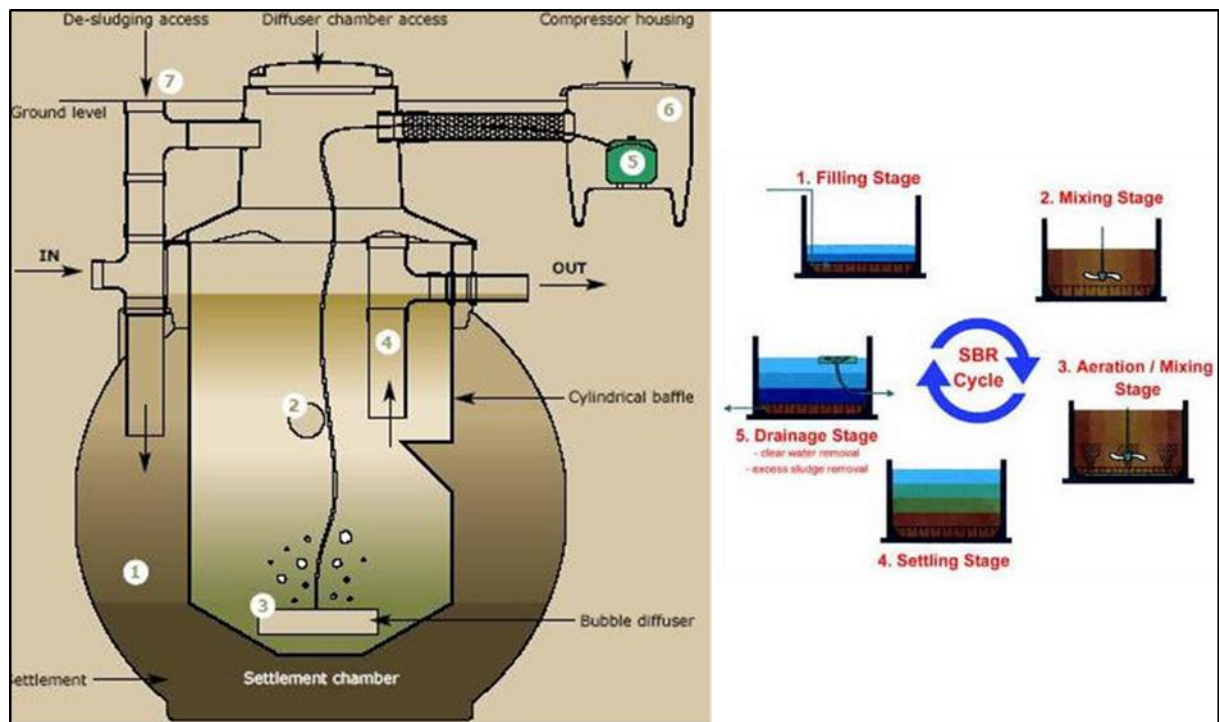
#### 2.8. Pollution control measures

IFC Performance Standard 3 requires projects to adopt internationally recognized technologies and practices for preventing and controlling pollution in order to avoid or minimize adverse impacts on human health and the environment. The various pollution control systems proposed as part of the project has been discussed below.

##### 2.8.1. Sewage Treatment Plant (STP)

About 60 KLD of domestic wastewater or sewage will be generated at site which is proposed to be treated in a Sewage Treatment Plant (STP) located within the site premises. The STP will be connected with all toilets, hand wash and shower rooms to ensure treatment of all

domestic waste water from the site before disposal into the Karnafuly River. About 16 KLD of waste water will be generated from on board ships, which will be channelized to the STP. The STP will preferably be based on Sequencing Batch Reactor (SBR) Technology that treat wastewater in a batch treatment process and will be 80 KLD of capacity. SBR is a biological, suspended colony type activated sludge purifier combed with oxidation and sedimentation in the same tank that follow each other in sequence. The SBR plant is controlled by an electric panel and is completely automatic. The SBR, reactor besides the biological phase to eliminate the BOD-COD and suspended solids is equipped with a simplified nitrification and de-nitrification treatment system to reduce nitrogen and a simplified de-phosphatizing system to reduce phosphorus. All the domestic water supplied for drinking, cooking and bathing purposes will be sourced from authorized suppliers. It will be ensured that all brackish water will be routed to proposed ETP within the premises of the site.



**Figure 22: Process Flow Diagram – Sequencing Batch Reactor (SBR)**

Source: <http://www.thewatertreatments.com/wastewater-sewage-treatment/sequential-batch-reactor-sbr/>

### 2.8.2. Wastewater treatment system

Apart from domestic sewage, other wastewater streams that will be generated as part of the dry dock operations include wastewater from dock cleaning wash water from hydro blasting process, sludge from vessel's tank cleaning, oily bilge water and contaminated ballast water from vessels. The quantities are estimated as below:



Table 9: Wastewater from Operation Phase

Type of Waste Water	Quantity KL*	Basis for Calculations	References Used Water
Hull/ other wash	20-30 KL	Considering pressure washing of 10-12 litres per minute and use of 4-6 spraying units, about 40-60 litres per minute of water will be consumed. The spraying units will work for half an hour daily during docking period, thus about 1200-1800 litres per day of water will be used. Docking period is normally 15 days, therefore about 18000 - 27000 liters of hull wash water will be generated during docking period, that is approximately 20 KL- 30 KL.	Discussions with experts and previous experience of KDDSEZL in their existing docks.
Bilge water	12-15 KL	It is assumed that 100,000 DWT vessel will generate about 1.2 - 1.5 KL/day of bilge water in total sailing period of 10 days.	Estimation of bilge water: Research report published by the Ministry of Infrastructure and Environment of Denmark (publicaties.minienm.nl/.../e ms-af valproductie- zeescheepvaart-summary.pdf).
Sludge from Tanks	10-12 KL	As a per a Cruise Ship Discharge Assessment Report prepared by USEPA, 1 - 2% of the heavy fuel oil consumed on board of ships will form the accumulated oil sludge. Fuel consumption for 100,000 DWT ship has been estimated as 50 KL/ day. Considering total sailing period of 10 days and 2% of fuel consumption, about 10 - 12 KL of oil sludge will be generated.	% of heavy fuel oil consumed: <a href="https://owpubauthor.epa.gov/p olwaste/vwd/upload/2009_01_2 8_oceans_cruise_ships_appendix .pdf">https://owpubauthor.epa.gov/p olwaste/vwd/upload/2009_01_2 8_oceans_cruise_ships_appendix .pdf</a> Fuel Consumption- <a href="http://chartervessel.blogspot.co m/2013/07/charter-solutions.html">http://chartervessel.blogspot.co m/2013/07/charter-solutions.html</a>
Cleaning of Oil Tanks	8000 KL	Amount of tank washings from crude oil tankers varies between 1.5 - 8% DWT. Considering maximum of 8% of tank wash and 100,000 DWT, about 8000 KL of oily sludge will be generated from cleaning of oil tanks.	% of oil Wash Tank- Final report on "Collection and treatment of Oily Ballast Waters from Tankers" IMO dated August 2004.
Oily Sludge	1250 KL	Oil sludge generated from the oil tankers is 1% of DWT. The density of oil as 0.8 has been considered. Thus, oil sludge generation amounts to 1250 KL.	% of oil Sludge from cleaning of Oil Tanks: Final report on "Collection and treatment of Oily Ballast Waters from Tankers" IMO dated August 2004
Dock Floor wash water	135 KL	The dimensions of the dock basin are: Length (l) - 255m and Width (w) - 48m. The total surface area to be cleaned is 2*l*w, i.e. 24,480 m <sup>2</sup> (~25,000 m <sup>2</sup> ). Considering flow rate of 10-27 liters/min and assuming 5 m <sup>2</sup> can be cleaned in one minute, about 50-135 KL of dock floor wash water will be generated.	Dimensions of proposed dry dock: Feasibility Report prepared by BMT Asia Pacific Flow Rate of Hydro Blasting: <a href="http://www.aquajetsme.com/hydro-blasting">http://www.aquajetsme.com/hydro-blasting</a>
Sewage from Vessels (already considered in Section 2.8.1)	16 KLD	About 40 crew members or passengers have been considered on board vessels entering dock. An average of 50 lpcd of fresh water requirement has been considered and 80% will be generated as waste water. Thus, sewage from vessels would be about 16 KL.	crew members: <a href="http://www.emma-maersk.com/specification/">http://www.emma-maersk.com/specification/</a>

\*A vessel normally remains in the dock for 10-15 days (depending on the work required), water related activities do not happen continuously. A vessel may require about 10,000 KL of water during the entire docking period.

\* Ballast water has not been considered in the above table as the amount of ballast water will vary depending upon the type of vessel and weight.

\* It is to be noted that all the above mentioned quantities has been estimated using different reported published by EPA, IMO, and other international agencies pertaining to subject like oily bilge water, tank washing from oil tanks, oily sludge etc. Reference of reports utilized with calculations has been detailed in Annex- IX- Waste Management Plan.

\* Discussions with experts dealing with waste water at ports have been held to corroborate the calculations and estimations for this project.

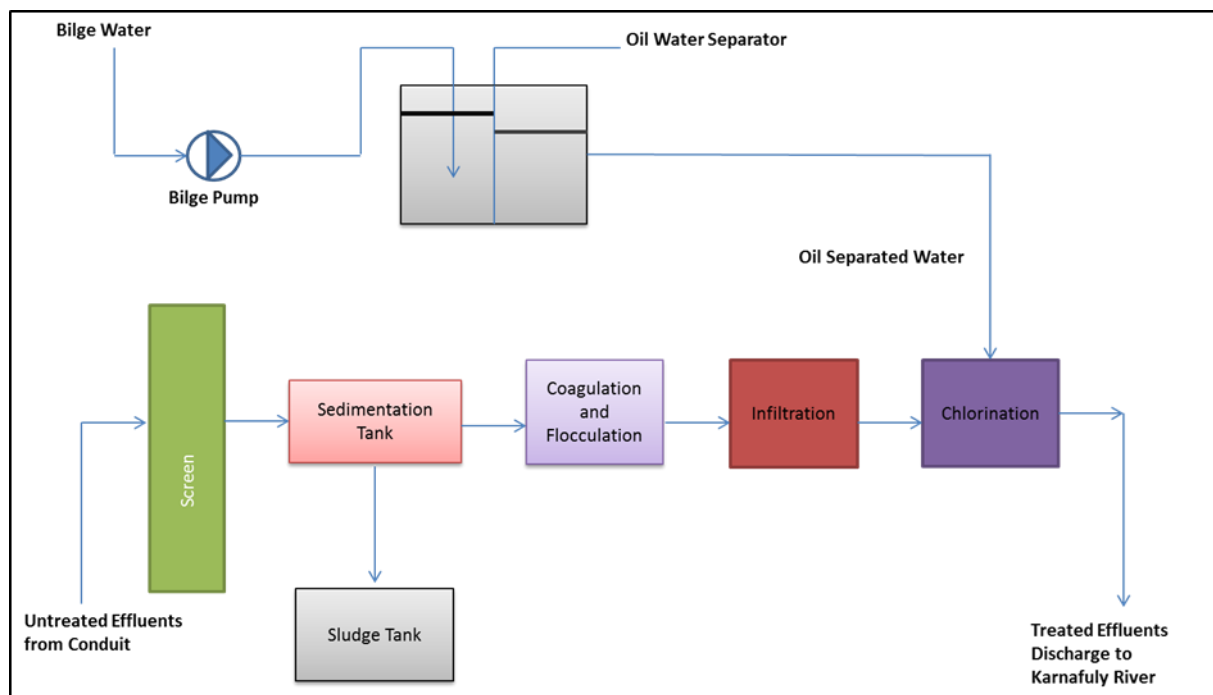
The KDDSEZL drainage system designs will comprise of networks of gutters, trenches, and/or culverts which will serve to collect the heavier settle-able solids transported in industrial wash water flows.

KDDSEZL will put in place adequate systems and techniques to segregate, collect, and transfer contaminated and uncontaminated wastewater streams (and materials causing contamination) to environmentally acceptable treatment systems. This will include segregation of clean water flows from both spent abrasive and any already polluted wastewaters.

The wastewaters are divided into three streams.

- The first stream comprises of hydrostatic water, ships cooling water, and miscellaneous other equipment cooling water discharges, which will be collected in a clean water conduit. These unpolluted waters will be discharged directly into the River without treatment.
- The second stream comprises of dry dock sanitary wastewater and ships non-oily wastewater, which would be collected and pumped to a sewage treatment plant.
- The third stream, comprises of all other wastewater discharges including ships oily wastewater, dock floor wash water, miscellaneous equipment washings, spills, sewer leaks, rain, and clean water which accidentally contacts the dock floor, could be collected and treated prior to disposal.

**Hull Cleaning Waste:** Several methods are used to remove paint, rust, and marine growth, such as barnacles and algae, from the metal surfaces of ship hulls. In all types of surface preparation, the old paint, rust, and marine organisms are found mixed in the spent blasting media. Hull wash water generated will be passed through a fine mesh screen system before entering tank. The mesh screen system will be cleaned regularly to ensure it is fully functional. The rejects from screen will form the sludge and stored in a tank separately. A settling system for further treatment will be installed on board the Dock wherein wastewater generated on the Dock will flow to the existing conduit on the side wings. A chemical dosage and flocculation process will be provided to the above treatment system to further remove the fine particles and soluble form of the contaminants.



**Figure 23: Proposed Effluent Treatment System**

**Oily Bilge water:** KDDSEZL shall provide for collection storage and transfer of oily bilge water and other potential waste to be generated from shipping activities. Oily bilge water will be pre-treated prior to channelizing it to the ETP. A bilge water holding tank will be provided with an oil-water separator, wherein the use of an emulsion breaking bilge water cleaning system can help to achieve this. After free oil is separated from preheated oily bilge water, the remaining emulsified bilge water is directed to a sedimentation tank proposed for temporary storage of waste water. The oil sludge generated will be collected in a separated tank designed enough to cater storage of 10 m<sup>3</sup> of sludge. This particular tank should be located below bilge water holding tank for the purpose of facilitating its drain without the need for a drain pump. All pumping, valves, metering and coupling equipment will be watertight and monitored for leaks. The sludge generated will be stored and sold to DoE approved vendors. Alarm system to be installed that can automatically detect and close the discharge effluent from the oil / water separator when an oil concentration of 15 parts per million (ppm) is reached.

#### Effluent treatment Facilities Proposed

1. A Central Effluent Treatment Plant (ETP) will be put in place for treatment of Dock wash water, including hull washing. It is estimated that the total capacity of the plant will be 80 KLD, with a stand by storage tank of 25 m<sup>3</sup>. The treatment plant will have a mesh to remove suspended material, sedimentation chamber to remove grit and other suspended matter. Traces of heavy metals will be removed by coagulation and flocculation; the water will be chlorinated to remove any microorganism before disposal. The location of Effluent Treatment Plant has been shown in the following

figure which is in proximity to plate shop, pipe shop, electrical instrumentation shop, machine shop and steel fabrication area.

2. An Oil Water Separator of 20KLD capacity will be provided for treatment of Bilge and other oil contaminated water. The treated water will be chlorinated prior to disposal.

### **Oil Tank Wash Generated from Cleaning of Oil Tankers**

After the cleaning of oil tanks, the water containing oil will be pumped out to a holding tank which can allow some separation of the oil and water. Chemical treatment of an emulsion is usually directed toward the destabilization of the dispersed oil droplets or the destruction of emulsifying agents present in a first stage followed by the removal of the separated oil. Appropriate de-emulsifiers can be added to enhance the decantation process, before discharging into the river<sup>6</sup>. The optimum demulsifier dosage much depends on the specific nature of the oil waste. Oily Sludge settled down after decantation will be filled in drums and will be transported to nearby Cement and Kiln industries in Chittagong Area.

### **2.8.3. Ballast water treatment**

A number of IMO approved Ballast Water Treatment technology options are currently available including one or more of the processes listed below. With the exception of a small number of systems, all use a 2-stage approach involving mechanical separation (1st stage) followed by physical/chemical treatment (2nd stage). It is noted that some of the available systems use a combination or two or more physical and/or chemical treatment processes.

Mechanical	Physical	Chemical
Cyclonic Separation Filtration	Ultra Sound Cavitation Ultra Violet Heat De-oxygenation Coagulation	Electro chlorination Ozonation Chlorination Chlorine Dioxide Advanced Oxidation

KDDSEZL will put in place a land based technology to ensure treatment of Ballast water; it will be an online treatment with filtration followed by Ultraviolet/ Electro-chlorination.



Ballast water treatment is accomplished using a simple three-step process of filtration, injection of a biocide solution, and residual oxidant neutralization. The first phase is filtration using a 40 micron stainless steel mesh filter to remove organisms, large particles, and sediments. The second phase of the treatment process is electrochemical generation of the biocide solution (chlorine). This involves passing a small supply, about 1/100 of total ballast flow, through electrolytic cells. The resulting disinfectant solution is injected directly into the incoming ballast water line where it will oxidize potential aquatic invasive species. The third and final treatment process phase is residual oxidant neutralization to ensure

environmental acceptability. When the treated ballast water is ready to be discharged, sodium bisulphite is injected directly into the ballast water discharge line. The sodium bisulphite (oxidant neutralization) addition is controlled with ORP and metering pump technology.

The selection of treatment technology will consider the volume of 10% more than the maximum capacity of the largest vessel allowed at site. The flow rate, pump size and retention time will be maintained by an interim storage tank. The detailed design of the treatment facility will be arrived at after selection of the supply vendor and detailed designing.

## **2.9. Project cost**

At this stage, a preliminary budgetary estimation for construction phase of the project has been worked out by KDDSEZL. The construction cost of the project has been estimated as USD 105.2 Million which include cost for dredging and reclamation works, building and civil works, construction of dry dock, jetty and equipment and machinery procurement and commissioning, but excludes land procurement cost.

## Chapter 3

### POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

#### 3. Policy, legal and administrative framework

This chapter provides a description of the regulatory framework applicable to the SEZL. It highlights environmental, health & safety and social regulations with applicable permits and standards in association with the Project. It broadly focuses on the:

- Legal Enforcement Agencies at National Level;
- Applicable national and local Environmental and Social Laws, Regulations and Policies;
- World Bank Environmental Safeguard Policies and expected trigger ability;
- World Bank (WB) Environmental Impact Assessment Guidelines;
- International & National Environment Standards/ Guidelines; and
- Applicable International Conventions/Protocols.

##### 3.1. Legal enforcement agencies

The responsibility of formulation, implementation and modification of national level environmental laws in Bangladesh lies with the Ministry of Environment and Forests (MoEF). The Department of Environment (DoE) established under the Environmental Pollution Control Ordinance, 1977 which functions under the MoEF. It is responsible for carrying out the purposes and provisions of the Environment Conservation Act, 1995 as amended till 2010 (hereinafter referred as ECA) which is the umbrella legislation regulating environmental issues in the country. A brief description of the relevant legal enforcement agencies has been described in the following table.

**Table 10: Relevant Legal Enforcement Agencies and their Functions**

SN	Agency	Functions
1	<b>Ministry of Environment &amp; Forests (MoEF)</b>	<p>The MoEF is the nodal agency in the administrative structure of the Central Government, for the planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programmes. It oversees all environmental matters in the country and is a permanent member of the Executive Committee of the National Economic Council.</p> <p>It plays a pivotal role as a participant of the United Nations Environment Programme (UNEP). Its principal activities include:</p> <ul style="list-style-type: none"> <li>• Conservation &amp; survey of flora, fauna, forests and wildlife;</li> <li>• Prevention and control of pollution; and</li> <li>• Forestation &amp; regeneration of degraded areas and protection of environment in the frame work of legislations.</li> </ul>
2	<b>Department of Environment (DoE)</b>	<p>An Environment Pollution Control Board was setup under the Environment Pollution Control Ordinance, 1977. It underwent a series of subsequent restructuring and was finally renamed as Department of Environment in 1989. It is headed by a Director General appointed by the Government.</p> <p>The DoE through its head, divisional and district level offices conducts the following principal activities:</p> <ul style="list-style-type: none"> <li>• Advising the Government to avoid such manufacturing processes, commodities and substances which are likely to cause environmental pollution;</li> </ul>



SN	Agency	Functions
		<ul style="list-style-type: none"> <li>• Advisory and issuing directions to the concerned person regarding the environmentally sound use, storage, transportation, import and export of a hazardous substance or its components;</li> <li>• Conducting inquiries and research activities on conservation, improvement and pollution of the environment and rendering assistance to any other authority/organisation regarding the same;</li> <li>• Collection and publication of information about environmental pollution;</li> <li>• Conducting programs for observation of drinking water quality and issuing directives if necessary for adherence to drinking water quality standards;</li> <li>• Formulation of environmental guidelines;</li> <li>• Prescribing and modifying environmental quality standards pertaining to air, water, noise, vehicular emissions etc.;</li> <li>• Issuing Location Clearance and Environmental Clearance Certificates to Projects; and</li> <li>• Implementation of provisions of ECA and rules made there under.</li> </ul>
3	<b>Bangladesh Forest Department (BFD)</b>	It was established under the MoEF and is responsible for identifying and declaring of certain areas as reserved or protected or private forest lands. It implements the provisions of Forest Act, 1927 and National Forestry Policy, 1994. It's also responsible for wildlife preservation and protection through implementation of Wildlife (Preservation & Security) Act, 2012.
4	<b>Water Resources Planning Organization (WARPO)</b>	It was established under the Water Resources Planning Act, 1992. Its core functions include: <ul style="list-style-type: none"> <li>• Monitoring the implementation of National Water Management Plan (NWMP);</li> <li>• Upkeep of water resource assessments;</li> <li>• Maintenance, updating and dissemination of the National Water Resources Database (NWRD) and MIS;</li> <li>• Secretariat to the National Water Resources Council (NWRC) and the Executive Committee of the National Water Resources Council (ECNWRC);</li> <li>• Responding to the NWRC/ECNWRC requests for information and advice;</li> <li>• Periodic update of the NWMP;</li> <li>• Assisting other agencies in planning, monitoring, studies and investigations;</li> <li>• Adhoc advice on policy, strategy, institutional and legal issues;</li> <li>• Laying down effluent discharge standards into river in consultation with DoE;</li> <li>• Special studies and research as required.</li> </ul>
5	<b>Ministry of Shipping (MOS)</b>	The Ministry of Shipping encompasses within its fold shipping and port sectors which also oversee the safety and environmental matters and the regulatory aspects of maritime shipping. It is responsible for: <ul style="list-style-type: none"> <li>• Development and maintenance of waterways, inland water transport, ports, ocean shipping, development and expansion of physical infrastructural facilities etc.</li> <li>• Managing and maintaining inland, island and inter island ferry-boat and shipping services;</li> <li>• Formulation and implementation of act, rules and policies regarding the aforementioned issues.</li> </ul>
6	<b>Bangladesh Inland Water Transport Authority (BIWTA)</b>	It was setup in 1958 under the provisions of East Pakistan Inland Water Transport Authority Ordinance 1958. Its specific functions include: <ul style="list-style-type: none"> <li>• Carry out river conservancy works;</li> <li>• Disseminate navigational and meteorological information including publication of river charts;</li> <li>• Draw up programmers of dredging requirements and priorities for efficient maintenance of existing navigable waterways and for resuscitation of dead or</li> </ul>

SN	Agency	Functions
		dying rivers, channels, or canals, including development of new channels and canals for navigation; and <ul style="list-style-type: none"> <li>• Develop, maintain and operate inland river ports, landing/ferry ghats and terminal facilities in such ports or ghats.</li> </ul>
7	<b>Ministry of Fisheries and Livestock (MOFL)</b>	The main functions of the MOFL include: <ul style="list-style-type: none"> <li>• Preservation of fisheries resources;</li> <li>• Fulfilling the requirement of animal protein through proper management and planned development;</li> <li>• Increasing socio-economic conditions of fishermen;</li> <li>• Creating employment opportunities for rural unemployed and landless people;</li> <li>• Expanding foreign exchange earnings by exporting fish and fishery products;</li> <li>• Developing innovative technologies through research for fisheries development and preservation; and</li> <li>• Protection of fishes through implementation of Protection and Conservation of Fish Act, 1950 as amended till date.</li> </ul>
8	<b>Bangladesh Power Development Board (BPDB)</b>	It is a statutory body created in May 1, 1972 and is responsible for major portion of generation and distribution of electricity mainly in urban areas except Dhaka and West Zone of the country. It has undertaken a massive capacity expansion plan to add about 10500 MW generation capacities in next 5 years to achieve 24000 MW Capacity according to Power System Master Plan (PSMP) 2021.
9	<b>Bangladesh Energy Regulatory Commission (BERC)</b>	It was established under the Bangladesh Energy Regulatory Commission Act, 2003. Some of its key functions include: <ul style="list-style-type: none"> <li>• Issue, cancel, amend and determine conditions of licenses, exemption of licenses and determine the conditions to be followed by such exempted persons;</li> <li>• Regulation of generation, storage, supply, and transmission of energy;</li> <li>• Determine tariff for electricity distribution etc.;</li> <li>• Ensure control of environmental standard of energy under existing laws;</li> <li>• Extend co-operation and advice to the Government, if necessary, regarding electricity generation, transmission, marketing, supply, distribution and storage of energy.</li> </ul>
10	<b>Ministry of Labour and Employment (MOLE)</b>	It was established with following objectives: <ul style="list-style-type: none"> <li>• Creation of employment opportunity;</li> <li>• Creation of semi-skilled and skilled manpower;</li> <li>• Enhancement of productivity of factories by creating friendly working environment between workers &amp; employers;</li> <li>• Ensuring welfare of workers in different industrial areas;</li> <li>• Implementation of labor laws;</li> <li>• Fixing up minimum wages of labor; and</li> <li>• Ensuring justice through Labor Court.</li> </ul> It has been divided into four departments, viz: <ul style="list-style-type: none"> <li>• Directorate of Labor</li> <li>• Chief Inspector of Factory and Establishment</li> <li>• Minimum Wages Board</li> <li>• Labor Appeal Tribunal</li> </ul>
11	<b>Ministry of Law and Parliamentary Affairs</b>	This ministry is divided in to the Law and Justice Division and the Parliamentary Affairs Division for functional purposes. The Law and Justice Division of the Ministry of Law, Justice and Parliamentary Affairs has the responsibility of providing legal advisory services to other ministries, divisions, departments, and organizations of the Government. The parliamentary affairs division is assisted by the law commission and the human rights commission and its main function lies in formulating, scrutinizing

SN	Agency	Functions
		and preparing legislations. When needed, it provides legal opinions and translations for other ministries.
12	<b>Ministry of Land</b>	The ministry of land is in charge of land administration, management and development for the overall growth of the nation. The Ministry manages Government owned lands, vested properties and abandoned properties. It is responsible for the collection of land development tax, land surveying and record keeping and updating. Land Acquisition and requisition fall under the responsibilities of this ministry.
13	<b>Board of Investment (BOI), Bangladesh</b>	The Board of Investment was established in 1989 by the Investment Board Act. The specific functions of board are: <ul style="list-style-type: none"> <li>• Implementation of all provisions as lay down under The Investment Board Act, 1989;</li> <li>• To promote domestic and foreign investment as well to enhance international competitiveness of Bangladesh;</li> <li>• To identify the hindrance of investment and provide necessary facilities and assistance in the establishment of industries.</li> </ul>
14	<b>Civil Aviation Authority (CAA), Bangladesh</b>	The Government of the People's Republic of Bangladesh formed Civil Aviation Authority, Bangladesh in the year of 1985. The main functions of CAA are: <ul style="list-style-type: none"> <li>• It is responsible for registration of aircrafts and issues license to each personnel responsible for flight operations;</li> <li>• To regulate air traffic and provides facilities and services for aeronautical telecommunications and air navigation;</li> <li>• The authority is responsible for construction, maintenance and development of airports and aerodromes.</li> </ul>
15	<b>Union Parishad</b>	Union Parishad (UP) currently is the only elected statutory local government body for the rural Bangladesh. A UP consists of a chairman and twelve members. They are elected on the basis of adult franchise. Each UP has a full-time Secretary, appointed by the Deputy Commissioner (DC). The functions of UP are: <ul style="list-style-type: none"> <li>• Maintenance of law and order and conduction of censuses of all kinds;</li> <li>• Registration of births, deaths, blind people, beggars and destitute;</li> <li>• Planning and implementation of development schemes in the field of agriculture, forestry, fisheries, livestock, education, health, small and micro enterprises, communications, irrigation and flood control;</li> <li>• Protection and maintenance of public property such as roads, bridges, canals, embankments, markets, telephones and electricity lines.</li> </ul>

### 3.2. Applicable environmental and social laws, regulations and policies

The relevant Acts and Rules pertaining to the Project have been summarized in the following table.

**Table 11: Applicable Environmental, Health and Safety and Social Laws, Regulations and Policies**

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<b>National Environment Policy, 1992 and Action Plan</b> It sets out the framework for establishment of legislations related to 15 sectors including environment, water, agriculture, water resources development, forest & wildlife, fisheries etc. The key provisions of the policy are:	Ministry of Environment and Forests, Bangladesh  Department of Environment (DoE), Bangladesh	KDDSEZL should ensure that Project activities comply with the provisions made under the policy and the legislations made there under for implementing the same.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<ul style="list-style-type: none"> <li>Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) of all new public and private sector industrial Projects is mandatory;</li> <li>Adoption of corrective measures by polluting industries in phases;</li> <li>Prevention of land erosion, and environmentally sound management of newly accreted land;</li> <li>Conservation of wildlife, bio-diversity, forest, fisheries and livestock.</li> </ul>		
<p><b>The Environment Conservation Act, 1995 as amended till October 5, 2010</b> (hereinafter referred as ECA)</p> <p><b>The Environment Conservation Rules, 1997 as amended till February 16, 2002</b> (hereinafter referred as ECR)</p> <p>The salient features of the Act are as follows:</p> <ul style="list-style-type: none"> <li>A Department of Environment (DoE) to be established subsidiary to the MoEF to exercise the provisions of the Act;</li> <li>The Government of Bangladesh (GoB) will declare Ecologically Critical Areas (ECA) and specify the activities or processes that cannot be initiated or continued in an ECA;</li> <li>An industrial unit/Project cannot be established without obtaining an Environmental Clearance Certificate (ECC) from the Director General of DoE;</li> <li>Publication of environmental guidelines related to environmental pollution control and mitigation, conservation and improvement of the environment;</li> <li>Prescription of rules for implementing the provisions of the Act.</li> </ul> <p>The provisions under the ECR are summarized as follows:</p> <ul style="list-style-type: none"> <li>The industries for the purpose of obtaining ECC have been classified into the following 4 categories based on their site and impact on the environment: <ul style="list-style-type: none"> <li>Green</li> <li>Orange –A</li> <li>Orange – B</li> <li>Red</li> </ul> </li> </ul> <p><i>The list of industries falling under each category has been annexed in the Schedule – I to the ECR.</i></p> <ul style="list-style-type: none"> <li>For proposed industries falling under the Orange A&amp;B and Red categories, a Location Clearance Certificate (LCC) needs to be</li> </ul>	<p>Ministry of Environment and Forests (MoEF), Bangladesh</p> <p>Department of Environment (DOE), Bangladesh</p>	<p>The proposed Project being a Dry Dock Special Economic Zone which will facilitate building and dry docking of ocean going vessels up to 100,000 DWT falls under the Red category as classified under Schedule-I of the ECR.</p> <p>KDDSEZL shall ensure compliance with the applicable provisions of the Act and the Rules made there under.</p> <p><b><i>Reportedly KDDSEZL has received a No Objection Certificate (NOC) from Bairag Union Parishad for the project Project site, which attached in Annex-2.</i></b></p> <p>KDDSEZL shall ensure that Location Clearance Certificate (LCC) for the proposed Project site is obtained.</p> <p>Furthermore, KDDSEZL shall apply for the Environmental Clearance Certificate (ECC) in the requisite manner along with prescribed documents.</p> <p>The EIA to be submitted along with ECC application shall be as per the TOR provided by the DoE.</p> <p>KDDSEZL shall ensure that pollutant emissions/discharges from various sources etc. during Project activities are well within</p>

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<p>obtained from DoE prior to the issuance of ECC;</p> <ul style="list-style-type: none"> <li>The Project entrepreneur shall apply for ECC in Form 3 along with prescribed documents and application fees;</li> <li>ECC (for Red category) will be valid for 1 year from the issuance date and shall be renewed at least 30 days prior to expiry;</li> <li>Various environmental quality standards pertaining to air, water, sound, odor etc. have been laid down in the schedules attached to the Act.</li> <li>Emissions and waste discharge standards have been laid down in Schedules 9-11.</li> <li>The person in charge of facility/unit shall notify the Director General, DoE in case of pollutant emission/ discharge in excess of prescribed standards or where there is a possibility of the same.</li> </ul>		<p>the standards prescribed in the Schedules 2-12 of the ECR 1997. Some of the standards have been revised by the DoE viz.</p> <p>Ambient Air Quality standard Vehicular Emission standards Ambient Noise Standards</p> <p><b><i>The various applicable standards have been provided in subsequent sections. Compliance to such standards shall be ensured by KDDSEZL.</i></b></p>
<p><b>National Industrial Policy, 2010</b></p> <p>The policy aims to ensure the industrialization process is compliant with internationally agreed environment, health, and safety and labour standards.</p> <p>The government will ensure assistance for creating alternative employment, keeping the socio-economic backdrop in mind, for any privatization proposal.</p>	Ministries of Industries	KDDSEZL shall ensure that the proposed Project is registered as prescribed by the Act.
<p><b>Investment Board Act (1989)</b></p> <p>Board of Investment, established under this act, is the principal private investment promotion and facilitation agency of Bangladesh which is responsible for implementation of provisions of above said policy.</p> <p>Under the provision of this act as per Schedule 11, All industries established in non-governmental sectors licensed by the Board shall be registered in the prescribed manner.</p> <p>As per Schedule 15 of this act, any industrial undertaking licensed transgresses any provision of this Act or of any rule made there under or breaks any condition relating to the license, the Board may, in such manner as may be prescribed, cancel the license of the industrial undertaking.</p>	Board of Investment (BOI), Bangladesh	KDDSEZL shall ensure that the proposed Project is registered as prescribed by the Act.
<p><b>National Water Policy, 1997</b></p> <p>This policy aims to provide direction to all agencies working with the water sector, and</p>	Water Resource Planning Organization	KDDSEZL will ensure that the project effluent disposal meets

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<p>institutions that relate to the water sector. The WARPO shall:</p> <ul style="list-style-type: none"> <li>Establish zoning regulations for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities; and</li> <li>Establish standards for effluent disposal into common water courses in consultation with DoE.</li> <li>The effluent disposal will be monitored regularly by relevant Government agencies in order to prevent water pollution.</li> </ul>		<p>the prescribed quality standards set down by the DoE</p>
<p><b>National Water Management Plan, 2001 (Approved in 2004)</b></p> <p>The objectives of the Plan are listed below:          To operationalize directives given in National Water Policy and to do in accordance with the Government Approved Development Strategy.          To address issues related to harnessing and development of all forms of surface and ground water and management of these resources in an efficient and equitable manner.          Consultation and participation with the direct beneficiaries in the hand over and development of water schemes.</p>	<p>Water Resource Planning Organization (WARPO)</p>	<p>KDDSEZL should ensure that a well- designed and managed dredging programme to be implemented to reduce the amount of dredged volumes.</p> <p>KDDSEZL should ensure implementation Chittagong Flood Protection program with provision of embankment, proper maintenance of sea dykes, drainage sluices etc.</p>
<p><b>Bangladesh Water Act, 2013</b></p> <p>The key features of the Act are:</p> <ul style="list-style-type: none"> <li>A National Water Resources Council (NWRC) to be established for implementing the provisions of the Act</li> <li>A National Water Policy shall be adopted by the Council addressing the following issues:             <ol style="list-style-type: none"> <li>Purpose and sectors of water use</li> <li>Affordability of water users</li> <li>Actual cost of water abstraction and distribution</li> <li>Financial ability and backwardness of water users of any group thereof</li> <li>Water demand and supply</li> <li>Any other issues considered relevant by GoB</li> </ol> </li> <li>An Executive Committee of the Council shall be established or ensuring efficient performance of the Council.</li> <li>The GoB can declare certain areas as Water Stress Areas for the protection of water sources or aquifers.</li> <li>Water zone demarcation (industrial, agricultural, brackish water aquaculture and hatchery water zones) through gazette</li> </ul>	<p>Water Resource Planning Organization (WARPO)</p>	<p>This Act was implemented in 2013 and the NWRC and Executive Committee are yet to be formulated. Upon formation of the aforementioned bodies, water stress areas and related provisions may be prescribed.</p> <p><b><i>KDDSEZL shall ensure compliance with legal requirements under such provisions if applicable.</i></b></p>



Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<p>notification and issuance of protection order for efficient water management in such zones.</p> <ul style="list-style-type: none"> <li>• Declaration of flood control zone and its management.</li> <li>• Restriction on abstraction of total water from any water source.</li> </ul>		
<p><b>Ground Water Management Ordinance, 1985</b></p> <p>As per the provisions as per schedule 5 of this act, no tube well shall be installed in any place without a license granted by the Union Parishad.</p> <p>Also, no application shall be entertained by the Union Parishad unless it is accompanied by such fee as may be prescribed under the requirements of this ordinance.</p>	<p>Ministry of Environment and Forests, Bangladesh</p>	<p>KDDSEZL should ensure that no tube-well shall be installed in any place without a license granted by the Union Parishad.</p> <p>KDDSEZL should furnish the following information: the aquifer condition of the soil where the tube-well is to be installed; The distance of the nearest existing tube-well; The area likely to be benefited by the tube-well; The likely effect on the existing tube-wells including tube wells used for domestic purpose; The suitability of the site for installation of the tube-well; and The conditions on which a license, if any, may be granted.</p>
<p><b>The National Fisheries Policy, 1999</b></p> <p>The objectives of the fisheries policy are:</p> <ul style="list-style-type: none"> <li>• Enhancement of the fisheries production;</li> <li>• Poverty alleviation through creation of self-employment and improvement of socio-economic conditions of the fishermen;</li> <li>• Fulfilling the demand for animal protein;</li> <li>• Achieve economic growth through earning foreign currency by exporting fish and fisheries products; and</li> <li>• Maintain ecological balance, conserve biodiversity, ensure public health and provide recreational facilities.</li> </ul> <p>The policy broadly aims at fisheries development, regulation of aquaculture, biodiversity conservation and formulation of laws to ban the disposal of any untreated industrial effluents into the water bodies.</p>	<p>Ministry of Fisheries and Livestock (MoFL)</p> <p>Department of Fisheries (DoF)</p>	<p>KDDSEZL shall ensure that during Project operation, no untreated effluent is disposed into the river. The treated effluent shall also meet the standards stipulated under the ECR.</p>
<p><b>Protection and Conservation of Fish Act, 1950 as amended through February 16, 1995</b></p> <p>This Act was promulgated for conservation of fish in Bangladesh and their protection against</p>	<p>Ministry of Environment and Forests, Bangladesh</p> <p>Department of</p>	<p>KDDSEZL shall ensure compliance with provisions mandated under this Act.</p>

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
indiscriminate fishing, poisoning due to industrial effluent disposal into the water, oil spills, etc.	Fisheries	
<b>Protection and Conservation of Fish Rules, 1985</b>  The Rules were prescribed under the provisions of Protection and Conservation of Fish Act. It provides the regulations for prohibition of fishing during certain periods, licenses for catching fishes, prevention of fish destruction due to explosives and industrial effluent disposal etc.	Ministry of Environment and Forests, Bangladesh  Department of Fisheries	KDDSEZL shall ensure that untreated effluent is not disposed into the river. The treated effluent shall comply with the discharge standards stipulated under the ECR.
<b>The Marine Fisheries Ordinance, 1983</b>  Schedule 20 of the ordinance prescribed that no foreign fishing vessel without a license enter the Bangladesh fisheries waters except for any purpose set out in section 21.  As per provisions mandated in Schedule 15, No fishing vessel shall be operated so as to interfere with navigational aids or with shipping in established shipping routes.  Schedule 29 mentions that no person is entitled to fishing, dredges, extracts sand or gravel, discharges or deposits waste or any other polluting matter, or in any other way disturbs, alters or destroys fish or their natural breeding grounds or habitats in any marine reserves declared under section 28.	Ministry of Environment and Forest, Bangladesh.  Department of Fisheries.	KDDSEZL shall ensure that no foreign fishing vessel shall enter the Bangladesh fisheries waters without a licence.  KDDSEZL should ensure that discharge of pollution or any other waste should not be done in any marine reserves. Also, no dredges sand or gravel to be extracted from water reserves that are declared as marine reserves.
<b>Ports Act, 1908</b>  The Act was promulgated to consolidate the enactments related to the ports and port charges.  As per section 6 of the act, spread of any reporting of the vessels with the port. Infectious or contagious disease from vessels arriving or sailing from any port, for the prevention of danger arising to the public health.  As per Section 21, throwing of ballast or rubbish (likely to form bank or shoal or to be detrimental to navigation) or oil/oil mixed with water is prohibited without the consent of port conservator into the port or upon any place from which the same is liable to be washed into any such port either by ordinary/high tides/storms/land-floods etc.	Ministry of Shipping (MoS)	KDDSEZL shall ensure that the vessels/ ships coming to the port comply with provisions Chapter IV pertaining to safety of shipping, port fees and reporting of the vessels with the port.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<p>As per Section 31, no vessel of measurement <math>\geq 200</math> tons shall enter/leave into any port without a pilot. A vessel of measurement <math>&gt;100</math> but <math>&lt;200</math> tons shall enter a port without a pilot authority in writing so to do has been obtained from the conservator or some officer empowered by him to give such authority.</p> <p>As per section 39 of the act the master of the vessel has to report to the conservator of the port within 24 hours after its arrival.</p>		
<p><b>Ports Rules, 1966</b></p> <p>Section II deals with discharge of passengers/ballast/cargo. Under Rule 31, a survey certificate or route permit is a pre-requisite for a vessel to transport, load and unload passengers/cargo/fuel onto a port which shall be issued by the port Conservator/competent authority.</p> <p>Section III of the Rules prohibits the discharge of oil/oil mixed with water into water within the limits of port without the permission of the port Conservator</p> <p>The disposal of oil/oil mixed with water shall be done outside the port limits by the vessel owner by making his own arrangements.</p>	<p>Bangladesh Inland Water Transport Authority (BIWTA)</p>	<p>KDDSEZL shall ensure that all vessels discharging cargo or passengers have a valid survey certificate and route permit in possession. KDDSEZL shall also ensure that all the rules covered under section I, II, III, IV, V VI are complied with.</p>
<p><b>Inland Shipping Ordinance, 1976</b></p> <p>This ordinance was promulgated to provide for the survey, registration and control of navigation of vessels plying on inland waters.</p> <p>As per chapter II of this ordinance, every inland ship is required to be surveyed and registered after approval of design.</p> <p>The owner or master of every inland ship immediately on receipt of the certificate, cause one of the duplicates thereof to be affixed on some conspicuous part of the ship where it may be easily read by all persons on board.</p> <p>As per section 56, every inland ship shall be equipped with lifesaving apparatus and Firefighting equipments.</p> <p>Section 60 prescribes that every inland ship to be equipped with sanitation facilities and no inland ship activity shall be conducted to cause pollution of inland water.</p>	<p>Bangladesh Inland Water Transport Authority (BIWTA)</p>	<p>KDDSEZL shall ensure the following as mandated by the Ordinance:</p> <p>All the inland ships shall have a valid route permit granted by the GoB/relevant authority.</p> <p>Inland ship shall be equipped with firefighting equipment's, lifesaving apparatus and measures against explosion, collision and other accidents as prescribed.</p>
<p><b>Chittagong Port Authority Ordinance 1976</b></p> <p>Section 18 of this ordinance describes the power to permit any erection of private docks. The Authority may, by order in writing and subject to such conditions as may be specified therein, permit any person to make, erect, or fix below</p>	<p>Chittagong port Authority (CPA)</p>	<p>KDDSEZL shall ensure that permit from CPA has been procured for development of KDDSEZL</p> <p>KDDSEZL shall also ensure that no person except authority shall make, or erect or fix below</p>

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
high water-mark within the Port any dock, pier, structure or mooring. As per section 17, no person except the Authority shall make, erect or fix below high water-mark within the Port any dock, pier, erection or mooring.		high-water mark within the port and dock.
<b>The Dangerous Cargoes Act, 1953</b>  This was promulgated to provide provisions related to the safety of ports with respect to the transit, working and storage of dangerous cargoes.	Deputy Conservator of port Board of Trade or the Ministry of Communication  Chief of Naval Staff.	KDDSEZL shall ensure that the provisions made under this Act are complied with during transportation of dangerous cargo in vessels/ships and to ensure safety of port.
<b>The Building and Construction Act, 1952</b>  As per Section 3A of this act, no owner or occupier of a building shall, without obtaining previous permission from the Authorized Officer or the Committee use the building for the purpose other than that mentioned in the sanction. All the construction, re-construction works to be undertaken as per terms or conditions prescribed.	Authorized Officer or Committee	KDDSEZL shall ensure that no building or tank shall be constructed without prior permission from the Authorized Officer or Committee of the area.
<b>The Vehicle Act, 1927</b>  As per section 4 of this act, no owner or person in charge of a vehicle shall allow any person under the age of eighteen years to drive the same in any public place. As per section 7, no person shall drive a vehicle in a public place unless he is licensed in the prescribed manner. Every vehicle must possess a valid registration certificate as per section 11 of this act.	Bangladesh Road Transport Authority	KDDSEZL shall ensure that every vehicle possess a certification of registration as required under this act.
<b>The Motor Vehicle Ordinance Act, 1983 (as modified on November, 1990)</b>  As per section 3 of the ordinance, no person shall drive a motor vehicle in any public place unless he holds an effective driving license. No person under the age of eighteen years shall drive a motor vehicle in any public place.	Bangladesh Road Transport Authority	KDDSEZL shall ensure that no person shall drive a motor vehicle in any public place unless he holds an effective driving license issued to himself authorizing him to drive the vehicle.
<b>Fatal Accidents Act, 1855</b>  This Act was promulgated to provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. The company will be liable to pay compensation in case of death of any	Ministry of Labour and Employment	KDDSEZL shall ensure compliance to the Rules.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
worker/employee or damages in case death has not ensued but such circumstances could have resulted in death.		
<p><b>Bangladesh Labour Act, 2006 (as amended through July 22, 2013)</b></p> <p>The provisions prescribed under chapters pertaining to occupational health and safety, and compensations due to accidents are entailed below.</p> <p><b>Chapter V: Health and Hygiene</b> The chapter deals with provisions regarding cleanliness of the any facility, drinking water supply, ventilation, lighting, dust bean and spittoons, etc.</p> <p><b>Chapter VI: Safety</b> This chapter addresses the issues regarding safety of building and machinery, precautions in case of fire, fencing of machinery, work on or near machinery in motion, hoists and lifts protection of eyes, explosive or inflammable dust/gas, etc.</p> <p><b>Chapter VII: Special Provisions related to Health, Hygiene and Safety</b> This chapter deals with provisions to be taken in case of hazardous operations, notice to be given in accidents, notice of certain dangerous occurrences and diseases etc.</p> <p><b>Chapter VIII: Welfare</b> This chapter prescribes the provisions to be facilitated in the facility regarding first-aid appliances, safety record books, washing facilities, canteens, shelters, rooms for children, etc.</p> <p>This Act consolidates and amends the laws relating to employment of labor, relations between workers and employers, determination of minimum wages, payment of wages and compensation for injuries to workers, formation of trade unions, raising and settlement of industrial disputes, health, safety, welfare and working conditions of workers, apprenticeship and matters connected therewith.</p> <p>The provisions prescribed under chapters pertaining to labour benefits and entitlements are as follows: Conditions of Service and Employment Employment of Adolescent Maternity Benefit Working Hours and Leave</p>	Ministry of Labour and Employment	<p>KDDSEZL shall ensure that all conditions provided in chapters V, VI, VII and VIII of the Act, pertaining to Health, hygiene safety and welfare are met in accordance with the amended act.</p> <p>During the construction and operation phases of the proposed Project, KDDSEZL shall ensure the facilitation of the following provisions: Management of workers under service rules as approved by the Chief Inspector. Provision of Letter of Appointment and ID card (with photograph) for each and every worker. Maintenance of Service Book with the requisite details. Retrenchment Policy and conditions of re-employment of retrenched workers, termination of employment etc. Provisions regarding gratuity, provident fund and other payments at the time of retirement of workers. Any adolescent employed in any dangerous operation shall be in possession of Certificate of Fitness issued by a registered medical practitioner. Maternity benefits shall be paid as stipulated in the Act. Cleanliness of the facility through washing, painting and varnishing etc. for ensuring hygiene. Ventilation and removal dusts and fumes through adequate number of exhaust systems. Adequate number of drinking water facilities equipped with cooling systems at convenient places in the unit. All such places shall be legibly marked 'Drinking water' in Bangla.</p>

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<p>Wages and Payment</p> <p>Workmen's Compensation for Injury by Accidents</p> <p>Trade Unions and Industrial Relations</p> <p>Regulation of Employment and Safety of Dock Workers</p>		<p>Separate and adequate number of latrines and urinals for men and women. They shall be maintained in a clean and sanitary condition at all times with suitable detergents and disinfectants.</p> <p>Leave Policy stating the working hours and the number of leaves the workers are entitled to under the provisions of the Act.</p> <p>Compensation/wages shall be stated in the Letter of Appointment given to the workers/employees.</p> <p>KDDSEZL shall ensure that there is no policy restricting the association of workers'/trade unions.</p> <p>Workmen's Compensation Policy stating the compensation to be meted out in case of injury due to accidents. Safety of KDDSEZL workers engaged in loading and unloading of industries as per prescribed provisions.</p>
<p><b>Bangladesh Factories Act, 1965</b></p> <p>As per section 6 of the Act, the occupier shall furnish some information to Chief Inspector at least fifteen days before he begins to occupy or use any premises as a factory.</p> <p>As per Section 8, the plans and specifications must be approved by Chief Inspector.</p> <p>Provisions for cleanliness, disposal of effluents, ventilation, lightning, latrines and urinals have been described in Chapter II of the Act.</p> <p>Chapter IV and V prescribe provisions for safety and welfare of the workers.</p>	Chief Inspector of the Area	<p>KDDSEZL shall ensure that approval for plan and specifications has been procured from Chief Inspector of area.</p> <p>KDDSEZL ensures that provisions as prescribed in chapters II, III and IV are complied with.</p>
<p><b>National Child Labor Elimination Policy, 2010</b></p> <p>The National Child Labor Elimination Policy 2010 has been adopted to provide a framework towards eradicating all forms of child labor by 2015. The policy defines and lays guidelines for underage workers, regulation of their working hours, wages, nutrition needs, mental health, education and overall work environment.</p>	<p>Ministry of Labor and Employment</p> <p>Ministry of Women and Child Welfare</p>	<p>During all stages concerning employment of labor, KDDSEZL should take the policy as a guidance document for following ethical practices at workplace, in dealing with adolescent workers, if at all.</p>



Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
As per the policy, a child is a person under the age of 14. A person between the ages of 14 and 18 is an adolescent, and should be granted special amendments, if compelled to work due to poor economic status. The policy also entails that a child may not be employed as a regular employee, not be made to work in hazardous settings, provided breaks more frequent than those for regular employees and have enough time left for study.		
<p><b>Children's Act, 2013 (Act No. 24 of 2013).</b></p> <p>The Act implements the Nation's ratification to the UN Convention on the Rights of the Child (CRC), and replaces The Children's Act of 1974. The main components of the act are as follows:</p> <p>The Act changes the legal definition of a child from being a person under the age of 14 to one under the age of 18.</p> <p>It enforces the national authorities to establish Child Welfare Boards in each district, besides one at the national level.</p> <p>It criminalizes any kind of cruelty inflicted on children while they are working in both the formal and informal sectors.</p> <p>The Act further prescribes stricter punishments for using or exploiting children in begging, in brothels, and in carrying drugs, arms, or other illegal commodities.</p>	<p>Ministry of Law, Justice and Parliamentary Affairs.</p> <p>District commissioner's Office.</p>	<p>KDDSEZL must ensure that at through all stages of construction and operation, no juvenile (children between ages 14 and 18) are engaged on site.</p>
<p><b>The Acquisition and Requisition of Immovable Property Ordinance, 1982</b></p> <p>The ordinance consolidates and amends the laws relating to acquisition and requisition of immovable property by the government. It lays down the procedures and conditions for acquisition of land and other immovable properties such as common property resources (wells, places of worship, burial grounds, etc.).</p> <p>As per Section 8 of this ordinance, the amount of compensation to be determined taking into consideration market value and decision of Deputy Commissioner.</p>	<p>Ministry of Land, Bangladesh</p>	<p><b>There is a total of 18.23 acres land</b> comprising of private land of SEZL was procured from residents of project villagers on a willing buyer – willing seller basis.</p> <p>KDDSEZL shall ensure the compliance with provisions of this ordinance relating to compensation.</p> <p>Land legality papers are attached in <b>Annex-2</b>.</p>
<p><b>The Bangladesh Inland Water Transport Corporation Order, 1972 (President's Order)</b></p> <p>This ordinance has been established for the provision of a Corporation for the purpose of operation, promotion and development of coastal and inland shipping and water transport services.</p>	<p>Bangladesh Inland Water Transportation Authority (BITWA)</p>	<p>KDDSEZL should ensure the compliance with provisions of the orders.</p>

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
<b>The Civil Aviation Authority Ordinance, 1985</b>  As per section 11 of the ordinance, only Civil Aviation Authority have control over:  All the civil airports and aerodromes in Bangladesh including their planning, construction, operation and maintenance; All air routes in Bangladesh; Air space management of civil airports and aerodromes.	Civil Aviation Authority, Bangladesh	KDDSEZL shall ensure compliance with rules made under this ordinance.

The key permits required to be obtained by KDDSEZL for the construction and operations of the proposed power plant are set out in the following table.

**Table 12: Key Permits required to obtain KDDSEZL**

Permit	Permitting Authority	Relevant Legislation	Role of Permit
<b>Permission for Construction of a Building (construction of buildings)</b>	Authorized Officer or Committee	The Building and Construction Act, 1952	Authorization to construct the proposed Project
<b>Location Clearance Certificate (for establishing the Project)</b>	Director General, DoE	Environment Conservation Rules, 1997	Authorization to construct the proposed Project
<b>Environmental Clearance Certificate</b>	DoE, Bangladesh	Environment Conservation Rules, 1997	Authorization to set up the plant with limited environmental effects of development and operation of the proposed Project.
<b>Permit for establishment of Economic Zone</b>	Bangladesh Economic Zones Authority (BEZA)	Bangladesh Private Economic Zones Policy, 2015	Permit from BEZA to be procured for erection of KDDSEZL.
<b>Installation of a tube -well</b>	Ministry of Environment and Forests, Bangladesh Union/ Upazila Parishad	Ground Water Management Ordinance 1985	Installation of tube in any place.
<b>No Objection Certificate from Union Parishad</b>	Union/ Upazila Parishad	Environment Conservation Rules, 1997	A consent in form of NOC from respective Union Parishad
<b>Approval of Plans and registration of the proposed Project</b>	Chief Inspector	The Factories Act, 1965	Approval of plans and specifications of the Project.

### 3.3. World Bank's operational policies and guidelines

The World Bank follows an operational policy statement (updated in February, 2011), which stipulates that all operations are carried out in an environmentally responsible manner and that Projects must comply with all local environment legal obligations and appropriate World Bank guidelines. The World Bank sets out its procedures and policies with regard to

conducting environmental assessments on Operational Policy 4.01: Environmental Assessment (October, 1991) and its updates and other pertinent Guidelines.

### 3.3.1. Applicability

World Bank Environmental and Social Safeguard Policies provide ten (10) potential issues that may need to be considered in an EIA, depending on the specific characteristics of each Project. Following table summarizes the expected applicability of the potential Safeguard Policies for KDDSEZL.

**Table 13: Potential World Bank Environmental Safeguard Policies and Applicability to Project**

Safeguard Policy	Requirement	Policy Triggered	Applicability/ Compliance
<b>Environment Assessment (OP 4.01)</b>	The Bank requires environmental assessment (EA) of Projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.	Yes	<p>This policy applies to all Projects requiring a Category (A) Environmental Assessment under OP 4.01.</p> <p>All environmental and social aspects included in the proposed Project are adequately examined.</p> <p>The Project is likely to have significant potential adverse environmental risks &amp; impacts in its area of influence regarding the natural environment, water, land, human health and safety.</p>
<b>Natural Habitats (OP 4.04)</b>	The Bank requires borrowers to incorporate into their development and environmental strategies analyses of any major natural habitat issues, including identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, priorities for conservation, and associated recurrent-funding and capacity-building needs.	Yes	<p>The Ganges river dolphin <i>Platanista gangetica</i>, commonly known as susu, is distributed in the Ganga-Brahmaputra- Meghna and Karnaphuli-Sangu river systems of India, Nepal and Bangladesh. The species is categorised as Endangered on the International Union for the Conservation of Nature's (IUCN) Red List. However, the average DO of the water of the Karnaphuli is below the WHO standard which has lead to the decrease in fish stocks.</p> <p>Detailed ecological study has been carried out which is presented in section 4.8 of this ESIA report. A comprehensive waste management Plan (Annexure IX) has been developed to manage the waste that will be generated due to the project which has been detailed out in Section 8.4 of ESIA report.</p>
<b>Pest Management (OP 4.09)</b>	In appraising a Project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote	No	Project Proponent will ensure that the requirements of the operational policy will be adhered to during procurement of pesticides for the Project.

Safeguard Policy	Requirement	Policy Triggered	Applicability/ Compliance
	and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the Project components to strengthen such capacity.		
<b>Involuntary Resettlement (OP 4.12)</b>	World Bank recognizes that Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out.	Yes	The land required for the Project has been purchased through land acquisition between landowners and the Proponents of KDDSEZL. As the land purchase was registered with the land registrar of the locality and the sale deed requires a witness of a local person from the area, the land purchase process has reportedly been transparent. Consultations with stakeholders also revealed that all the land procured for the proposed project comprises of barren land which has been reclaimed by a fill material (i.e., river bed sand) up to 2m to raise the site elevation prior to commencement of project construction activities.
<b>Indigenous People (OP 4.10)</b>	The Bank recognizes that the identities and cultures of Indigenous Peoples are inextricably linked to the lands on which they live and the natural resources on which they depend. Hence, A Project proposed for Bank financing must be screened for presence of indigenous people.	No	Census records and public consultations indicate that there are no Indigenous populations in the study area.
<b>Forests (OP 4.36)</b>	If a Project involves significant conversion or degradation of natural forests or related natural habitats that the Bank determines are not critical, and the Bank determines that there are no feasible alternatives to the Project and its sitting, and comprehensive analysis demonstrates that overall benefits from the Project substantially Outweigh the environmental costs; the Bank may finance the Project provided that it incorporates appropriate mitigation measures.	No	The proposed project does not comprise any kind of forest land. However, a patch of mangroves was observed to be present about 300m south west of the site boundary. The impacts of the proposed project on the mangroves have been discussed in Section 7 of the report.
<b>Physical Cultural Resources (OP 4.11)</b>	The borrower needs to addresses impacts on physical cultural resources in Projects proposed for Bank financing, as an integral part of the environmental assessment (EA) process.	No	No such tangible forms of cultural heritage or objects were found within the Project area.  Two mosques were observed to be present with in the Badalpura village during the site visit, which are not

Safeguard Policy	Requirement	Policy Triggered	Applicability/ Compliance
			likely to get affected due to the proposed project.
<b>Safety of Dams (OP 4.37)</b>	When the Bank finances a Project that includes the construction of a new dam, it requires that the dam be designed and its construction supervised by experienced and competent professionals.	No	The project does not involve any construction of dam. The project is also not dependent on any existing dam.
<b>Project in Disputed Areas (OP 7.60)</b>	Projects in Disputed Areas may affect the relations between the Bank and its borrowers, and between the claimants to the disputed area. Therefore, the Bank will only finance Projects in disputed areas when either there is no objection from the other claimant to the disputed area, or when the special circumstances of the case support Bank financing, notwithstanding the objection.	No	The proposed Project is not situated in a disputed area. Any component likely to be financed as part of the Project is not situated in a disputed area.
<b>Projects on International Waterways (OP 7.50)</b>	The Bank recognizes that the cooperation and goodwill of riparians is essential for the efficient use and protection of the waterway. Therefore, it attaches great importance to riparians' making appropriate agreements or arrangements for these purposes for the entire waterway or any part thereof.	No	Karnafuly River is not a recognized international waterway. The river is fully blocked by the Kaptai Dam which is about 65km upstream of Chittagong. Also, there is no water abstraction issue in this Project.

### 3.3.2. Categorization of projects

The Bank screens the Private Sector Activity in order to determine the nature and extent of the environmental and social assessment needed, based on the type, location, sensitivity, and scale of the activity, as well as the nature and magnitude of its potential impacts. This screening also identifies any additional information required to complete the Bank's environmental and social review and determine whether to support the activity. The Private Sector Activity is categorized by the Bank as Category A, B, C, depending on the nature of the activity and financing mechanism, as follows:

**Table 14: World Bank's Categorization for Projects**

Category	Justification
Category A	Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented;
Category B	Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures;
Category C	Business activities with minimal or no adverse environmental or social risks and/or impacts;
Category FI	Business activities that involve investment of Bank funds through a financial intermediary, in sub-Projects that may result in adverse environmental impacts.

**Box 1: Applicability for World Bank Project Categorization**

*Since the proposed project is a Dry Dock Specialized Economic Zone dedicated for ship repairs up to 100,000 DWT which will have impacts both in its construction and operation phase, the project is classified as a Category A project as per the Bank's categorization system. As per the information requirements, the applicant i.e., KDDSEZL is required to submit the following documents along with the financing application:*

- ◆ *EIA report is to be prepared which will examines the Project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without Project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance;*
- ◆ *Public consultations with Project-affected groups and local non-governmental organizations (NGOs) about the Project's environmental aspects is to be undertaken at least twice; once during preparation of the Terms of Reference (ToR) for the EIA (Scoping), and also after the draft EIA has been prepared;*
- ◆ *The draft EA report is to be made available at a public place accessible to Project-affected groups and local NGOs;*
- ◆ *EMP and/or Action Plans demonstrating the set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.*

### 3.4. Applicability of IFC performance standards

The IFC Performance Standards stipulates that any proposed Project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety, and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;



- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

**Performance Standard (PS) 1: Assessment and Management of Environmental and Social Risks and Impacts**

PS 1 establishes the importance of:

- Integrated assessment to identify the environmental and social impacts, risks, and opportunities of Projects;
- Effective community engagement through disclosure of Project-related information and consultation with local communities on matters that directly affect them; and
- The Project Proponent's management of environmental and social performance throughout the life of the Project.

PS 1 is applicable to all Projects and associated facilities having environmental and/or social risks and/or impacts. Some of the key environmental and social impacts that the proposed Project can be associated with:

- Disposal of Dredged material (particularly if the sediments are contaminated and accumulation of hazardous materials);
- Air emissions in terms of ship's propulsion, engines, fuel storage and transfer (release of SO<sub>2</sub>, NO<sub>x</sub> and Volatile Organic Compounds);
- Emission of dust from dry bulk material storage and handling facilities;
- Discharge of various type of effluents into river-sewage from ship operations, bilge water, vessel cleaning water.
- Management of solid waste generating from ship activities and hazardous material;
- Land acquisition and possible resettlement of local population; and
- Loss of livelihood of local population due to Project operations etc.

**Box 2: Applicability to PS1**

*PS 1 is applicable for the project and an Environmental and Social Impact Assessment (ESIA) study needs to be conducted prior to the commencement of the project. KDDSEZL also needs to develop and implement an Environmental and Social Management System (ESMS) to manage the identified risks associated with its operations during construction and operation phase of the project.*

**Performance Standard 2: Labour and Working Conditions**

PS 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The objectives of the PS 2 are:

- To promote the fair treatment, non-discrimination, and equal opportunity of workers;

- To establish, maintain, and improve the worker-management relationship;
- To promote compliance with national employment and labor laws;
- To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain;
- To promote safe and healthy working conditions, and the health of workers; and
- To avoid the use of forced labor.

The applicability of PS 2 will be more important during the construction phase as operation phase will have lesser number of staff. This PS covers not only the main plant employees, but all employees/workers, even indirect workers working through contractors. Migrant workers will be engaged for the Project and they will be provided accommodation in labor camps. Hence, standards pertaining to campsites will be applicable.

#### Box 3: Applicability to PS2

*PS 2 are applicable to the Project and KDDSEZL shall ensure provision of adequate facilities such as access to clean water, sanitary facilities and other necessary facilities at the construction sites. KDDSEZL shall ensure measures to prevent child labor, forced labor, and discrimination are strictly implemented. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be regulated as per the national labor and employment laws.*

#### **Performance Standard 3: Resource Efficiency and Pollution Prevention**

The PS 3 outlines approach to pollution prevention and abatement in line with internationally disseminated technologies and practices with the following objectives:

- Avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from activities; and
- Promote the reduction of emissions that contribute to climate change.

#### Box 4: Applicability to PS3

*The impacts and risks associated with the generation, use, storage, release, and/or disposal of pollutants has been assessed as part of this EIA. KDDSEZL shall ensure implementation of the mitigation measures provided in the ESMP. KDDSEZL shall also ensure that pollution control measures are planned and implemented right from the Project conception stage. Practices like minimal release of waste/emissions, safe disposal of waste, waste water management etc. shall be considered prior to each Project phase. PS 3 is therefore applicable for the proposed Project.*

#### **Performance Standard 4: Community Health, Safety and Security**

PS 4 recognizes that Project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner, that avoids or minimizes risks to the Affected Communities.

**Box 5: Applicability to PS4**

*The Applicability of this PS has been extended to construction as well as operational phases of the Project. It will be associated with unloading and loading of activities of different industries, movement of vehicles, noise generation, etc. Community health and safety consideration related to the Project has been addressed while assessing the environmental and social risks and impacts. Security staff will be engaged from local community whereas labor engaged will be both local as well as migrant.*

*A stakeholder engagement process has been formulated as a part of community engagement requirements consistent with the requirements of PS 1 including the informed consultation and participation process of Affected Communities. It will also include dissemination of information pertaining to security arrangements to workers and community. Also, KDDSEZL will construct and operate the structural elements of the Project in accordance with GIIP taking into consideration safety risks to the affected community.*

**Performance Standard 5: Land Acquisition and Involuntary Resettlement**

PS 5 recognizes that Project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of affected persons and community.

**Box 6: Applicability to PS5**

*A portion of land required for the Project has been purchased through negotiated settlements between landowners and KDDSEZL's land procurement representatives. The procured lands were reclaimed after filling it up by river sand. The land procurement has not resulted in loss of livelihood of the landowners since the land was not being used for any economic activities by the villagers prior to sale (as the land was treated as non-agricultural barren land). There has also not been any physical displacement or resettlement as none of the procured lands were inhabited. Thus PS 5 will not be applicable.*

**Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**

PS 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. This standard is aimed to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

**Box 7: Applicability to PS6**

*The proposed project will involve discharge of various type of waste water generating from ship activities like sewage and ballast water, bilge water and vessel-cleaning wastewater from ships. This poses risk to aquatic species (especially fishes) present in Karnafuly River.*

*KDDSEZL shall ensure that the discharge of waste water will be undertaken only after suitable treatment of the waste and the limit of the parameters have to be within the standards prescribed by applicable national laws and international guidelines whichever of the two is more stringent. It shall ensure that indiscriminate fishing is prohibited in the project area as mandated by the national laws. PS 6 will be applicable in addressing the aforementioned issues and managing the risks posed by such project operations.*

*The details of this PS have been detailed out in the ESIA study, while implementation of the actions necessary to meet the requirements of this PS shall be managed through the suggested mitigation measures. The operation phase of the proposed project shall ensure protection of fauna and flora of the site and surroundings.*

### **Performance Standard 7: Indigenous Peoples**

PS 7 recognizes Indigenous Peoples as social groups with identities that are distinct from mainstream groups in national societies, and are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development.

#### **Box 8: Applicability to PS7**

*Census records and public consultations indicate that there are no Indigenous populations in the study area. Thus, PS 7 shall not be applicable to this Project.*

### **Performance Standard 8**

PS 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their Project activities. In addition, the requirements of this Performance Standard on a Project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

#### **Box 9: Applicability to PS8**

*This PS is applicable when tangible forms of cultural heritage, unique natural features or tangible objects that embody cultural values and certain instances of intangible forms of culture are impacted or are proposed to be used for commercial purposes. No such tangible forms of cultural heritage or objects were found in the project area. Hence this PS is not applicable to the proposed project.*

## **3.5. Applicable World Bank group EHS guidelines**

The Equator Principle III requires follow up of the environmental, health and safety requirements as per the following guidelines released by International Finance Cooperation (IFC) on 30<sup>th</sup> April, 2007. These guidelines ensure that the Projects are developed in a

manner that is socially responsible and reflects sound environmental management practices. EHS considerations into the site selection and plant design processes should be considered in order to maximize the range of options available to prevent and control potential negative impacts.

1. Environmental, Health, and Safety General Guidelines;
2. Environmental, Health, and Safety Guidelines for Ports, Harbors and Terminals;
3. Environmental, Health, and Safety Guidelines for Shipping.

The key requirements stated in the EHS guidelines have been discussed in the following table.

**Table 15: Key Requirements as per EHS Guidelines of IFC**

SN	Relevant Requirements as Stated in EHS Guidelines
<b>1.</b>	<b>Dredged Material Management</b>
	<ul style="list-style-type: none"> <li>Dredging should only be conducted if necessary, and based on an assessment of the need for new infrastructure components</li> <li>Materials should be evaluated for their physical, chemical, biological, and engineering properties</li> <li>Methods should be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material.</li> <li>Use of techniques (e.g. silt curtains), to minimize adverse impacts on aquatic life from the re-suspension of sediments.</li> <li>Inspection and monitoring of dredging activities for evaluation of the effectiveness of impact prevention strategies.</li> <li>Analysis of dredged material to select appropriate disposal options (land reclamation)</li> <li>Use of borrow pits or dikes reduces the spread of sediments and effects on benthic organisms</li> <li>Confined disposal facilities to be used, when open water disposal is not feasible.</li> </ul>
<b>2.</b>	<b>Air Emissions</b>
	<b>a. Combustion Sources</b>
	<ul style="list-style-type: none"> <li>Using low-sulfur fuels, if feasible, or as required by international regulations</li> <li>Keeping transfer equipment (e.g. cranes, forklifts, and trucks) in good working condition</li> <li>Upgrading the land vehicle fleet with less-polluting trucks and vehicles, and using alternative fuels and fuel mixtures</li> <li>Encouraging reduction in engine idling during on- and off-loading activities and storage planning</li> <li>Avoiding installation of firefighting or refrigeration systems contain chlorofluorocarbons (CFCs), in accordance with applicable phase-out requirements</li> </ul>
<b>3.</b>	<b>Wastewater</b>
	<b>a. Port Sewage and Storm water</b>
	<ul style="list-style-type: none"> <li>Avoiding installation of storm drainage catch basins that discharge directly into surface waters, using containment basins</li> <li>Oil / water separators and trapping catch basins should be maintained regularly to keep them operational</li> <li>Installing filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) to prevent sediment and particulates from reaching the surface water.</li> </ul>
	<b>b. Ship Waste water</b>
	<ul style="list-style-type: none"> <li>Oily waste and wastewater should be collected in barges, vehicles, or central collection systems and storage tanks.</li> <li>Wastewater with noxious chemicals from bulk tank cleaning should be collected through appropriate on-site or off-site treatment prior to discharge.</li> <li>Smaller vessels used for harbor services should be equipped with recycling or chemical toilets, or holding tanks, that can be discharged to shore facilities</li> </ul>

SN	Relevant Requirements as Stated in EHS Guidelines
	<ul style="list-style-type: none"> <li>Segregated and dedicated ballast tanks and crude oil washing activities as well as maintaining a written record of cargo and ballast operations</li> </ul>
	<ul style="list-style-type: none"> <li>For oil tankers that carry ballast water in cargo tanks, oil-contaminated ballast water should be discharged to shore reception facilities before filling the cargo tank with oil</li> </ul>
	<ul style="list-style-type: none"> <li>When safe to do so, exchanging of ballast water in deep open water as far as possible from the coast.</li> </ul>
	<ul style="list-style-type: none"> <li>Uptake of organisms in ballast water should be avoided.</li> </ul>
	<ul style="list-style-type: none"> <li>Use and operation of a certified on-board sewage treatment system, as applicable according to international standards</li> </ul>
	<ul style="list-style-type: none"> <li>For vessels operating in coastal waters, all black water should be collected in holding tanks on board and delivered to port reception facilities for further treatment.</li> </ul>
	<ul style="list-style-type: none"> <li>After unloading of chemical tankers, water used to wash the cargo tanks should be discharged to reception facilities ashore</li> </ul>
	<ul style="list-style-type: none"> <li>All bilge water, separated oily residues, and sludge should be discharged to port reception facilities, except where ships are equipped with certified oily water separators (OWS), which may discharge treated water to sea.</li> </ul>
	<ul style="list-style-type: none"> <li>Alarm system that can automatically detect and close the discharge effluent from the oil / water separator when an oil concentration of 15 parts per million (ppm) is reached.</li> </ul>
<b>4.</b>	<b>Waste Management</b>
	<ul style="list-style-type: none"> <li>Waste reception facilities should provide adequate capacity to receive ship generated wastes including appropriately sized and located receptacles, and the capacity to deal with seasonal fluctuations</li> </ul>
	<b>a. Ship Wastes</b>
	<ul style="list-style-type: none"> <li>Information should be available for ship captains to identify solid waste reception facilities and acceptable handling procedures.</li> </ul>
	<ul style="list-style-type: none"> <li>A collection and disposal system should be developed for ship-generated garbage</li> </ul>
	<ul style="list-style-type: none"> <li>Food waste from ships delivered to the port should be managed according to applicable local requirements which may include rendering, incineration, or landfilling of food waste and mixed waste containing food waste.</li> </ul>
	<ul style="list-style-type: none"> <li>Reduction in the use of consumable materials to the extent feasible and in the volume of bilge sludge delivered ashore.</li> </ul>
	<ul style="list-style-type: none"> <li>Stripping wastes should be cleaned up immediately to reduce potential releases related to wind or storm water.</li> </ul>
	<ul style="list-style-type: none"> <li>Chemical paint strippers based on methylene chloride should be avoided, or reused and recycled until their effectiveness is compromised.</li> </ul>
	<ul style="list-style-type: none"> <li>Water-based cutting oils and degreasers should be used wherever possible.</li> </ul>
<b>5.</b>	<b>Hazardous materials and oil</b>
	<b>a. Spill Prevention</b>
	<ul style="list-style-type: none"> <li>Oil and chemical-handling facilities should be located with consideration of natural drainage systems and environmentally-sensitive areas</li> </ul>
	<ul style="list-style-type: none"> <li>Provision of secondary containment for above ground liquid storage tanks and tanker truck loading and unloading areas</li> </ul>
	<ul style="list-style-type: none"> <li>Covered and ventilated temporary storage areas should be provided for leaking hazardous cargo and designed to facilitate collection of leaks and spills</li> </ul>
	<ul style="list-style-type: none"> <li>Fuel dispensing equipment should be equipped with “breakaway” hose connections that provide emergency shutdown</li> </ul>
	<ul style="list-style-type: none"> <li>Operational certification of the ship according to applicable requirements depending on the purpose and capacity of the vessel</li> </ul>
	<ul style="list-style-type: none"> <li>Conducting ship to ship transfer of cargo oil (lightering) activities in accordance with specific safety regulations and guidance to minimize the risk of spills</li> </ul>
	<ul style="list-style-type: none"> <li>Maintaining the necessary specific oil and noxious liquid substances spill prevention plans and procedures for operations in Special Areas</li> </ul>



SN	Relevant Requirements as Stated in EHS Guidelines
	<ul style="list-style-type: none"> <li>Avoidance of antifouling paint containing Tributyltin, and removal or application of a sealer coat over existing TBT-based paint, in accordance with applicable regulations and guidance</li> </ul>
	<ul style="list-style-type: none"> <li>Avoidance of antifouling paint with biocides or other substances that may be harmful to the environment on ships that operate mainly in fresh or brackish water areas, where fouling may be less prevalent</li> </ul>
	<ul style="list-style-type: none"> <li>For vessels operating in marine environments, paint with the minimum effective copper concentration should be used</li> </ul>
	<ul style="list-style-type: none"> <li>During painting and stripping activities, shrouds should be used between the vessel and pier / shore to prevent spillage into the water. Spray techniques should be considered to minimize paint overspray.</li> </ul>
	<b>b. Spill Control Planning</b>
	<ul style="list-style-type: none"> <li>Identification of areas those are sensitive to spills and releases of hazardous materials and locations of any water intakes.</li> </ul>
	<ul style="list-style-type: none"> <li>Outlining responsibility for managing spills, releases, and other pollution incidents, including reporting and alerting mechanisms.</li> </ul>
	<ul style="list-style-type: none"> <li>Provision of specialized oil spill response equipment (e.g. containment booms, recovery devices, and oil recovery or dispersant application vessels)</li> </ul>
	<ul style="list-style-type: none"> <li>Training of response personnel in deployment of equipment, and testing of the contingency plan through regular reporting and alerting exercises.</li> </ul>
	<b>c. Dangerous Goods Handling</b>
	<ul style="list-style-type: none"> <li>Establishment of segregated and access-controlled storage areas with the means to collect or contain accidental releases;</li> </ul>
	<ul style="list-style-type: none"> <li>Dangerous Goods Manifests for hazardous materials whether in transit, loading or unloading to and from ships, including proper shipping (technical) name, hazard class, United Nations number, and packing group;</li> </ul>
	<ul style="list-style-type: none"> <li>Emergency response procedures specific to dangerous goods</li> </ul>
<b>6.</b>	<b>Noise</b>
	<ul style="list-style-type: none"> <li>Siting facilities with consideration of distances from the noise sources to the receptors (e.g., residential receptors, schools, hospitals, religious places) to the extent possible</li> </ul>
	<ul style="list-style-type: none"> <li>Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound-absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g., helical steel springs and rubber elements);</li> </ul>
	<ul style="list-style-type: none"> <li>Identify and mark 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 &gt;85 dBA).</li> </ul>
	<ul style="list-style-type: none"> <li>Noise monitoring may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.</li> </ul>
<b>7.</b>	<b>Biodiversity</b>
	<ul style="list-style-type: none"> <li>Special consideration for areas of high biodiversity value or those required for the survival of critically endangered or endangered flora and fauna is to be given.</li> </ul>
	<ul style="list-style-type: none"> <li>The depth of the port should be considered at the design phase in terms of habitat destruction and the amount and nature of dredging required.</li> </ul>
	<ul style="list-style-type: none"> <li>Cleaning or repair of ballast tanks should be equipped with adequate reception facilities able to prevent the introduction of invasive species</li> </ul>
<b>8.</b>	<b>Occupational Health and Safety</b>
	<b>a. Physical Hazards</b>
	<ul style="list-style-type: none"> <li>Separation of people from vehicles and making vehicle passageways one-way, to the extent practical</li> </ul>
	<ul style="list-style-type: none"> <li>Constructing the areas to be: of adequate strength to support the heaviest expected loads; level, or with only a slight slope; free from holes, cracks, depressions, unnecessary curbs, or other raised objects; continuous; and skid resistant</li> </ul>

SN	Relevant Requirements as Stated in EHS Guidelines
	<ul style="list-style-type: none"> <li>Avoiding placing cargo on, or allowing passage of vehicles over, any hatch cover that is not of adequate strength for that purpose</li> </ul>
	<ul style="list-style-type: none"> <li>Clearly marking (indicating its own weight) all lifting beams and frames, vacuum lifting, or magnetic lifting device and every other item of loose gear weighing more than 100 kilograms (kg)</li> </ul>
	<ul style="list-style-type: none"> <li>Inspecting disposable pallets and similar disposable devices before use and avoiding re-use of such disposable devices</li> </ul>
	<ul style="list-style-type: none"> <li>Equipping lifting appliances with means of emergency escape from the driver's cabin and a safe means for the removal of an injured or ill driver</li> </ul>
	<ul style="list-style-type: none"> <li>Risk of free fall of materials should be minimized by installing telescoping arm loaders and conveyors;</li> </ul>
	<ul style="list-style-type: none"> <li>Materials handling operations should follow a simple, linear layout to reduce the need for multiple transfer points</li> </ul>
	<ul style="list-style-type: none"> <li>Ensuring all seafarers is trained to manage the types of hazards applicable to their assigned responsibilities.</li> </ul>
	<ul style="list-style-type: none"> <li>Regular inspection and maintenance of decks areas, including railings, catwalks, stairs, and other walking areas to prevent the existence of cracks, worn or missing parts, and other falling and tripping hazards</li> </ul>
	<ul style="list-style-type: none"> <li>Decks and gratings should be kept clear of grease, garbage, and ice to avoid risk of slipping, and any spillage should be cleaned up immediately</li> </ul>
	<ul style="list-style-type: none"> <li>Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area</li> </ul>
	<ul style="list-style-type: none"> <li>Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area</li> </ul>
	<b>b. Chemical Hazards</b>
	<ul style="list-style-type: none"> <li>Consider generation of ammonia on site from urea or use of aqueous ammonia in place of pure liquefied ammonia;</li> </ul>
	<ul style="list-style-type: none"> <li>Consider use of sodium hypochlorite in place of gaseous chlorine.</li> </ul>
	<ul style="list-style-type: none"> <li>Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits.</li> </ul>
	<ul style="list-style-type: none"> <li>Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards.</li> </ul>
	<ul style="list-style-type: none"> <li>Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE</li> </ul>
	<ul style="list-style-type: none"> <li>Implementation of smoking and naked light regulations during materials transfer activities and hot work permits during ship maintenance</li> </ul>
	<ul style="list-style-type: none"> <li>Proper tank cleaning and venting, and operation, maintenance and inspection of inert gas systems</li> </ul>
	<ul style="list-style-type: none"> <li>Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time.</li> </ul>
	<ul style="list-style-type: none"> <li>Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, etc.).</li> </ul>
	<b>c. Confined Spaces</b>
	<ul style="list-style-type: none"> <li>Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.</li> </ul>
	<ul style="list-style-type: none"> <li>Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible.</li> </ul>
	<ul style="list-style-type: none"> <li>Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing.</li> </ul>
	<ul style="list-style-type: none"> <li>Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.</li> </ul>
	<ul style="list-style-type: none"> <li>Appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified.</li> </ul>

SN	Relevant Requirements as Stated in EHS Guidelines
	<b>d. Community Health and Safety</b>
	<ul style="list-style-type: none"> <li>Operators should implement a Safety Management System (SMS) able to effectively identify and correct unsafe conditions</li> </ul>
	<ul style="list-style-type: none"> <li>The Safety Management System should include comprehensive emergency preparedness and response plans that provide a coordinated response based on the port and community resources required to manage the nature and severity of the emergency event.</li> </ul>
	<ul style="list-style-type: none"> <li>Visual impacts, including excessive background illumination, should be prevented during the port planning process or managed during operations through the installation of natural visual barriers such as vegetation or light shades, as applicable.</li> </ul>
	<ul style="list-style-type: none"> <li>Fire suppression and control includes all automatic and manual fire protection installations</li> </ul>

### 3.6. Asian Development Bank (ADB) safeguard principles and policies

#### 3.6.1. Safeguard Policy Statement (SPS), 2009

Built upon the three previous safeguard policies on the Involuntary Resettlement Policy (1995), the Policy on Indigenous Peoples (1998) and the Environment Policy (2002), the Safeguard Policy Statement was approved in 2009. The safeguard policies are operational policies that seek to avoid, minimize or mitigate adverse environmental and social impacts including protecting the rights of those likely to be affected or marginalized by the developmental process. ADB's safeguard policy framework consists of three operational policies on the environment, indigenous peoples and involuntary resettlement. A brief detail of all three operational policies have been mentioned below:

**Environmental Safeguard:** This safeguard is meant to ensure the environmental soundness and sustainability of Projects and to support the integration of environmental considerations into the Project decision making process.

#### Box 10: Applicability to Environmental Safeguards

*The proposed project is a Dry Dock Specialized Economic Zone dedicated for ship repairs up to 100,000 DWT and is likely to have significant environmental impacts during construction and operation phase. The impacts and risks associated with the generation, use, storage, release, and/or disposal of pollutants has been assessed as part of this ESIA and appropriate mitigation measures have been proposed. Practices like minimal release of waste/emissions, safe disposal of waste, waste water management etc. shall be considered prior to each project phase. The Environmental Safeguard is thus applicable to the proposed project.*

**Involuntary Resettlement Safeguard:** This safeguard has been placed in order to avoid involuntary resettlement whenever possible; to minimize involuntary resettlement by exploring Project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre- Project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

#### Box 11: Applicability to Involuntary Resettlement Safeguards

*The project is proposed to be developed on reclaimed land which has been lost due to erosion of the Karnafuly river. The land was not used for any activity and no physical structure was present on the land parcels as understood through consultations held with the local population of Badalpura village. The sale of land has been undertaken directly on a 'willing buyer willing seller'*

*basis by KDDSEZL with the landowners. Hence, as no physical and economic displacement in terms of involuntary acquisition of land and involuntary restrictions on land use is triggered, the Involuntary Resettlement Safeguard is not applicable for the proposed project*

**Indigenous Peoples Safeguard:** This safeguard looks at designing and implementing Projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems and cultural uniqueness as defined by the Indigenous Peoples themselves so that they receive culturally appropriate social and economic benefits; do not suffer adverse impacts as a result of Projects; and participate actively in Projects that affect them.

**Box 12: Applicability to Indigenous Peoples Safeguards**

*The proposed Project area does not report any indigenous tribes, minorities or aboriginals. Hence the Indigenous Peoples Safeguard and the requirements there under are not applicable for this Project.*

**Information, Consultation and Disclosure:** Consultation and participation are essential in achieving the safeguard policy objectives. This implies that there is a need for prior and informed consultation with affected persons and communities in the context of safeguard planning and for continued consultation during Project implementation to identify and help address safeguard issues that may arise. The consultation process begins early in the Project preparation stage and is carried out on an ongoing basis throughout the Project cycle. It provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people and is undertaken in an atmosphere free of intimidation or coercion. In addition, it is gender inclusive and responsive and tailored to the needs of disadvantaged and vulnerable groups and enables the incorporation of all relevant views of affected people and other stakeholders into decision making.

ADB requires the borrowers/clients to engage with communities, groups or people affected by proposed Projects and with civil society through information disclosure, consultation and informed participation in a manner commensurate with the risks to and impacts on affected communities. For Projects with significant adverse environmental, involuntary resettlement or Indigenous Peoples impacts, ADB Project teams will participate in consultation activities to understand the concerns of affected people and ensure that such concerns are addressed in Project design and safeguard plans.

A series of consultations were carried out with the land sellers, community and other (direct and indirect) stakeholders involved in the proposed Project by KDDSEZL and Shahidul Consultant. Details pertaining to the consultation process are provided in relevant section of this report.

### **3.6.2. Social Protection Strategy, 2001**

ADB has designed a set of policies and programs for social protection in 2001, that is, to reduce poverty and vulnerability by promoting efficient labor markets, diminishing people's exposure to risks, and enhancing their capacity to protect themselves against hazards and

interruption/loss of income. The basic aim of the Social Protection Strategy (SPS) is to assist individuals to break the cycle of poverty and enhance the quality of growth through adequate and developed social protection systems in the member countries of ADB. The type of risks covered through the SPS may be economic, environment or social/governance related.

The proposed Project shall ensure that the requirements of the ADB's SPS are complied with. Priority shall be given to any identified vulnerable groups. Based on the gender analysis and status of women in the Project area, measures for ensuring their overall development shall be taken up by the Project Proponent. KDDSEZL shall comply with applicable labor laws in relation to the Project. KDDSEZL shall also take the following measures to comply with the core labor standards for the ADB financed portion of the Project;

- a) Carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged by the Borrower);
- b) Not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;
- c) Engage contractors and other providers of goods and services:
  - I. Who do not employ child labor or forced labor;
  - II. Who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (A) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (B) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and
  - III. Whose subcontracts contain provisions which are consistent with paragraphs (i) and (ii) above.

### **3.6.3. Public Communications Policy, 2011**

The Public Communications Policy (PCP) of ADB, originally formulated in 2005 and revised in 2011, is aimed at promoting improved access to information about ADB's operations related to fund Projects. It endorses greater transparency and accountability to stakeholders involved in a Project. The PCP establishes the disclosure requirements for documents and information related to Projects. It mandates Project-related documents normally produced during the Project cycle to be posted on the web.

### 3.6.4. Categorization of projects

As part of its review of a Project's expected social and environmental impacts, ADB uses a classification system. This classification is used to reflect the significance of potential environmental impacts understood as a result of the client's impact assessment and to establish ADB's safeguard requirements. The categories used by ADB are:

- Category A Projects: Projects which are likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented;
- Category B Projects: Projects with potential adverse environmental impacts that are less in number, generally site-specific, mostly reversible and readily addressed through mitigation measures;
- Category C Projects: Projects with minimal or no adverse environmental impacts;
- Category FI Projects: Projects which involve investment of ADB funds to or through a financial investment.

#### Box 13: Applicability for ADB Project Categorization

*Since the proposed project is a Dry Dock Specialized Economic Zone dedicated for ship repairs up to 100,000 DWT which will have reversible impacts both in its construction and operation phase, that can be readily addressed through the proposed mitigation measures, the project is classified as a 'Category B' project as per the Bank's categorization system based on Environmental Safeguards. Categorization of the project as per Involuntary Resettlement and Indigenous Peoples is 'Category C'*

### 3.7. Equator principle financial institutions (EPFIS) guidelines

Equator Principles are a set of principles aiming towards promotion of responsible environmental stewardship and socially responsible development, including fulfilling responsibility to respect human rights by undertaking due diligence.

#### Principle 1: Review and Categorization

Using categorization, the EPFI's environmental and social due diligence is commensurate with the nature, scale and stage of the Project, and with the level of environmental and social risks and impacts. The categories are:

*Category A* – Projects with potential significant adverse environmental and social risks and/or impacts those are diverse, irreversible or unprecedented;

*Category B* – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and

*Category C* – Projects with minimal or no adverse environmental and social risks and/or impacts.



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**Principle 2: Environmental and Social Assessment**

For all Category A and Category B Projects, the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental impacts of the proposed Project. The Assessment Documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.

**Principle 3: Applicable Environmental and Social Standards**

The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Bangladesh being a Non-Designated Country, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

**Principle 4: Environmental and Social Management System and Equator Principles Action Plan**

For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards.

**Principle 5: Stakeholder Engagement**

The EPFI will require the client to demonstrate effective Stakeholder Engagement as an on-going process in a structured and culturally appropriate manner for all Category A and Category B Projects. The client will conduct an Informed Consultation and Participation process. The consultation process will be tailored to the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups.

To facilitate Stakeholder Engagement, the client will, commensurate to the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner.

**Principle 6: Grievance Mechanism**

For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.

**Principle 7: Independent Review**

For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.

**Principle 8: Covenants**

For all Category A and Category B Projects, the client will covenant the financial documentation:

- To comply with all the relevant host country social and environmental laws, regulations and permits in all material respects;
- To comply with Action Plan (where applicable) during construction and operation of the Project in all material aspects;
- To provide periodic reports in a format agreed with EPFIs (frequency to be agreed, but not less than annually) that documents compliance against APs, as well as against local laws and permits; and
- To decommission the facilities in accordance with an agreed decommissioning plan.

**Principle 9: Independent Monitoring and Reporting**

To ensure ongoing monitoring and reporting over the life of the Project, the EPFIs will, for all A Category Projects and where appropriate Category B, require appointment of an independent environmental and/or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information, to be shared with the EPFIs.

**Principle 10: Reporting and Transparency**

Each EPFI is committed to issuing periodic public reports about Project implementation processes and experience with due regard for appropriate Project confidentiality.

**3.8. International and national environment standards/ guidelines**

Bangladesh and World Bank environmental standards and guidelines relevant to the construction and operation of the KDDSEZL cover the following issues:

- Atmospheric emissions and ambient air quality;
- Water Quality;
- Liquid effluent discharges to the marine environment;
- Noise emissions and ambient noise levels.

**3.8.1. Ambient air quality standards**

As per IFC EHS Guidelines, “the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through

clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". The current Air Quality Guidelines are:

**Table 16: Ambient Air Quality Guidelines**

Parameter	Averaging Period	Guideline value in $\mu\text{g}/\text{m}^3$
Sulphur Dioxide ( $\text{SO}_2$ )	24-hour	125 (Interim target-1)
		50 (Interim target-2)
		20 (guideline)
Nitrogen dioxide ( $\text{NO}_2$ )	10 minutes	500 (guideline)
	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter $\text{PM}_{10}$	1-year	70 (Interim target-1)
		50 (Interim target-2)
		30 (Interim target-3)
		20 (guideline)
	24-hour	150 (Interim target-1)
		100 (Interim target-2)
		75 (Interim target-3)
		50 (guideline)
Particulate Matter $\text{PM}_{2.5}$	1-year	35 (Interim target-1)
		25 (Interim target-2)
		15 (Interim target-3)
		10 (guideline)
	24-hour	75 (Interim target-1)
		50 (Interim target-2)
		37.5 (Interim target-3)
		25 (guideline)
Ozone	8-hour daily	160 (Interim target-1)
	maximum	100 (guideline)

\* Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines

As per the provisions of Rules 12 and 13 of the ECR 1997, the MoEF is responsible for laying down environmental quality standards (pertaining to air, water, sound, odour and other components) and standards for discharge and emission of waste. Ambient air quality standards have been stipulated in Schedule 2 (Standards for Air) of the Rules. However, these standards were revised by MoEF in 2005. The revised standards have been illustrated in the following table.

**Table 17: Air quality Standards of Bangladesh (2005)**

Pollutant	Averaging Time	Concentration
Carbon Monoxide ( $\text{CO}$ ) ( $\text{mg}/\text{m}^3$ )	8 hours	10 (9 ppm)
	1 hour	40 (35 ppm)
Lead ( $\text{Pb}$ ) ( $\mu\text{g}/\text{m}^3$ )	Annual	0.5
Oxides of Nitrogen ( $\text{NO}_x$ ) ( $\mu\text{g}/\text{m}^3$ )	Annual	100 (0.053 ppm)
Sulphur dioxide ( $\text{SO}_2$ ) ( $\mu\text{g}/\text{m}^3$ )	Annual	80 (0.03 ppm)
	24 hours	365 (0.14 ppm)
Suspended Particulate Matter (SPM) ( $\mu\text{g}/\text{m}^3$ )	8 hours	200
Coarse Particulates ( $\text{PM}_{10}$ ) ( $\mu\text{g}/\text{m}^3$ )	Annual	50
	24 hours	150
Fine Particulates ( $\text{PM}_{2.5}$ ) ( $\mu\text{g}/\text{m}^3$ )	Annual	15
	24 hours	65
Ozone ( $\text{O}_3$ ) ( $\mu\text{g}/\text{m}^3$ )	8 hours	157 (0.08 ppm)

Pollutant	Averaging Time	Concentration
	1 hour	235 (0.12 ppm)

Source: Air Quality Standards, 2005

([http://www.case-moef.gov.bd/file\\_zone/reports\\_publications/BGD%20AQ%20and%20VES%20standard\\_BW.pdf](http://www.case-moef.gov.bd/file_zone/reports_publications/BGD%20AQ%20and%20VES%20standard_BW.pdf))

### 3.8.2. Water quality standards

As per Schedule 12 of the ECR 1997, designated best use classification has been prescribed for inland surface water as given in table below.

**Table 18: Standards for Inland Surface Water**

SN	Best Practice based classification	Parameter			
		pH	BOD mg/l	DO mg/l	Total Coliform number/100
1.	Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less
2.	Water usable for recreational activity	6.5-8.5	3 or less	5 or more	200 or less
3.	Source of drinking water for supply after conventional treatment	6.5-8.5	6 or less	6 or more	5000 or less
4.	Water usable by fisheries	6.5-8.5	6 or less	5 or more	---
5.	Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or more	5000 or less
6.	Water usable for irrigation	6.5-8.5	10 or less	5 or more	1000 or less

Notes:

1. In water used for pisciculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water – 2250  $\mu$  mhos/cm (at a temperature of 25 ° C); Sodium less than 26%; boron less than 0.2%.

The standards for drinking water have been presented in the Table as per Schedule 12 of ECR-1997.

**Table 19: Standards for Drinking Water**

SN	Parameters	DoE Standards (Drinking Water Standards)
1.	pH	6.5 – 8.5
2.	Temperature (in ° C)	20-30° C
3.	Turbidity (in NTU)	10
4.	Color	15 Hazen
5.	TDS (in mg/l)	1000 mg/l
6.	TSS (in mg/l)	10 mg/l
7.	Oil and Grease (in mg/l)	0.01 mg/l
8.	Chlorides (in mg/l)	150-600 mg/l
9.	Total Hardness (in mg/l)	200-500 mg/l
10.	Calcium (in mg/l)	75 mg/l
11.	Magnesium (in mg/l)	30-35 mg/l
12.	Sulphate (in mg/l)	400 mg/l
13.	Fluorides (in mg/l)	1.0 mg/l
14.	Nitrate (in mg/l)	10 mg/l
15.	Iron (in mg/l)	0.3-1.0 mg/l
16.	COD (in mg/l)	4 mg/l
17.	BOD (in mg/l)	0.2 mg/l

SN	Parameters	DoE Standards (Drinking Water Standards)
18.	Ammonia (in mg/l)	0.5 mg/l
19.	Phosphate (in mg/l)	6 mg/l
20.	Copper (in mg/l)	1 mg/l
21.	Mercury (in mg/l)	0.001 mg/l
22.	Balium (in mg/l)	0.01 mg/l
23.	Cadmium (in mg/l)	0.005 mg/l
24.	Arsenic (in mg/l)	0.05 mg/l
25.	Lead (in mg/l)	0.05 mg/l
26.	Zinc (in mg/l)	5 mg/l
27.	Chromium (in mg/l)	0.05 mg/l
28.	Manganese (in mg/l)	0.1 mg/l
29.	Total Coliform (in n/100 ml)	0
30.	Faecal Coliform (in n/100 ml)	0
40.	Chlorophyll (in mg/l)	--
41.	Aluminium (in mg/l)	0.2
42.	Benzene (in mg/l)	0.01 mg/l
43.	Boron (in mg/l)	0.2 mg/l
44.	Chlorinated alkanes Carbontetrachloride (in mg/l) Dichloroethylene (in mg/l) 1,2 dichloroethylene (in mg/l) Tetrachloroethylene (in mg/l) Trichloroethylene (in mg/l)	0.01 mg/l 0.001 mg/l 0.03 mg/l 0.03 mg/l 0.09 mg/l
45.	Chlorinated phenols - pentachlorophenol (in mg/l) trichlorophenol (in mg/l)	0.03 mg/l 0.03 mg/l
46.	Chlorine (residual) (in mg/l)	0.2 mg/l
47.	Chloroform	0.09 mg/l
48.	Cyanide	0.1 mg/l
49.	Detergents	0.2 mg/l
50.	DO	6 mg/l
51.	Kjeldhl Nitrogen (total)	1 mg/l
52.	Nickel	0.1 mg/l
53.	Nitrite	<1 mg/l
54.	Odor	Odorless
55.	Phenolic Compounds	0.002 mg/l
56.	Silver	0.02 mg/l
57.	Sodium	200 mg/l
58.	Suspended particulate matters	10 mg/l
59.	Sulfide	400 mg/l
60.	Tin	2 mg/l
61.	Selenium	0.01 mg/l
62.	Potassium	12 mg/l
63.	Radioactive materials (gross alpha activity)	0.01 Bq/l
64.	Radioactive materials (gross beta activity)	0.1 Bq/l

### 3.8.3. Liquid effluent discharges

As per Schedule 10 of ECR 1997, standards for Waste from Industrial Units or Project Waste have been described. The same has been detailed in table below:

**Table 20: Standards for Liquid Effluent Discharge**

SN	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage System connected to treatment at second stage	Irrigated Land
1.	Ammonical Nitrogen (as elementary N)	mg/l	50	75	75
2.	Ammonia (as free ammonia)	mg/l	5	5	15
3.	Arsenic (as)	mg/l	0.2	0.05	0.2
4.	BOD <sub>5</sub> at 20°C	mg/l	50	250	100
5.	Boron	mg/l	2	2	2
6.	Cadmium (as Cd)	mg/l	0.5	0.05	0.05
7.	Chloride	mg/l	600	600	600
8.	Chromium (as total Cr)	mg/l	0.5	1.0	1.0
9.	COD	mg/l	200	400	400
10.	Chromium (as hexavalent Cr)	mg/l	0.1	1.0	1.0
11.	Copper (as Cu)	mg/l	0.5	3.0	3.0
12.	Dissolved Oxygen (DO)	mg/l	4.5-8	4.5-8	4.5
13.	Electro-conductivity (EC)	micro mho/cm	1200	1200	1200
14.	Total Dissolved Solids	mg/l	2100	2100	2100
15.	Fluoride (as F)	mg/l	2	15	10
16.	Sulfide (as S)	mg/l	1	2	2
17.	Iron (as Fe)	mg/l	2	2	2
18.	Total Nitrogen (as N)	mg/l	100	100	100
19.	Lead (as Pb)	mg/l	0.1	1.0	0.1
20.	Manganese (as Mn)	mg/l	5	5	5
21.	Mercury (as Hg)	mg/l	0.01	0.01	0.01
22.	Nickel (as Ni)	mg/l	1.0	2.0	1.0
23.	Nitrate (as elementary N)	mg/l	10	Not yet Fixed	10
24.	Oil and Grease	mg/l	10	20	10
25.	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1.0	5	1.0
26.	Dissolved Phosphorus (as P)	mg/l	8	8	15
27.	Radioactive substance	To be specified by Bangladesh Atomic Energy Commission			
28.	pH	-	6-9	6-9	6-9
29.	Selenium (as Se)	mg/l	0.05	0.05	0.05
30.	Zinc (as Zn)	mg/l	5	10	10
40.	Total Dissolved Solids	mg/l	2100	2100	2100
41.	Temperature	°C	40	40	40-Summer
42.			45	45	45-Winter
43.	Suspended Solids (SS)	mg/l	150	500	200
44.	Cyanide (as Cn)	mg/l	0.1	2.0	0.2



## Notes:

- (1) These standards shall be applicable to all industries or Projects other than those specified under the heading “Standards for sector-wise industrial effluent or emission.”
- (2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a Project starts operation.
- (3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.
- (4) Inland Surface Water means drains/ponds/tanks/water bodies/ditches, canals, rivers, springs and estuaries.
- (5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.
- (6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.
- (7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

As per the IFC EHS guidelines, the treated sanitary sewage discharge is required to meet the following guideline values.

**Table 21: Treated Sewage Discharge Guideline Values of IFC**

SN	Parameters	Guideline Value
1.	pH	6 – 9
2.	BOD	30mg/l
3.	COD	125mg/l
4.	Total Nitrogen	125mg/l
5.	Oil and Grease	10 mg/l
6.	Total Suspended Solids	50 mg/l
7.	Total coliform bacteria	400 MPN/100 ml

## IFC Wastewater and Water Quality Monitoring Programme

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed. The following elements to be considered while setting up the programme:

- **Parameters:** The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements.
- **Monitoring type and frequency:** Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period.
- **Monitoring locations:** Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges.

- **Data Quality:** Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. QA/QC documentation should be included in monitoring reports.

### 3.8.4. Ambient noise standards

As per IFC EHS Guidelines, noise impacts should not exceed the levels presented in the Table below, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

**Table 22: Noise Level Guidelines as per IFC**

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

The MoEF under the provisions of ECR, 1997 is responsible for laying down ambient noise standards. Noise Pollution (Control) Rules, 2006 were laid down by the Ministry through a Gazette notification dated September 7, 2006. Ambient noise standards established as per the provisions Rule 5(2) of the aforementioned Rules have been furnished in the following table:

**Table 23: Ambient Noise Standards as per DoE**

SN	Type of Area	Limits in dB(A) $L_{eq}$	
		Day	Night
1.	Silent Zone	50	40
2.	Residential area	55	45
3.	Mixed area	60	50
4.	Commercial area	70	60
5.	Industrial area	75	70

**Note:**

1. dB(A)  $L_{eq}$  represents time-weighted average noise level on the Decibel-A scale
2. Day time is from 6am to 9pm, Night time is from 9pm to 6 am
3. Mixed area is mainly residential area, and also simultaneously used for commercial and industrial purposes
4. Area up to a radius of 100 m around hospitals/educational institutions/special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

### 3.9. Applicable international conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by becoming a Contracting Party (CP) i.e. ratifying treaties or as Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. Bangladesh has signed and ratified various Multilateral Environmental Agreements (MEAs), International Labor Organization (ILO) Conventions, and international maritime conventions. The relevant international conventions have been summarized in the following table.

Table 24: Applicable International Conventions

SN	International Conventions	Salient Features
<b>Multilateral Environmental Agreements (MEAs)</b>		
1.	Rio Declaration, 1992	Bangladesh is a signatory to Principle 4 of the declaration 1992 a global action program for sustainable development called <i>Rio Declaration</i> and <i>Agenda 21</i> was adopted in the annual United Nations Conference on Environment and Development (UNCED) held in Rio De Janeiro, Brazil.
2.	Convention on Biological Diversity, 1992	<p>It was adopted on June 5, 1992.</p> <p>The signatory has an obligation of:</p> <ul style="list-style-type: none"> <li>Introducing appropriate procedures requiring environmental impact assessments of its proposed Projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and</li> <li>Introducing appropriate arrangements to ensure that environmental consequences of its programs and policies, that are likely to have significant adverse impacts on biodiversity, are duly taken into account.</li> </ul> <p>As per the convention, EIA shall consider impacts on biodiversity due to Project activities.</p>
3.	Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar (1971)	<p>This is an intergovernmental treaty, which provides the framework for international co-operation for the conservation of wetlands habitat.</p> <p>Obligation for Contracting Parties include the designation of wetlands to the “List of Wetlands of International Importance”, the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves. Parts of Sundarbans Reserved Forest (Southwest of Bangladesh) are one of the Ramsar Sites.</p>
4.	United Nations Convention on the Law of Sea, Montego Bay, (1982)	<p>Main objectives of the convention are:</p> <ul style="list-style-type: none"> <li>To set up a comprehensive new legal regime for the sea and oceans, as far as environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment; and</li> <li>To establish basic environmental protection principals and rules on global and regional co-operation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to all sources of marine pollution.</li> </ul>

SN	International Conventions	Salient Features
5.	Kyoto Protocol	<p>The protocol is aimed at reducing greenhouse gas (GHG) emissions from various industrial activities and curbing its effects on the environment. Seven GHGs have been identified for targeted emission reduction namely:</p> <ul style="list-style-type: none"> <li>• Carbon dioxide (CO<sub>2</sub>)</li> <li>• Methane (CH<sub>4</sub>)</li> <li>• Sulphur hexafluoride (SF<sub>6</sub>)</li> <li>• Nitrous Oxide (N<sub>2</sub>O)</li> <li>• Nitrogen trifluoride (NF<sub>3</sub>)</li> <li>• Hydrofluorocarbons (HFCs)</li> <li>• Perfluorocarbons (PFC)</li> </ul> <p>The parties to the protocol shall reduce their GHG emissions through one or more of the three flexible mechanisms laid down under the protocol viz.:</p> <ol style="list-style-type: none"> <li>1. Clean Development Mechanism</li> <li>2. Joint Implementation</li> <li>3. International Emissions Trading</li> </ol> <p>The protocol formulated in 1997 and came into force in 2008. It's currently under its second commitment period which terminates in 2020. Bangladesh signed the protocol October 22, 2001. However, it has no binding emission reduction target as it's a developing nation.</p>
6.	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.	<p>It was formulated to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate. The wastes under the Convention's scope are listed under its Annex – I, II and III. In addition to conditions on the import and export of wastes, there are stringent requirements for notice, consent and tracking for movement of wastes across national boundaries.</p> <p>The Convention came into force on May 5, 1992. Bangladesh acceded it on April 1, 1993.</p>
<b>International Labour Organisation (ILO) Conventions</b>		
7.	International Labour Organisation	<p>Bangladesh has ratified many of the International Labour Organization conventions that are relevant to the Project including:</p> <ul style="list-style-type: none"> <li>• C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified);</li> </ul>

SN	International Conventions	Salient Features
		<ul style="list-style-type: none"> <li>• C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified);</li> <li>• C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified);</li> <li>• C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified);</li> <li>• C29 Forced Labour Convention, 1930 (30:11:1954, ratified) &amp; C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified);</li> <li>• C100 Equal Remuneration Convention, 1951 (25:09:1958, ratified);</li> <li>• C107 Indigenous and Tribal Populations Convention, 1957</li> <li>• C111 discrimination (Employment and Occupation) Convention, 1958 (03:06:1960, ratified) This Convention limits the hours of work in industrial undertaking to eight (8) in the day and forty-eight (48) in the week</li> </ul>
<b>Maritime Conventions, Protocols and Agreements</b>		
8.	International Maritime Organization Convention, 1948	<p>The Aims of the IMO include a range of objectives:</p> <ul style="list-style-type: none"> <li>• To provide machinery for co-operation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade, and to encourage the general adoption of the highest practicable standards in matters concerning maritime safety and efficiency of navigation;</li> <li>• To provide for the consideration by the Organization of any matters concerning shipping that may be referred to it by any organ or specialized agency of the United Nations;</li> <li>• To provide for the exchange of information among Governments on matters under consideration by the Organization.</li> </ul> <p>There have been a series of amendments to the Convention which are 1975 amendments, 1977 amendments, 1991 amendments. This Convention came into force in Bangladesh on May 27, 1976. The amendment 1993 acceded on November 7, 2002.</p>
9.	Convention on Facilitation of International Maritime Traffic (FACILITATION) London, 1965	<p>The Convention's main objectives are to facilitate maritime traffic by simplifying and reducing to a minimum the formalities, documentary requirements and procedures on the arrival, stay and departure of ships engaged in international voyages. The Convention came into force in Bangladesh on October 28, 2000.</p>
10.	Load Lines Convention, 1966	<p>It's related to limitations on the draught to which a ship may be loaded to ensure its safety. The Protocol of the</p>

SN	International Conventions	Salient Features
		Load Line Convention was acceded by GoB on November 4, 2002.
11.	Convention for The Suppression of Unlawful Acts of Violence Against the Safety of Maritime Navigation (SUA convention), 1988	<p>Its main purpose is to provide protection against unlawful acts of violence and penalised perpetrators of such acts. The unlawful acts include:</p> <p>The seizure of ships by force;</p> <ul style="list-style-type: none"> <li>• Acts of violence against persons on board ships; and</li> <li>• The placing of devices on board a ship which are likely to destroy or damage it.</li> </ul> <p>The convention mandates the signatories either to extradite or prosecute alleged offenders. The Convention came into force in Bangladesh on September 7, 2005.</p>
12.	International Convention for the Safety of Life at Sea (SOLAS), 1974	<p>The SOLAS Convention, one of the several IMO Conventions, in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The Convention was adopted on 1st November 1974 and came into force on 25th May 1980. Bangladesh has acceded to the SOLAS Convention on 6th November 1981, and to the SOLAS Protocol 1988 on 18th December 2002.</p> <p>The new regulation in SOLAS Chapter II-1 (Construction - Structure, subdivision and stability, machinery and electrical installations) prohibits the new installation of materials which contain asbestos on all ships. Regulation 3-5 (New installation of materials containing asbestos) states that the regulation shall apply to materials used for the structure, machinery, electrical installations and equipment covered by the SOLAS Convention.</p> <p>For all ships, new installation of materials which contain asbestos shall be prohibited except for:</p> <ul style="list-style-type: none"> <li>• vanes used in rotary vane compressors and rotary vane vacuum pumps;</li> <li>• watertight joints and linings used for the circulation of fluids when, at high temperature (in excess of 350°C) or pressure (in excess of 7 x 10<sup>6</sup> Pa), there is a risk of fire, corrosion or toxicity; and</li> <li>• Supple and flexible thermal insulation assemblies used for temperatures above 1000 °C.</li> </ul>



## Chapter 4

# DESCRIPTION OF THE BASELINE ENVIRONMENT OF PROJECT AREA

### 4. Site settings

The proposed project site is located in Badalpura Mouza of Bairag Union Parishad, Anwara Upazila (Sub- District) of Chittagong Division, Bangladesh. The site is located upstream of Marine Academy jetty encompassing the eastern Bank of Karnafuly River. The site is situated to the south of bend which is formed through meandering of Karnafuly River, with its flow towards Bay of Bengal. The site is located at an elevation of about 2-5m above mean sea level (amsl). The project site is also accessible via Chittagong-Anwara-Banshkhali road, located at a distance of 3.5km in east direction. No archeologically important monuments or ecologically sensitive zones are located within the site area. The site setting of the project site, in its immediate vicinity is as follows-

**North Direction:** The existing dry dock of the Chittagong Port, operated by Chittagong Dry Dock Limited, is situated at about 3 km from the project site in north direction. The Chittagong Port is located at an aerial distance of 6 km from the site towards north-west.

**East Direction:** The village Badalpura, which is the nearest rural setup is adjacent to the project site, in east direction. The upcoming Korean Export Processing Zone (KEPZ) is also located in close proximity towards east of the site, at a distance of 1 km.

**South Direction:** The Bangladesh Marine Academy is situated adjacent to the project site in south-east direction. The Academy has an existing jetty, just south of the project site, and currently KDDSEZL also has permission to use the jetty. A small patch of marshy wetland was observed just downstream of the above mentioned jetty comprising of mangrove species Kewra (*Sonneratia apetala*). These species are covered under the plantation program initiated by Forest Department of Bangladesh. The same land saturates with river water during high tide and emptied during low tide occurred in the Karnafuly River. Three fertilizer plants viz. Chittagong Urea Fertilizer Limited (CUFL), Di-Ammonium Phosphate Fertilizer Company Limited (DAPFCL) and Karnafuly Fertilizer Company (KAFCO) are present within range of 1 – 3.5 km south-west of the project site.

**West Direction:** Karnafuly River flows towards west of the site, forming an 'S' shaped bend, starting from fisheries cold storage of KSBL located at a distance of 8 km upstream and ending with the proposed project site, and finally falls into Bay of Bengal. The Shah Amanat International Airport is at an aerial distance of 2 km west from the project site.

#### Current Status

At present, the eastern part of the project site has been reclaimed up to 6m above ISLWL and is proposed to be raised by another 1m to achieve the required minimum elevation of

7m prior to commencement of project construction activities. The site area is characterized by low lying vacant area which was reclaimed with layers of sand. About half of the reclaimed land is fenced with wire barbs, mainly due to security reasons. Three watch towers are positioned at site. Currently, the site is being used for small ship building purposes. There is an existing workshop building at site, part of which is also utilized as site office. Workers are currently being accommodated in temporary labor units at site. The site also has an existing air aviation signal light post near the main entrance, which is a permanent structure and will not be removed even during operations of the project.

Out of total land 18.23 acres acquired for the project, an area of 7.82 acres comprising of private land was procured from residents of Badalpura village. The village is adjacent to the project site on the eastern side, separated only by a village road. The approach to the site, i.e. the main entrance, is also through the same road. Local populace of the area is dependent on boat activities in the Karnafuly River and its channels, as an occupation and also as a source of an earning for their livelihood.

#### **4.1. Physical environment**

##### **4.1.1. Physiography and topography**

Physiography is the terrain condition of a particular tract of land and reveals the surface condition of the land. Physiographic region/unit refers to a region in which all land tracts are similar in terms of physical characteristics, with a uniform geomorphic history, and whose pattern of topographical features or landforms differs significantly from that of adjacent regions.

In the context of physiography, Bangladesh may be classified into three distinct regions - floodplains, terraces and hills, further divided into twenty physiographic units. The study area of the proposed project forms a part of the Chittagong Coastal Plain, which is a narrow strip of land between the Chittagong Hill Tracts and the Bay of Bengal. This physiographic unit comprises of gently sloping, mainly loamy, alluvial flats adjoining the north-eastern hills, and extensive level clay plains adjoining the three main rivers Halda, Karnafuly and Sangu. Tidal clay plains occupy most of the off-shore islands in the south. The project site is located on the tidal floodplains along the lower course of the Karnafuly River.



Figure 24: Physiographic Units of Bangladesh

Source: National Encyclopedia of Bangladesh

#### 4.1.2. Surface geology

Bangladesh constitutes major parts of the Bengal Basin and has been evolved by formation of successive delta systems developed by the two great rivers of the Ganges and the Brahmaputra. The Bengal Basin is a structurally complex area formed due to the presence of an active Himalayan folded belt (thrust belt) in the north and Indo-Burman fold belt in the east. It is surrounded by the Archean (3.8 to 2.6 billion years old) Indian Platform (Shield) in the west, Tertiary (time range between 65 to 1.6 million years) and, in part, Mesozoic (225 to 65 million years) metamorphic Indo-Burman ranges in the east and the Archean basement of the Shillong Plateau in the north. Tectonically, Bangladesh is divided broadly into the following divisions, on the basis of basement behavior and fault characteristics:

##### a) Indian Platform and Shelf

- **Dinajpur slope (Himalayan Fore Deep)** - The Himalayan Fore deep lies south of the Main Boundary Thrust (MBT) all along the foothills of the Himalayas. It lies at the North West (NW) tip of Bangladesh and the basement occurs at 2500 m depth.
- **Rangpur Saddle**- The basement is most uplifted and covered with thin sedimentary deposits. The tentative boundary of the Rangpur Saddle at the northern and the southern slopes has been seismically defined by the approximately 700 m depth contour.

- **Bogra Slope-** the Bogra Shelf (Bogra slope) represents the southern slope of the Rangpur Saddle which is a regional monocline plunging gently towards south east to the Hinge zone. This zone marks the transition between the Rangpur Saddle and the Bengal Fore deep.

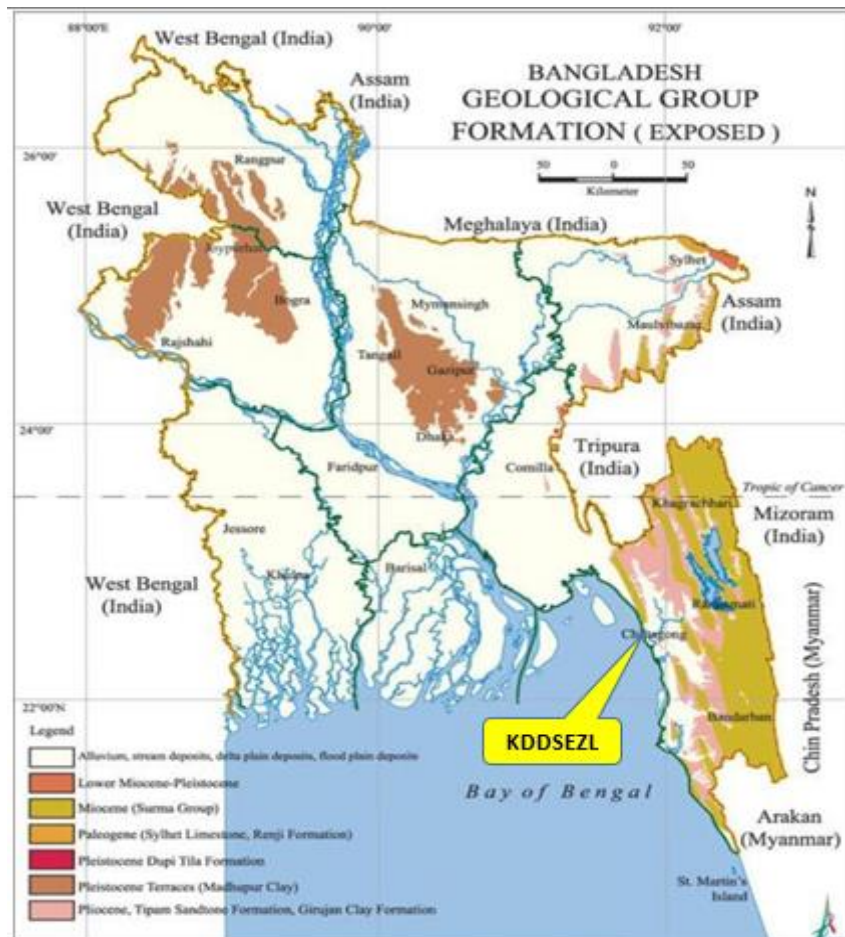


Figure 25: Geological Groups of Bangladesh

Source: National Encyclopedia of Bangladesh

#### b) Hinge Zone (Eocene slope break)

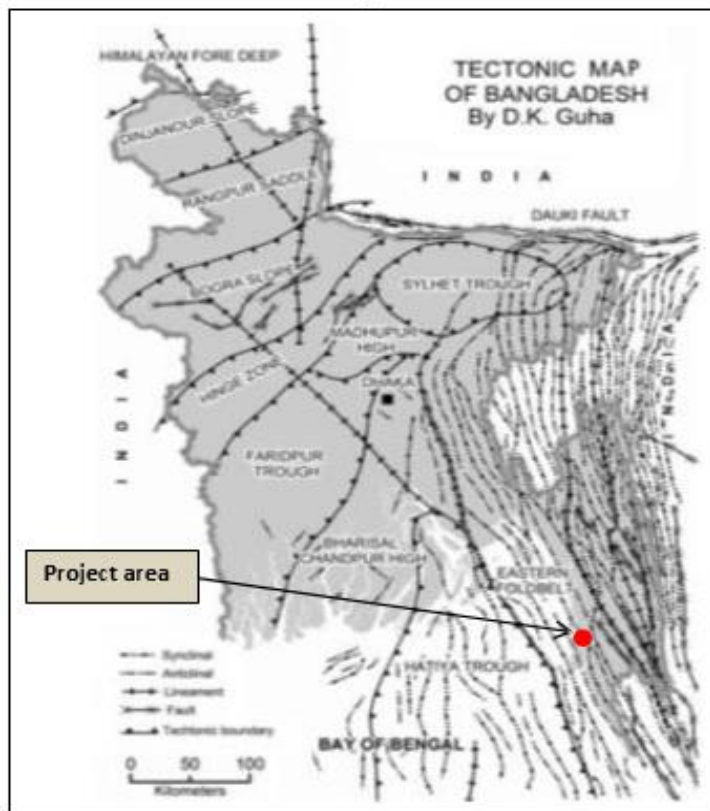
It is a narrow zone trending SSW-NNE from Sylhet-Mymensingh-Panba-Calcutta and further to the southwest along the coastline of Odisha. It is bound by the Bogra Shelf (or south slope of the Rangpur Saddle) by the seismic depth of 3500m to the top of the Eocene Sylhet Limestone, the most prominent sedimentary reflector in Bangladesh and West-Bengal.

#### c) Bengal Fore Deep

The Bengal Foredeep is flanked by Hinge Line in west and the Arakan Yoma Folded System in east which plays the most important role in the tectonic history of Bengal Basin. The Bengal Foredeep can be divided into two major regions: an Western Platform Flank and an Eastern Folded Flank. The Western Platform flank is further subdivided into the Faridpur Trough, the Barisal-Chandpur High, the Hatiya Trough, the Madhupur High and Sylhet Trough.

#### **d) Eastern Folded Flank**

The Folded belt extends S-N within Bangladesh for 450 km and is about 150 km wide, covering an area of 35 000 km<sup>2</sup> of on-shore area. The study area is situated in the Chittagong Tripura Folded Belt which is the youngest structural province along the western flank of the Indo-Burma Ranges. The Eocene flysch (marine sedimentary rock) sequences of the Indo-Burma Range constitute the eastern limit of this tectonic province. The age of the sediments outcropping in the folded belt ranges from Lower Miocene (about 24 million years before the present) to recent age. The Miocene sediments were deposited under marine and predominantly deltaic conditions in a rapidly subsiding, unstable basin, while the depositional environments were governed by subaqueous to sub-aerial, fluvial to lacustrine conditions in Plio-Pleistocene times (5 million years to 0.1 million years before the present).



**Figure 26: Tectonic Elements of Bangladesh**

Source: [http://217.174.128.43/web\\_data/iga\\_db/Bangladesh.pdf](http://217.174.128.43/web_data/iga_db/Bangladesh.pdf)

#### **4.1.3. Geomorphology (soil types)**

For the purpose of agricultural research and planning, Bangladesh has been divided into 30 agro ecological regions and 88 sub regions based on soil types and characteristics. The study area falls in the Chittagong Coastal Plain agro ecological zone (AEZ) consisting of highlands, medium highlands and medium low lands. This area is a compound unit of piedmont, river, tidal and estuarine floodplain landscapes. This area predominantly comprises of grey



piedmont soils with Grey silt loams and silty clay loams. These soils remain flooded in the monsoon season, but mainly drain early in the dry season and therefore face problem of high salinity in the dry season.

The general fertility level of the soils is medium, and nitrogen (N) and potassium (K) contents are limiting. The status of sulphur (S) is also high. Organic matter (OM) content is low to moderate and the status of zinc (Zn) and Boron (B) is medium. Table presents the major components of soil fertility of Chittagong Coastal Plain zone.

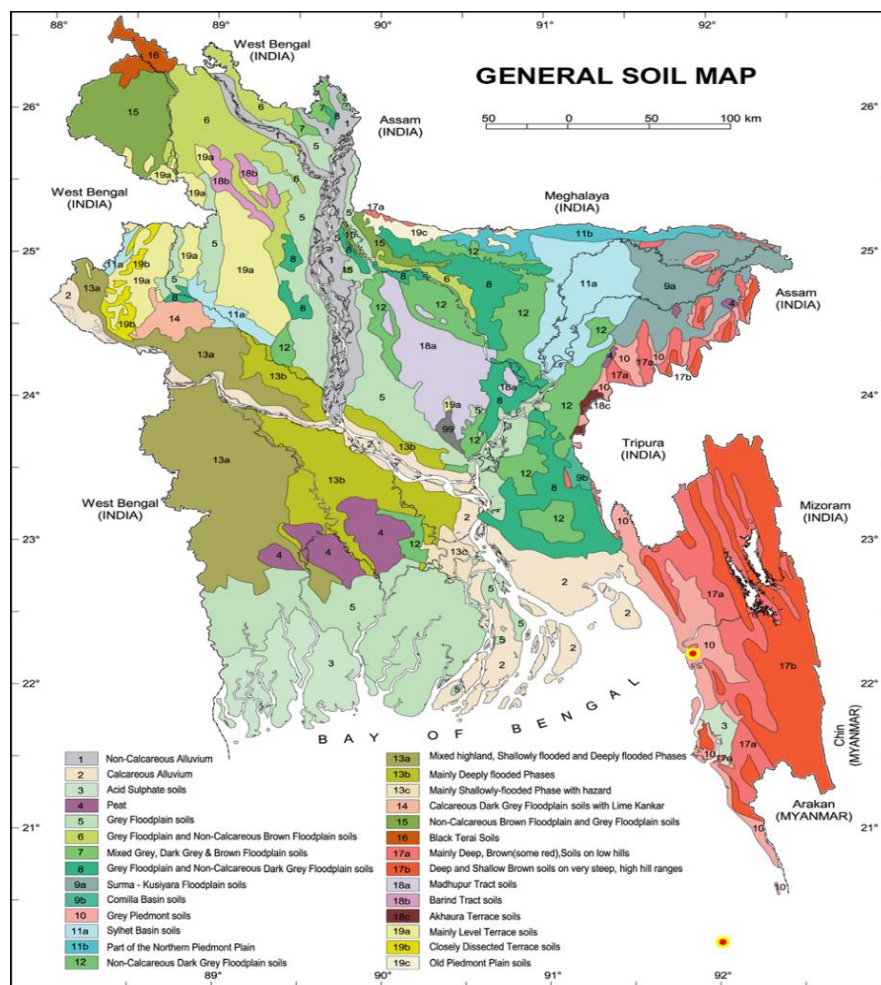
**Table 25: Status of Nutrients Present in Chittagong Coastal Plain Zone**

Major Land Type	Soil pH	Soil OM	Nutrient Status*								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Highland (17%)	4.3-6.0	L-M	L	VL-L	L-M	M-Opt	L-M	L-M	L-M	L-M	M
Medium Highland (43%)	4.4-6.2	L-M	L	VL-L	L-M	M-Opt	L-M	L-M	L-M	L-M	M
Medium Low Land (13%)	4.6-6.0	M	L	VL-L	L-M	M-Opt	L-M	L-M	L-M	L-M	M

\*OM = Organic matter; VL = Very low; Opt = Optimum; L = Low; H = High; M = Medium; VH = Very high

Source: EIA study of KDDL

The general soil types Bangladesh are presented in map given below.



**Figure 27: General Soil Map of Bangladesh**

Source: Soil Resource Development Institute (SRDI), Bangladesh



#### 4.1.4. Hydrogeology

The Ganges-Brahmaputra-Meghna delta system has the largest total sediment load in the world, eroded from the Himalayas and generating fluvio-deltaic sediment layers. The deposits of thick unconsolidated Pleistocene and Holocene alluvial sediments in this delta form one of the most productive fresh water aquifer systems in the world. Based on the principal geomorphological units, depositional environments and landforms in Bangladesh, the aquifers within the fluvial and deltaic areas of the country can be divided into three main types - upper shallow (or composite) aquifers, lower shallow (or main) aquifers and deep aquifers. Each aquifer division has unique geological characteristics, thickness, soil types, transmissivity, etc.

The aquifer type and characteristics of the Chittagong Coastal Plain, in which the study area is located, is presented in the Table below. District wise aquifer test analysis conducted by Bangladesh Water Development Board (BWDB) show that the transmissivity of aquifers in Chittagong district ranges from 114 – 600 m<sup>2</sup>/day while permeability ranges from 3-10 m/day.

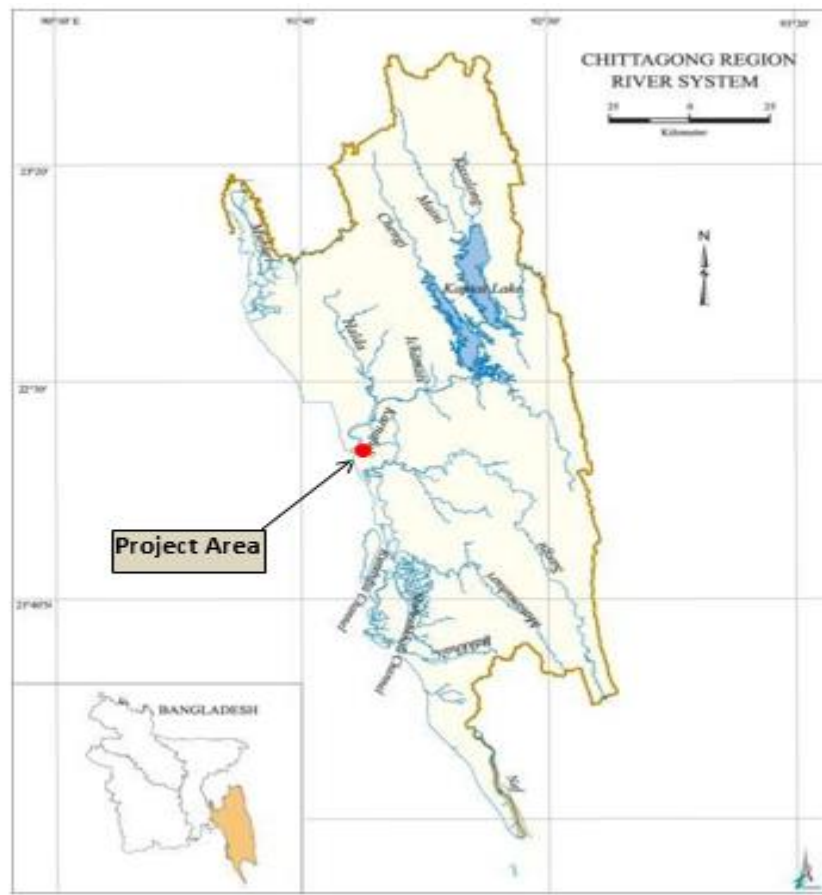
**Table 26: Aquifer Types and Characteristics of the Groundwater Regions of Bangladesh**

Physiographic Unit	Lithology	Thickness of Aquifer (m) /Depth to Main Aquifer (m)	Type of the Aquifer
Coastal Plains of Chittagong: Plains that exists in between the folded hill ranges in the east and coastline in the west; characteristically flat and plain.	A 25 to 30 m thick zone of silt and clay covers the aquifer materials. Clay thickness gradually increases towards the Bar Sandy materials are predominantly medium to coarse	A shallow aquifer of about 20-50m thickness exists near the surface Main aquifer is deep seated whose nature and extent are not known. Shallow aquifer exists at a depth of about 50m.	Semi-confined to confined.

Source: MPO, Technical Report No.5 - June, 1987

#### 4.1.5. Drainage pattern

The entire study area is part of the Chittagong Region river system, situated along the bank of Karnafuly River, which is the principal river in the region. The river flows through Rangamati district and the port city of Chittagong and discharges into the Bay of Bengal near Patenga. The main tributaries of the Karnafuly are the Halda, Ichamati, Kasalong and Thega rivers. Karnafuly River also has the single hydropower dam of the country built at Kaptai. Downstream of the Kaptai dam and reservoir, the Karnafuly receives very little water in the dry seasons.



**Figure 28: Chittagong Region River System**

Source: Banglapedia

#### 4.1.6. Natural hazards

##### Seismicity

The Geological Survey of Bangladesh (GSB) has divided the country into three seismic zones, as illustrated in the Figure, accompanied by an outline of a code for earthquake resistant design. According to the map, the project site falls in seismic Zone II, where the possible maximum earthquake magnitude in Richter's scale is 8.0, and the suggested Basic Seismic Coefficient is 0.05g. However, for design, the seismic loads acting on the structures shall be calculated according to Indian Standard IS 1893 with a seismic zone 5 and an importance factor of 1.5. Major earthquakes experienced in Bangladesh till date is provided in the Table below.

**Table 27: Major Earthquakes in the Region**

Date	Name/ Type of the Earthquake	Magnitude (Richter)	Epicentral Distance from Dhaka (km)	Epicentral Distance from Sylhet City (km)	Epicentral Distance from Chittagong (km)
10 <sup>th</sup> January, 1869	Cachar Earthquake	7.5	25	70	280
14 <sup>th</sup> July, 1885	Bengal Earthquake	7	170	220	350
12 <sup>th</sup> June, 1897	Great Indian Earthquak	8.7	230	80	340

Date	Name/ Type of the Earthquake	Magnitude (Richter)	Epicentral Distance from Dhaka (km)	Epicentral Distance from Sylhet City (km)	Epicentral Distance from Chittagong (km)
8 <sup>th</sup> July, 1918	Earthquake	7.6	150	60	200
2 <sup>nd</sup> July, 1930	Dhubri Earthquake	7.1	250	475	415
15 <sup>th</sup> January, 1934	Bihar-Nepal Earthquake	8.3	510	530	580
15 <sup>th</sup> August, 1950	Assam Earthquake	8.5	780	580	540

Source: <http://www.ddm.gov.bd/earthquake.php>

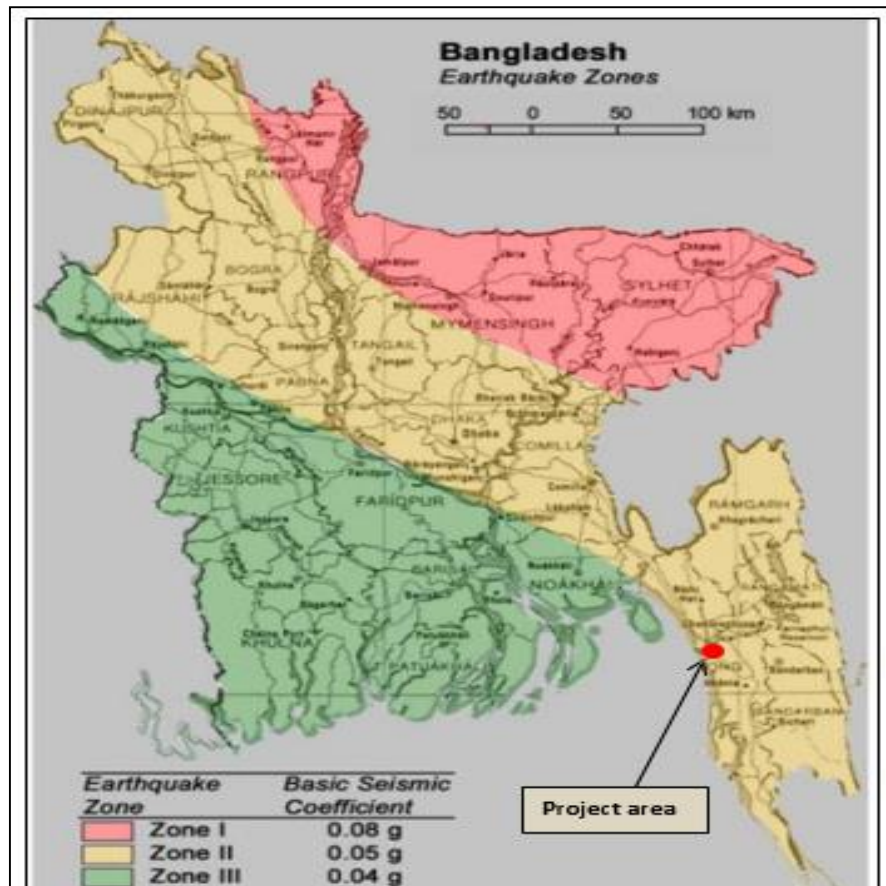


Figure 29: Seismic Zones of Bangladesh

Source: Geological Survey of Bangladesh

### Cyclonic Disasters

The area under the Chittagong Coastal Plains is subject to flash floods from the hills and shallow flooding that fluctuates in depth with the tide. The average daily rise in the tide is about two meters. The study area is susceptible to storm surges associated with cyclones. The coastal areas of Bangladesh experience major cyclones primarily in the months of May and October. The range of astronomical tides along the coast is so large during this period that the storm induced sea level becomes very high, resulting in a storm surge.

During the years 1797 to 1991, Bangladesh has been hit by 59 severe cyclones, 32 of which were accompanied by storm surges. Various studies suggest that the height of the surges

limited to a maximum of 10 meters in the bay have an occurrence frequency of approximately once per 20 years while surges with frequency of approximately once in 5 years have a height of about 7 m. Below table provides a list of major cyclones and storm surges in Chittagong coastal areas in the past.

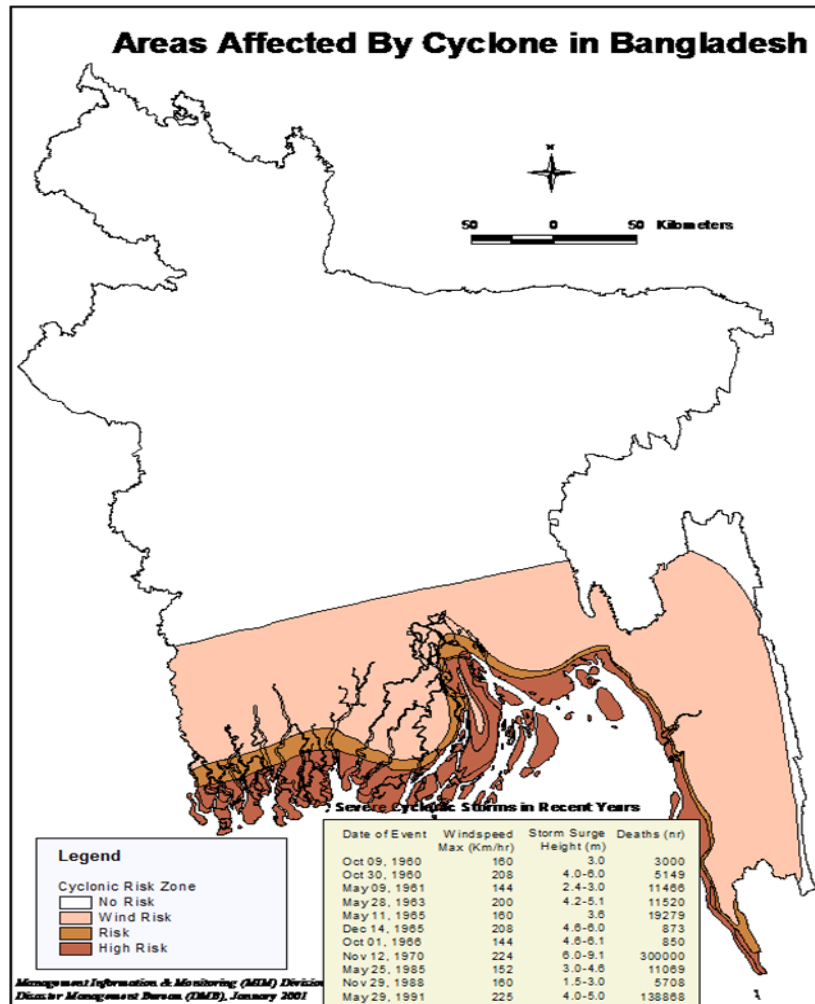


Figure 30: Cyclone Surge Susceptibility

Source: Disaster Management Board (DMB), Bangladesh

Table 28: Major Cyclones in Chittagong Coastal Area

Date	Nature of Phenomena	Approx. Loss/ Damage
1797, May-June	Most severe cyclone	Every hut levelled to ground and 2 vessels sunk in the Chittagong port
1876, 27 <sup>th</sup> Oct-1 <sup>st</sup> Nov	More severe storm surge of	400,000 lives were lost and 1st Nov
1897, October	Hurricane with surge	175,000 lives were lost
1909, October	Cyclonic storm surge	Damage data not available
1948, 17 <sup>th</sup> -19 <sup>th</sup> May	Cyclonic storm	Damage data not available
1960, 30 <sup>th</sup> – 31 <sup>st</sup> October	Severe cyclonic storm, w=161 to 210 km/h, s=4.2m and t=1.8m.	70% buildings in Hatia blown-off and 8,149 lives lost
1961, 27 <sup>th</sup> -30 <sup>th</sup> May	Cyclonic storm, w=95 to 145 km/h and total water level was 7m at Chittagong.	10,466 people killed
1962, 26 <sup>th</sup> – 30 <sup>th</sup> October	Cyclonic storm, w=200 km/h, s=5.8m and t=0.0m.	50,000 people killed

Date	Nature of Phenomena	Approx. Loss/ Damage
1963, 28-29 <sup>th</sup> May	Severe cyclonic storm, w=201 km/h, s=5m and t=0.3m at Chittagong.	11,520 people killed
1965, 10-12 <sup>th</sup> May	Severe cyclonic storm, w=161 km/h, s=4.0m and t=1.2m.	19,270 people killed
1965, 31 <sup>st</sup> May – 1 <sup>st</sup> June	Tide plus surge was 7.1m at Companyganj. At Chittagong 1.6m surge on tide	12,000 people killed
1966, 1 <sup>st</sup> October	Severe cyclonic storm, w=145 km/h, tide plus surge was 6-7m.	850 people killed
1967, 23-24 <sup>th</sup> October	Cyclonic storm, w=130 km/h, s=2m and t=0.0m.	128 people killed
1970, 5-7 <sup>th</sup> May	Cyclonic storm, w=148 km/h, s=2.3m and t=0.2m.	18 people killed
1970, 12-13 <sup>th</sup> November	Most severe cyclonic storm, w=222 km/h, s=5.5m and t=2.1m.	300,000 lives lost and innumerable animals were killed, widespread damage to crops and properties
1971, 5-6 <sup>th</sup> November	Cyclonic storm, w=105 km/h, s=2.1m and t=0.0m.	Damage data not available
1973, 16 <sup>th</sup> -18 <sup>th</sup> November	Cyclonic storm, w=165 km/h, s=3.5m and t=1.0m.	Damage data not available
1974, 24-28 <sup>th</sup> November	Severe cyclonic storm, w=161 km/h, s=3.1m and t=0.2m.	20 people killed
1975, 9-12 <sup>th</sup> May	Severe cyclonic storm, w=110 km/h.	5 people killed
1977, 9-12 <sup>th</sup> May	Cyclonic storm, w=113 km/h, s=0.6m and t=0.7m	Damage data not available
1983, 15 <sup>th</sup> October	Cyclonic storm, w=122 km/h.	43 persons were killed, 1000 fishermen missing and 20% aman crops destroyed
1983, 9 <sup>th</sup> November	Severe cyclonic storm, w=136 km/h, s=2.5m.	300 fishermen with 50 boats missing; 2000 houses, 22 institutions destroyed
1986, 9 <sup>th</sup> November	Cyclonic storm, w=110 km/h.	14 lives lost and huge damage to crops and properties
1991, 29 <sup>th</sup> April	Most severe cyclonic storm w=235 km/h, s=5.8m and t=1.7m.	145,000 people killed, 70,000 cattle killed, crops were damaged
1997, 19 <sup>th</sup> May	Severe cyclonic storm, w=232 km/h, s=3.1-4.6m	Death toll of about 155
2007, 15 <sup>th</sup> Nov	Severe cyclonic storm, w=223 km/h, s=4.2-4.6m	Death toll of about 3363
2009, 25 <sup>th</sup> May	Cyclonic storm, w=92 km/h	Death toll of about 190
2012, 16 <sup>th</sup> May	Cyclonic storm, w=130 km/h	Death toll of about 16

**Note:** w= Wind Speed; s= Surge height; t= Tidal height

**Source:** Asian Disaster and Preparedness Center (ADPC); Asian Disaster Reduction Center (ADRC)

#### 4.1.7. Hydrography and tidal conditions

##### Depth

For the purpose of hydrographical survey, the Chittagong Port Authority (CPA) has placed three bars in Karnafuly River and measured the depth of the river bed:

- Outer bar: at the mouth of the river with a least depth of approximately 5.2 meters from Indian Spring Low Water Level (ISLWL);
- Inner bar: at 2.26 km from the Outer bar with a minimum depth of approximately 7.2 meters; and

- Gupta bar: at 8.58 Km from the Outer bar with a minimum depth of about 6.9 meters. The depth at the Port's jetty berth ranges from 8.0 - 9.10 m and the depth at the mooring ranges from 8.8 - 10.5 m.

### Tide Levels

The Karnafuly River is a tidal river having semi-diurnal characteristics, with prominent diurnal effect, and is largely influenced by the high and low tides in the Bay of Bengal. The Bangladesh Inland Water Transport Authority (BIWTA) maintains an extensive network of automatic tide gauges (float type) along the inland waterways extending over the entire coastal belt and offshore islands in Bangladesh. For the purpose of preparation of annual tide tables, seventeen tide gauge stations have been established by BIWTA, out of which two are in Chittagong area. The observed mean tide levels at these stations are:

- At Khal No. 10: 2.664 m (above ISLWL)
- At Sadarghat: 2.481 m (above ISLWL)

The Chittagong Port Authority (CPA) also has three tide gauge stations in Chittagong area. The approximate tidal ranges as observed at these stations are in the following ranges:

- At Patenga: 1.5 m - 5.5 m (above ISLWL)
- At Khal No. 10: 1.5 m - 4.8 m (above ISLWL)
- At Sadarghat: 1.2 m - 4.2 m (above ISLWL)

### Freshets

During the months May to October freshets are expected. Freshets are caused by the normal velocity of flow of ebb tide augmented by flow of additional volume of water that drains into the river from the catchment area. Freshets are expected when rainfall intensity reaches 200mm in 24 hours.

### Wave Conditions

The wave heights are generally low showing distinct relationship with the wind conditions. Maximum wave heights over 2m were recorded only on a few days for short periods. The wave periods vary between 3-4 seconds with wave height of about 0.5m and about six seconds for 2m high waves. This information is based on observations made by NEI (Netherlands Economic Institute) 1972 - 1977.

### Current Conditions

The maximum current velocity opposite Khal No. 10 is as given below. During freshet ebbs, the current velocity goes up to 4.1 m/s.

**Table 29: Observed Current Conditions at Khal No. 10**

Period	Spring Tides	Neap Tides
SW Monsoon	2.3 – 2.8 m/s	1.3 – 1.8 m/s
Winter	Up to 1.5 m/s	Up to 1 m/s

Source: ESIA Study of Karnafuly Dry Dock by AECOM



### Hydrographic Survey

KDDSEZL had engaged the Department of Water Resources Engineering (WRE) under Bureau of Research Testing and Consultation (BRTC), Bangladesh University of Engineering and Technology (BUET) to undertake the mathematical model study for the proposed project. In relation to the study, a topographic and bathymetric survey of the Karnafuly River was undertaken by the WRE, BRTC, and BUET through Globe Survey Company. The findings of the survey were utilized for undertaking the mathematical modelling on siltation/erosion rates in Karnafuly River, assessment of dredging layout, estimation of dredging volume, bank line fixation, selection of jetty location, etc.

About 1.5 km of the Karnafuly river, with width extending from -0.9m ISLWL to high bank was surveyed for assessing the topographical and hydrological conditions of the river. Cross sections were surveyed at 50 m intervals. A Benchmark (BM) maintained by the CPA, located at the south west corner of M/s Incontrade Limited (on the right bank of the river) was selected as the reference BM for the study, with value of 7.037 m ISLWL. A staff gauge was installed at the site for water level monitoring during hydrographic and discharge measurement survey.

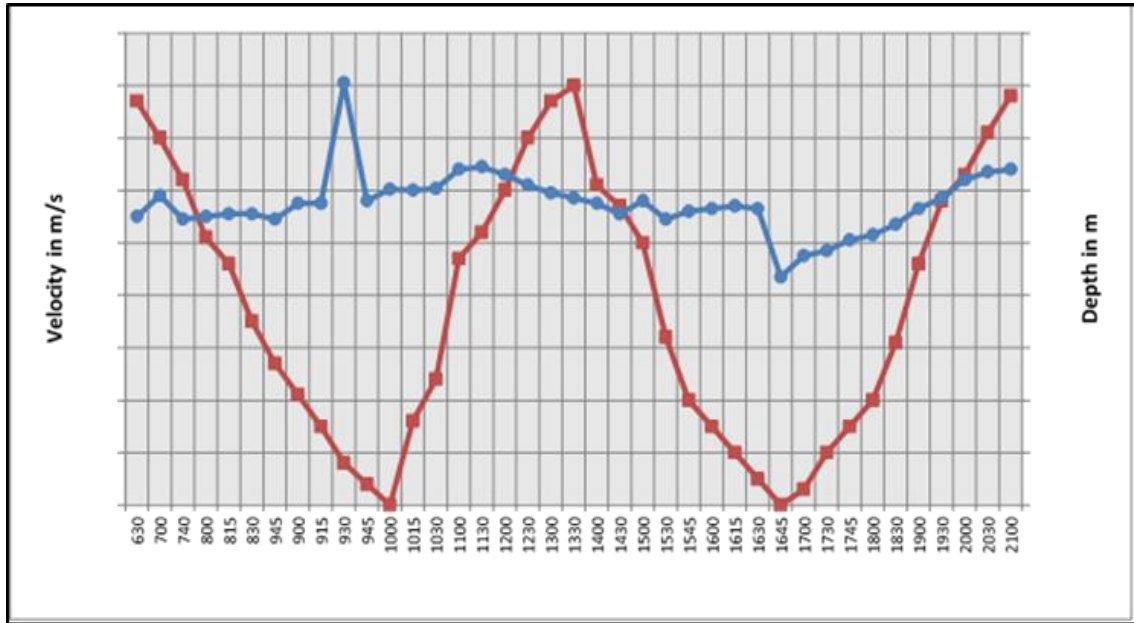
### Cross section Survey

Two inter visible points were established on the shore by 1 hour static Differential GPS (DGPS) observation at each point. The horizontal and vertical coordinates were determined and were used as reference points for the detailed topographic survey. For hydrographic survey, the riverbanks and waterlines were first surveyed by Total Station to ensure the river alignment and then the hydrographic cross sections were created. An echo sounder was also used to record the depth of water at 10m intervals. Water levels were recorded simultaneously at the gauge station. A total of 28 cross sections were thus surveyed.

Similarly, the offshore cross sections were also determined in alignment with the hydrographic cross sections, using electronic Total Station. The heights were taken at 10m intervals. Based on the survey, topographic and bathymetric contour map of the surveyed area was generated as attached in **Annexure VI**.

### Velocity measurement

Point velocity measurements were observed at a section during ebb tide and flood tide at 0.6 depth by current meter on 1<sup>st</sup> August 2013. Water level was monitored during observations using staff gauge. The observations are as provided in the figure below.

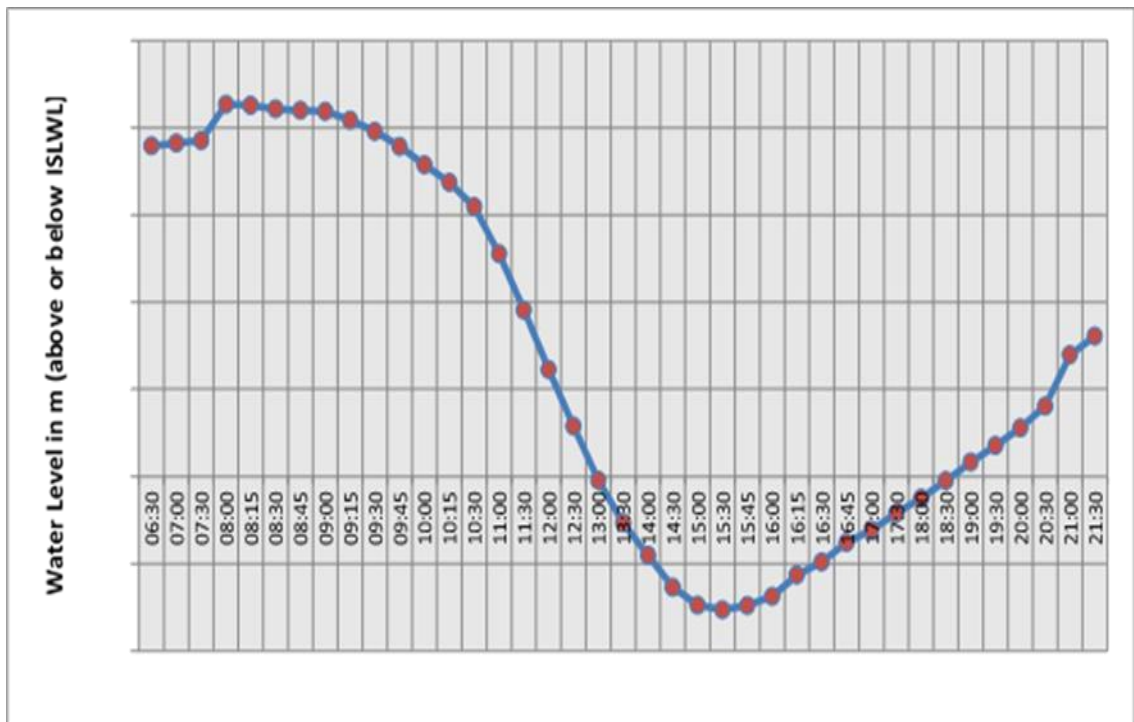


**Figure 31: Velocity and Depth Measurements**

Source: Topographic and Bathymetry Survey by Globe Survey Company

### Water Level measurement

Water level was monitored on 31<sup>st</sup> July and 1<sup>st</sup> August 2013. A staff gauge was installed at an identified location and a gauge reader was deployed to collect water level data. The observations from the second day are as indicated in the Figure below.



**Figure 32: Water Level Measurements**

Source: Topographic and Bathymetry Survey by Globe Survey Company

Note: ISLWL is 1.673m below mean sea level

#### 4.1.8. Mathematical modelling for assessing sedimentation potential of Karnafuly river

The Department of Water Resources Engineering (WRE) under Bureau of Research Testing and Consultation (BRTC), Bangladesh University of Engineering and Technology (BUET) has undertaken a Mathematical Model Study for the proposed project in order to understand the potential adverse effects on the channel navigability and morphological changes in the Karnafuly River.

The mathematical model used is known as the 'Morphological Numerical Model' of the river and was developed in 1987 for the CPA for studying different engineering schemes of the port. The model consists of a 'Hydrodynamic module' and an 'Erosion-Deposition' module which provides all the necessary data required for calculation of erosion-deposition rate in the river. The methodology adopted for the study and various assumptions considered have been listed below.

- A reconnaissance survey was conducted by BUET officials.
- The lower Karnafuly from B.N. Academy (at mouth of the sea) to Halda confluence point (0.5 km above Kalurghat Bridge) was discretized into smaller reaches of 100m each. The two upper branches above Halda were discretized with reaches of 2.5km each. The computational time used in running the model was 15 minutes. The model was calibrated and computed based on actual field data of lower Karnafuly.
- The model divides the entire river cross section into 300 grids.
- Hydrographic data of Karnafuly River for 2012-2013 from Halda confluence to sea mouth was collected from Hydrographic department of CPA. The maximum and minimum tidal ranges as reported by CPA are 4.8m ISLWL and 1.5m ISLWL respectively. These ranges are considered as respective spring tide and neap tide conditions in the model.
- Topographic, bathymetric and hydrographic survey was conducted through Globe Survey Company in July –Aug 2013.
- The model has considered development of the dry dock and dolphin jetty by KDDSEZL as well as CPA's proposed 1km long bulk cargo jetties at Laldiar Char area on the right bank of the river, just opposite to the proposed project.
- The effects of the project development and capital dredging works have been studied under three hydrological and two hydrodynamic conditions:
  - Normal flow situation under spring and neap tide condition o Flood flow situation under spring and neap tide condition
  - Dry flow situation under spring and neap tide condition
- Two major sources of freshet inflow to the Karnafuly have been considered, one at Panchpukuria in Halda and another at Kaptai, upstream of Karnafuly. The freshwater flows at these two locations considered for the study are as provided below:
  - Normal flow conditions (Oct-Mar, Jun-Jul): 10 cumec at Halda and 325 cumec at Kaptai
  - Flood flow condition (Aug-Sept): 800 cumec at Halda and 5000 cumec at Kaptai o Dry flow condition (Apr-May): no flow
  - Based on the river morphology, the dredging layout has been fixed (as provided in **Annexure II**). The river cross sections before and after the proposed capital dredging

around the proposed project site, as developed based on the study, is given in **Annexure III.**

### Assessment of Siltation and Erosion Rates

The study assessed the morphological changes due to the proposed project construction through the reach between Halda confluence and BN Academy. The pre- and post-jetty and dry dock basin siltation/ erosion rates for various conditions as mentioned above have been computed by the model. The section between Halda confluence and BN Academy along the Karnafuly River is divided into four reaches for the study.

**Table 30: Reaches and Grid Numbers assigned for the study**

Reach	Extent	Assigned Grid Nos.	Important Installations
Reach 1	From Kalurghat to Karnafuly 3rd Bridge	1 - 103	-
Reach 2	From Karnafuly 3rd Bridge to u/s of CPA Jetty no.1	104 - 140	-
Reach 3	From u/s of CPA Jetty no.1 to Khal no. 13 (Gupta sharp bend)	141 – 240	<u>Right Bank:</u> CPA jetties, Ruby Cement Jetties, Tank Terminal Jetty, Dry dock jetty, City Corporation Ghat, Upper part of Laldiar Char, etc. <u>Left Bank:</u> Dangar Char, Star Cement Jetty
Reach 4	From Gupta sharp bend (u/s of 241 – 300 Laldiar Char) to sea mouth	241 - 300	<u>Right Bank:</u> CPA's proposed 1km long Laldiar Char bulk cargo jetty, Patenga foreshore training wall <u>Left Bank:</u> KAFCO and CUFL

**Source:** ESIA Study of Karnafuly Dry Dock by AECOM

**Table 31: Pre- and Post- Project Siltation and Erosion Rates during Spring Tide Condition**

Flow Situation	Months	Reaches			
		Reach 1 (1-103)	Reach 2 (104-140)	Reach 3 (141-240)	Reach 4 (241-300)
Normal Flow	Oct-Mar, Jun-Jul	Maximum daily increase in siltation: 0.04 mm (grid 53) Maximum daily increase in Erosion: 0.04 mm (grid 51)	Maximum daily increase in siltation: 0.01 mm (grid 138) Maximum daily increase in Erosion: 0.01 mm (grid 133)	Maximum daily increase in siltation: 0.08 mm (grid 176) Maximum daily increase in Erosion: 0.03 mm (grid 174)	Maximum daily increase in siltation: 4.15 mm (grid 249) Maximum daily increase in Erosion: 7.40 mm (grid 250)
		<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b> , however grid nos. 249 and 251 needs monitoring against siltation. Also, since grid no. 250 is located within the reach of proposed jetties, the bank protection works will protect the bank against erosion.
Flood flow	Aug-Sept	Maximum daily increase in siltation: 0.03 mm (grid 53) Maximum daily increase in Erosion: 0.05 mm (grid 67)	Maximum daily increase in siltation: 0.01 mm (grid 104) Maximum daily increase in Erosion: 0.03 mm (grid 133)	Maximum daily increase in siltation: 0.02 mm (grid 205) Maximum daily increase in Erosion: 0.06 mm (grid 236)	Maximum daily increase in siltation: 1.92 mm (grid 249) Maximum daily increase in Erosion: 16.26 mm (grid 250) and 1.49 mm (grid 248)
		<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b> for other grids except those mentioned above. Since grid no. 248 and 250 is located within the reach of proposed jetties, the bank protection works will protect the bank against erosion. Grid nos. 249 and 251 needs monitoring against siltation.
Dry flow	Apr-May	Maximum daily increase in siltation: 0.03 mm (grid 53) Maximum daily increase in Erosion: 0.02 mm (grid 51)	Maximum daily increase in siltation: 0.01 mm (grid 104) Maximum daily increase in Erosion: 0.02 mm (grid 133)	Maximum daily increase in siltation: 0.03 mm (grid 173) Maximum daily increase in Erosion: 0.03 mm (grid 174)	Maximum daily increase in siltation: 3.81 mm (grid 249) Maximum daily increase in Erosion: 6.78 mm (grid 250)
		<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b> for other grids except those mentioned above. Since grid no. 250 is located within the reach of proposed jetties, the bank protection works will protect the bank against erosion. Grid nos. 249 and 251 needs monitoring against siltation

Source: ESIA Study of Karnafuly Dry Dock by AECOM

**Table 32: Pre- and Post- Project Siltation and Erosion Rates during Neap Tide Condition**

Flow Situation	Months	Reaches			
		Reach 1 (1-103)	Reach 2 (104-140)	Reach 3 (141-240)	Reach 4 (241-300)
Normal Flow	Oct-Mar, Jun-Jul	Maximum daily increase in siltation: 0.01 mm (grid 53) Erosion was not observed at any grid in this reach.	Maximum daily increase in siltation: 0.01 mm (grid 134) Maximum daily increase in Erosion: 0.02 mm (grid 133)	No change in daily siltation. Maximum daily increase in Erosion: 0.01 mm (grid 174)	Maximum daily increase in siltation: 4.10 mm (grid 249) Maximum daily increase in Erosion: 1.94 mm (grid 250)
		<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Insignificant</b> for other grid nos. However, grid nos. 249 and 251 needs monitoring against siltation. Also, since grid no. 250 is located within the reach of proposed jetties, the bank protection works will protect the bank against erosion.
Flood flow	Aug-Sept	Maximum daily increase in siltation: 0.01 mm (grid 53) Erosion was not observed at any grid in this reach.	Maximum daily increase in siltation: 0.01 mm (grid 104) increase in Erosion: 0.02 mm (grid 140)	No change in daily siltation. Maximum daily increase in Erosion: 0.02 mm (grid 236)	Maximum daily increase in siltation: 3.98 mm (grid 249) Maximum daily increase in Erosion: 5.50 mm (grid 250)
		<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b> for other grids except those mentioned above. Since grid no. 250 is located within the reach of proposed jetties, the bank protection works will protect the bank against erosion. Grid nos. 249 and 251 needs monitoring against siltation.
Dry flow	Apr-May	Maximum daily increase in siltation: 0.01 mm (grid 53) Erosion was not	No change in daily siltation. Erosion was not observed at any grid in this reach.	Maximum daily increase in siltation: 0.02 mm (grid 233) No change in daily erosion	Maximum daily increase in siltation: 3.98 mm (grid 249) Maximum daily increase in Erosion: 1.71 mm (grid 250)



Flow Situation	Months	Reaches			
		Reach 1 (1-103)	Reach 2 (104-140)	Reach 3 (141-240)	Reach 4 (241-300)
		observed at any grid in this reach.			
		<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b>	<b>Overall insignificant</b> for other grids except those mentioned above. Since grid no. 250 is located within the reach of proposed jetties, the bank protection works will protect the bank against erosion. Grid nos. 249 and 251 needs monitoring against siltation

*Source:* ESIA Study of Karnafuly Dry Dock by AECOM

## Conclusion

The Table below presents the annual changes of siltation and erosion values greater than 10 mm. Out of 300 grids along the entire surveyed section of the river, annual change in siltation and erosion values greater than 10 mm are found in six and two grids respectively. The annual change in siltation values observed is 1420 mm (grid no.249) and 542 mm (grid no. 251). The annual change in erosion value observed is 2058 mm (grid no. 250).

**Table 33: Annual change in siltation or erosion (mm) Pre- and Post- Project**

Grid No.	Top Width (m)	Depth ISLWL (m)	Annual change in siltation or erosion (mm) Pre- and Post-project
249	560	-8.3	1420
251	606	-10.2	542
252	618	-9.8	53
253	630	-9.0	48
254	652	-6.8	242
255	657	-7.9	87
248	526	-7.9	-184
250	611	-8.5	-2058

*Source:* Mathematical Model Study for the proposed project, WRE, BRTC, BUET

It is thus concluded from the study that out of 300 grids, only two grids (249 and 251) require monitoring for siltation. The overall impact of the proposed project construction on siltation is considered to be negligible for spring tide and neap tides normal, flood and dry flow conditions. The layout of the proposed dolphin jetties will encroach 4 m ISLWL bathymetry and capital dredging will be necessary for maintaining 7 m ISLWL depth at the proposed jetties, dry dock basin and approach channel.

Similarly, monitoring against erosion is required at grid no. 250 on both banks. However, this grid falls within the reach of the proposed project jetty on the left bank and the CPA's proposed Laldiar Char jetty on the right bank and it is presumed that the banks will eventually get protected against erosion as part of the bank protection works. Hence the overall impact of the proposed project construction on erosion is also considered to be negligible.

In addition, it is also understood that the channel of 450 m available between the proposed KDDSEZL and proposed Laldiar Char jetty will be sufficient for surface navigation of vessels to and from upstream Chittagong port. The movement of vessels will be controlled by CPA and the berthing at the proposed jetty will conform to the CPA regulations.

### 4.1.9. Existing land use pattern

The existing land use pattern of the study area was assessed through land use maps that were generated using available satellite imagery. An area of 5km from the proposed site was considered for preparation of land use land cover map (LULC). The major land use classes delineated are dense vegetation, agriculture land, built up land, open land, river, roads and water bodies.

## Methodology

Visual and digital interpretation techniques were used to derive the land use/land cover information from the images procured from the satellite. Changes in land use pattern were identified using IRS R2, IRS P6 and IRS 1D satellite imagery, owing to their good spectral and temporal resolution and moderate spatial resolution. Three time zones (year of 2002, 2008 and 2013) have been considered for analysis of change in land use pattern in the study area. After procuring the images, all of them were geo-referenced into the Universal Transverse Mercator (UTM 46 N) coordinate system and 1984 datum used. 2<sup>nd</sup> order polynomial transformation was used to achieve higher accuracy in geo-referencing. Details of satellite imagery procured have been shown in the Table.

**Table 34: Details of Satellite Imagery Used**

Name of Satellite	Name of Sensor	Date of Product	Path & Row	Special Resolution
IRS-R2	LISS4	5-Nov-13	111, 56	5m
IRS-P6	LISS4	19-Nov-08	101, 75	6m
IRS-1D	PAN	17-Feb-02	112, 56C0	5m

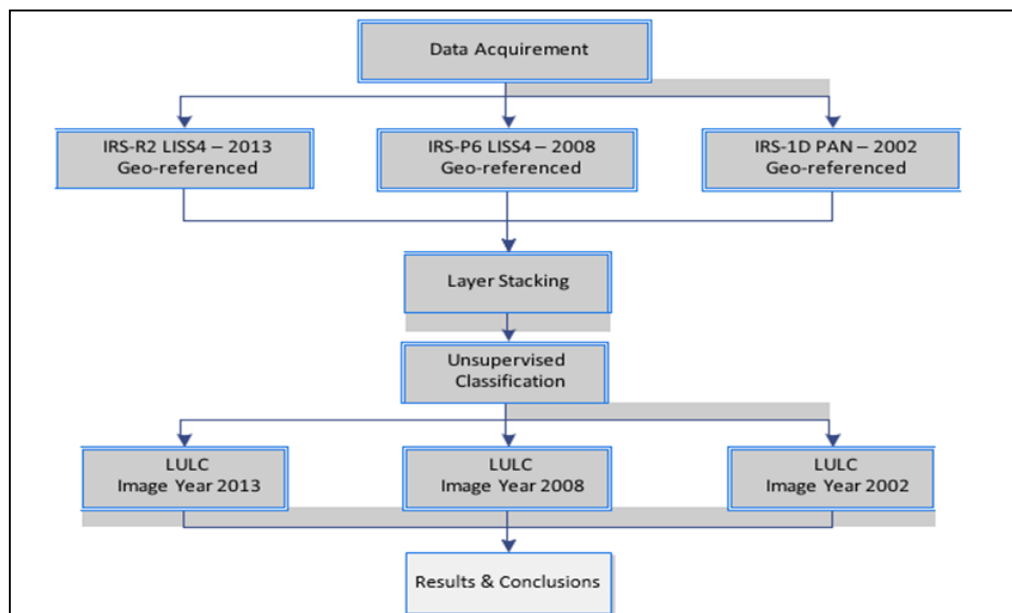
Source: ESIA Study of Karnafuly Dry Dock by AECOM

These images were processed in software namely ERDAS Imagine 10 and Arc GIS 10 for preparation of LULC maps for three different temporal resolutions using unsupervised classification method which have been shown in the Table. A Flow diagram showing the steps that were taken to create land use/land cover mapping from satellite image is shown in the following Figure.

**Table 35: Details of Software Used with their respective Functions**

Software	Function
Arc GIS 10	Preparation of Vector Layer, Thematic map, Data Base Generation and Analysis
ERDAS Imagine 10	Layer Stag, Image Classification, Subset, Raster Analysis and Accuracy Assessment

Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 33: Workflow Diagram**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The results of land use analysis for three different temporal resolutions (year 2002, 2008 and 2013) is provided in the Table below, covering eight different classes (Dense vegetation, Agriculture Land, Built-up Land, River, Water body, Roads, and Airport Runway).

**Table 36: Land Use Classification of the Study Area for Different Time Zones**

Land Class	Year 2002		Year 2008		Year 2013	
	Area (Sq.km)	Area (%)	Area (Sq.km)	Area (%)	Area (Sq.km)	Area (%)
Dense Vegetation	8.93	8.93	21.63	21.62	19.39	19.38
Agriculture Land	59.70	59.67	42.48	42.45	34.47	34.45
Built-up Land	6.86	6.86	5.50	5.49	17.45	17.44
Open Land	3.19	3.20	7.88	7.88	7.88	7.88
Airport Runway	0.25	0.25	0.25	0.25	0.25	0.25
River	14.58	14.57	16.27	16.26	16.79	16.78
Roads	1.22	1.22	1.22	1.22	1.22	1.22
Water body	5.30	5.30	4.82	4.81	2.59	2.59
	100.00	100.00	100.00	100.00	100.00	100.00

Source: ESIA Study of Karnafuly Dry Dock by AECOM

To assess change in land use pattern over three different temporal resolutions (2002- 2008, 2008-2013), a comparative analysis has been carried out by taking the difference between each category in terms of area (sq.km) covered and in percentage (%). Table below provides the results of comparative analysis carried out for period of 2002-2008 and 2008-2013. It is observed that there has been an increase of 12.7% in forest cover from time period of 2002 to 2008, whereas agricultural land has witnessed a decrease of 17.23%. Comparative analysis indicates that agriculture land has been converted to other land-use categories occurred in the study area within span of 5 years. There has also been an increase in land use of open land and river by 4.68% and 1.69% respectively. During time period of 2008 to 2013, built up area of study area has increased by 11.95%. There has been a decrease of 8.05% in agricultural land over this time period time which can be attributed to human interferences and urbanization etc. Dense vegetation and water bodies in study area have been decreased by 2.24% and 2.22% respectively. The three land use land cover maps have been presented in Figures below.

**Table 37: Comparative Analysis of Land Use Pattern in Study Area**

Land Use	Year 2002 to 2008		Year 2008 to 2013	
	Area (Sq.km)	Area (%)	Area (Sq.km)	Area (%)
Dense Vegetation	+12.70	12.70	-2.24	2.24
Agriculture Land	-17.23	17.22	-8.01	8.00
Built-up Land	-1.37	1.37	+11.95	11.95
Open Land	+4.68	4.68	0	0.00
Airport Runway	0	0.00	0	0.00
River	+1.69	1.69	-0.51	0.52
Roads	0	0.00	0	0.00

Source: ESIA Study of Karnafuly Dry Dock by AECOM

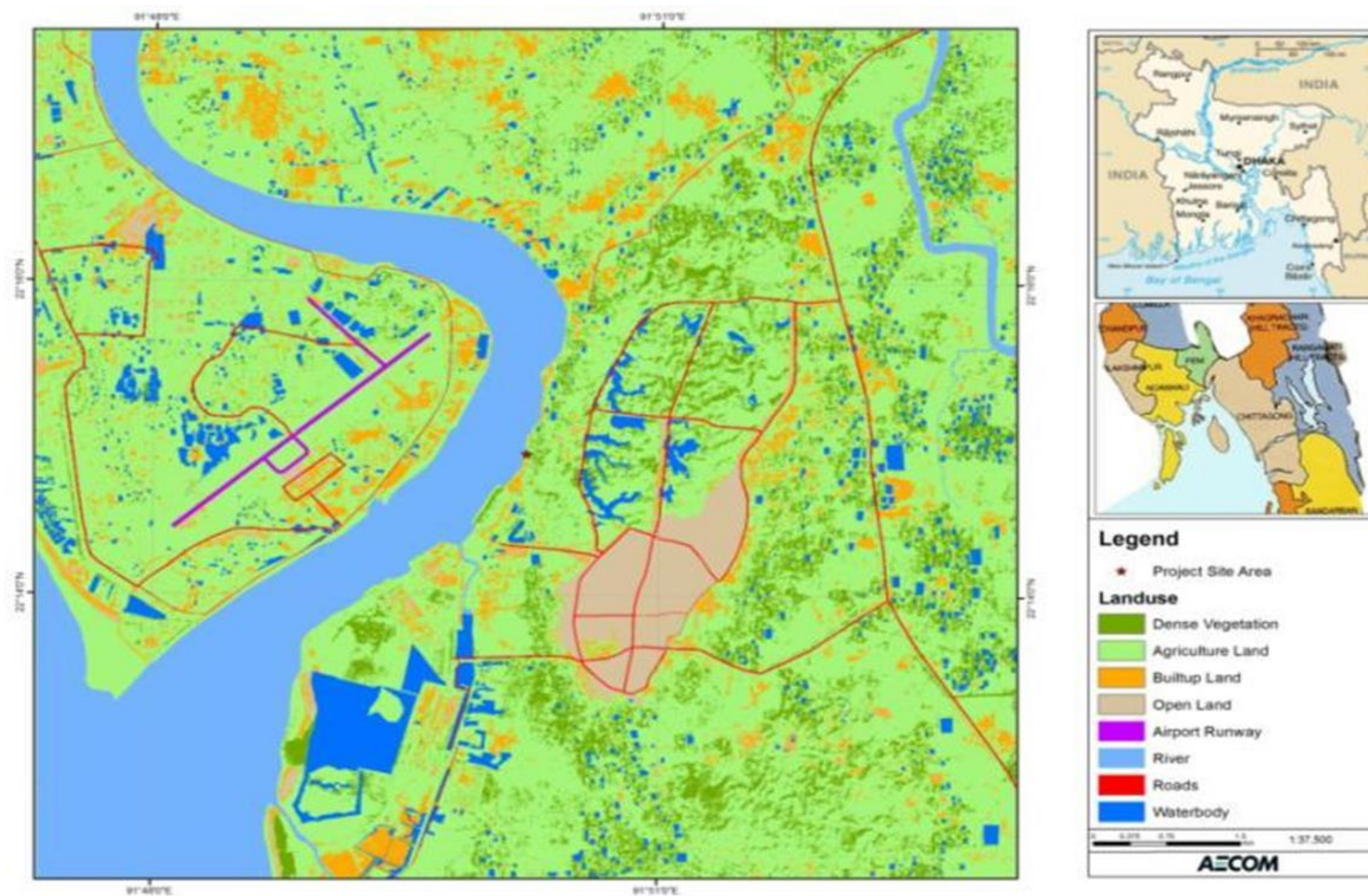


Figure 34: LULC Map of the Study Area, 2002

Source: ESIA Study of Karnafuly Dry Dock by AECOM



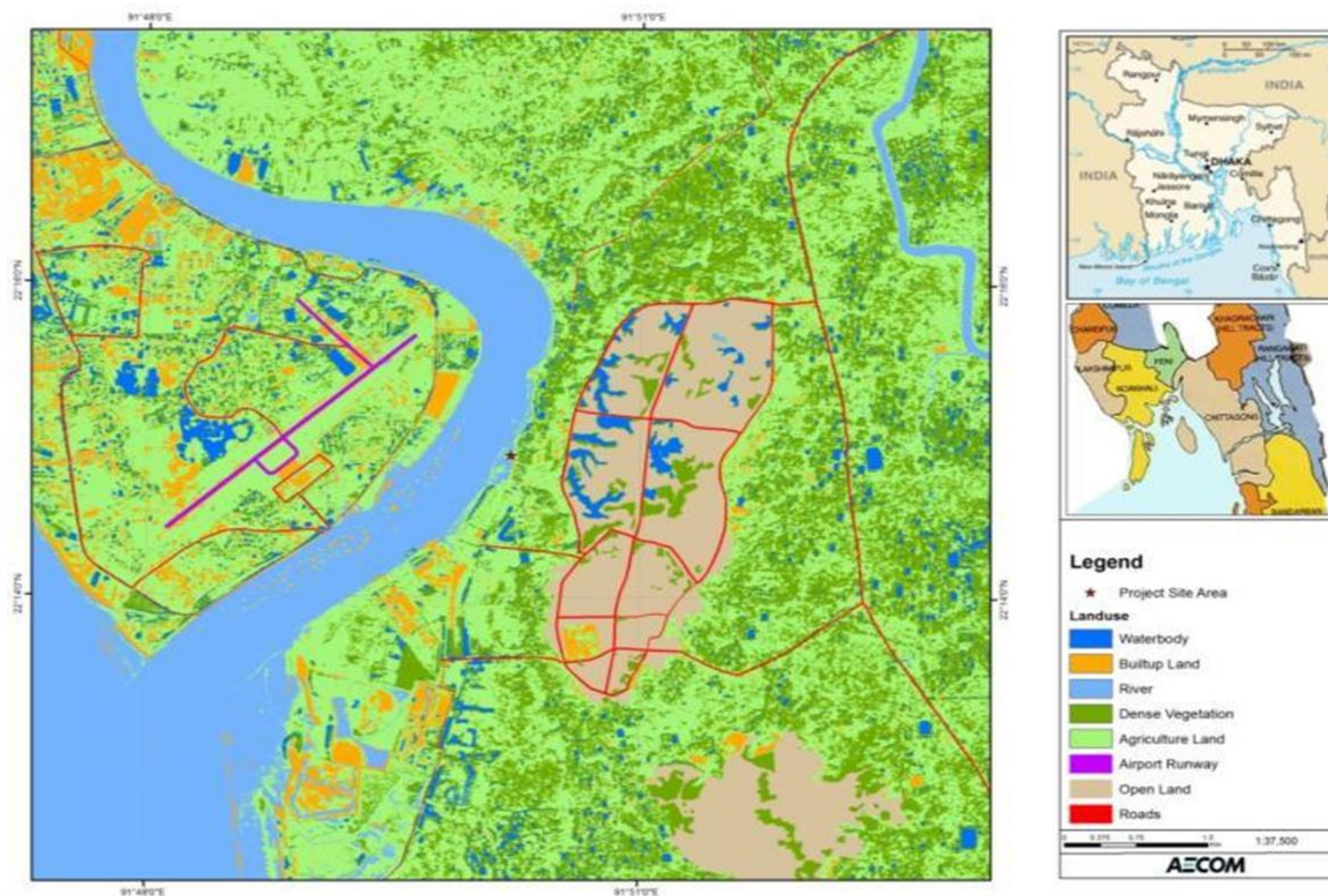


Figure 35: LULC Map of the Study Area, 2008

Source: ESIA Study of Karnafuly Dry Dock by AECOM



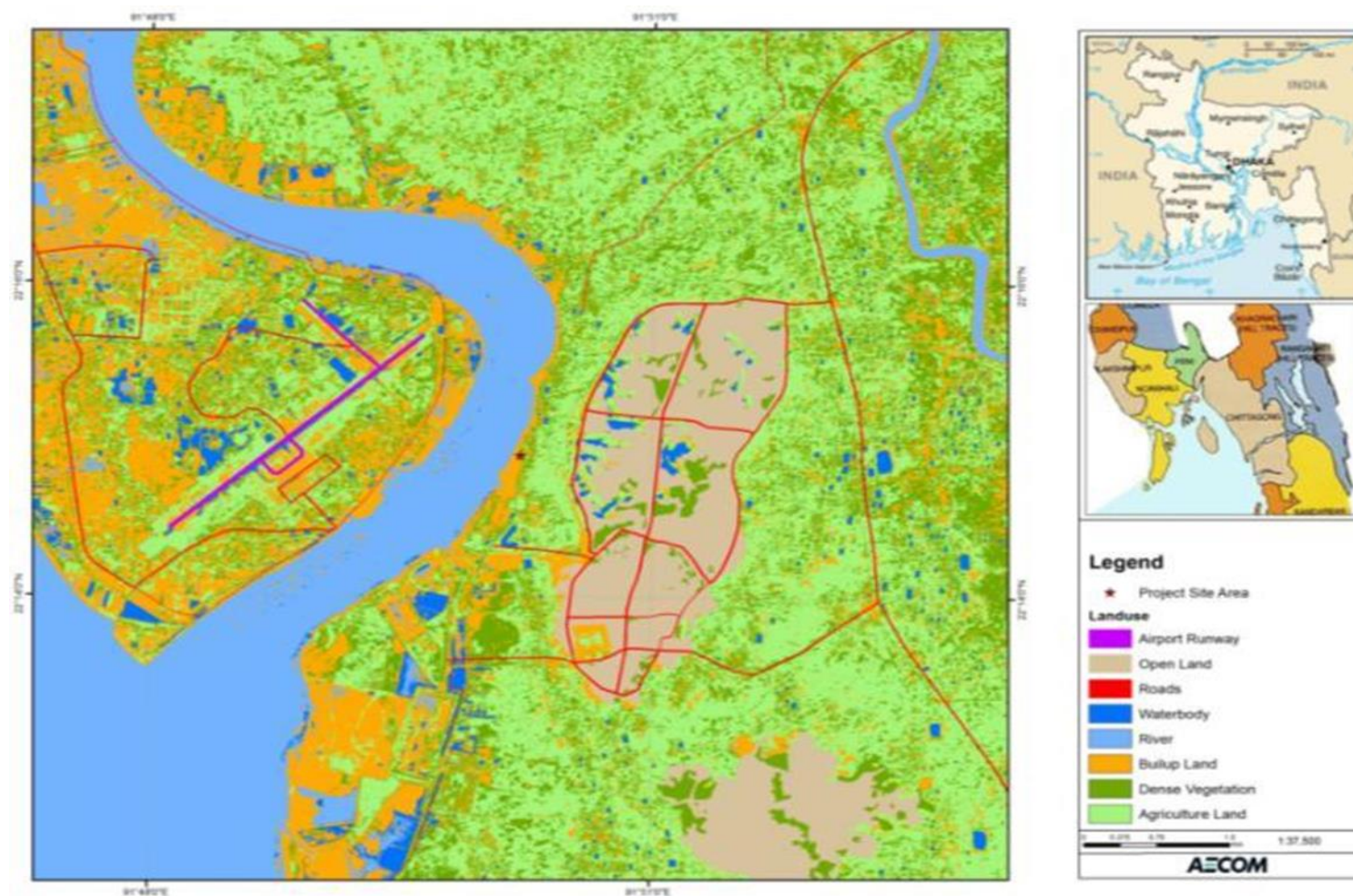


Figure 36: LULC Map of the Study Area, 2013

Source: ESIA Study of Karnafuly Dry Dock by AECOM

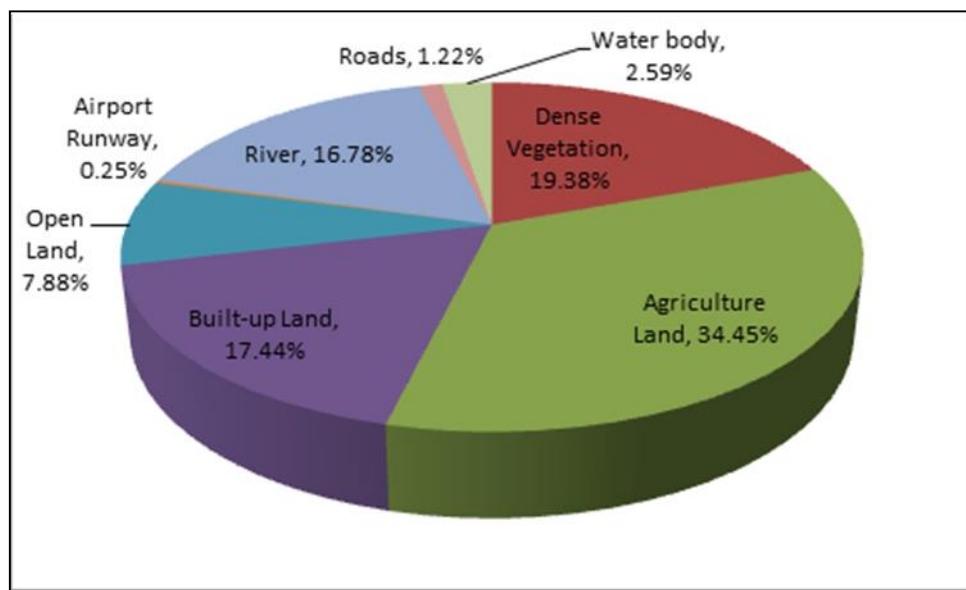
## Current Land Use

The land use classification of study area is provided in the Table and represented graphically in the Figure. A total of 19.39 % of the area is covered under dense vegetation while agriculture land covers about 34.47%. Human habitation totals to 17.45%, mainly on the western bank of Karnafuly River. Airport runway and roads form 0.25% and 1.22% of the total land use pattern of the study area. Open land forms 7.88% of the total area wherein water body constitutes 2.59%.

**Table 38: Land Use Classification of Study Area**

Land Class	Area (Sq.km)
Dense Vegetation	19.39
Agriculture Land	34.47
Built-up Land	17.45
Open Land	7.88
Airport Runway	0.25
River	16.79
Roads	1.22
Water body	2.59

Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 37: Graphical Representation of Land use classification**

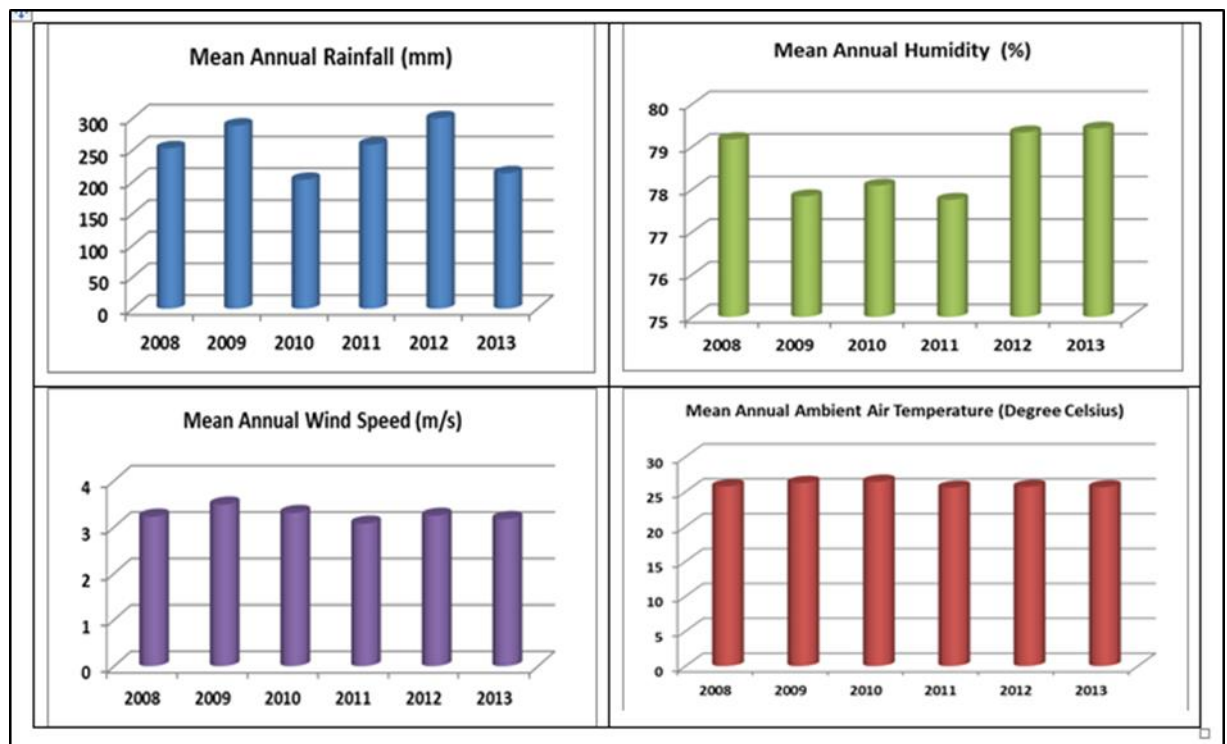
### 4.1.10. Climate and meteorology

The climatic condition of the project area is largely tropical and humid, characterized by typical coastal environment. From the meteorological point of view, climate of Bangladesh is divided into Pre-Monsoon (March to May), Monsoon (June to September), Post-Monsoon (October to November) and winter (December to February).

Based on the meteorological observations from Chittagong Meteorological Station of past six years (2008-2013) it can be inferred that mean annual precipitation ranges from 200 - 300 mm, with highest rainfall during the months of May to October. Presence of river and

natural water bodies in the vicinity leads to a very humid atmosphere with humidity in the range of 77% to 79%. The mean ambient air temperature varies from 18.4°C in winter to 29.1°C during summers. The recorded data of last six years (2008-2013) measured at Chittagong station shows that Wind speed is in the range of 4.2 to 8.7 m/s characterized by the Southern winds from the Bay of Bengal.

Climatological data from Bangladesh Meteorological Department's (BMD) Chittagong Meteorological Station for the period of 2008 to 2013 is given below the Table and presented in the Figure.



**Figure 38:** Meteorological Data (based on observations from 2008 to 2013) for Chittagong Station

**Table 39:** Meteorological Data (based on observations from 2008 to 2013) for Chittagong Station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual
<b>Total Rainfall (in mm)</b>													
2008	64	7	6	1	244	538	963	757	250	171	31	0	252.67
2009	0	2	3	114	373	434	1244	693	281	300	17	0	288.42
2010	0	8	40	46	346	747	267	516	116	294	38	19	203.08
2011	0	0	35	133	276	481	562	806	762	46	0	0	258.42
2012	0	0	30	192	188	1337	788	299	170	636	3	0	303.58
2013	0	0	3	58	773	513	405	267	173	369	0	0	213.42
<b>Average Humidity (in %)</b>													
2008	77	67	79	73	77	83	87	87	85	81	75	79	79.17
2009	71	67	72	79	79	82	87	86	84	80	74	73	77.83
2010	72	63	74	78	80	86	83	85	84	82	77	73	78.08
2011	68	67	69	77	80	85	84	87	85	80	74	77	77.75
2012	68	62	76	80	80	86	88	86	85	84	77	80	79.33
2013	72	64	77	77	85	84	84	86	84	85	78	77	79.42
<b>Wind Speed (in m/s)</b>													

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual
2008	5.3	5.6	5.7	5.2	7.2	8.6	8.6	8.4	6	4.8	5	4.8	3.22
2009	6.3	7.5	6.3	8.6	7.2	6.5	8.7	7.3	6.8	5.6	4.9	5.5	3.48
2010	6.3	7.2	8.6	7.9	6.3	7.5	7.4	5.7	5.2	4.5	5.3	5.1	3.30
2011	5.5	6.3	6.7	6.4	6.2	7	6.2	5.5	5.8	4.2	6.7	5.2	3.07
2012	6	6.3	6.6	6.8	6	7.5	6.8	6.2	6.5	6.2	5	5.8	3.24
2013	5.9	7.3	7.2	6.7	7.4	7	6.3	6.1	5.3	5.2	5.1	4.6	3.17
<b>Wind Direction (blowing to)</b>													
2008	N	N	WSW	S	SSE	SSE	SE	ESE	E	NNW	NNW	NNW	-
2009	WSW	WSW	WSW	SSE	SSE	E	E	E	E	NNW	NNW	NNW	-
2010	NW	W	E	ESE	ESE	ESE	ESE	ESE	ESE	E	NNW	NNW	-
2011	NNW	NNW	WSW	WSW	ESE	ESE	ESE	ESE	ESE	ESE	W	NNW	-
2012	NNW	NNW	SSE	S	S	S	SE	SSE	SSE	W	NNE	N	-
2013	NNE	N	W	SSW	S	SSE	SSE	SSE	SSE	NNE	NNE	NNE	-
<b>Mean Ambient Air Temperature (in degree Celsius)</b>													
2008	19.9	20.9	25.8	28.4	28.9	28.3	27.3	27.6	27.9	27.6	24.6	21.9	25.76
2009	20.9	23.2	26.6	28.7	28.9	28.8	27.7	28	28.3	27.5	25.4	21.1	26.26
2010	19.8	23.1	27.2	29.1	29	28.4	28.7	28.5	28.5	28.2	25.6	21.1	26.43
2011	19	22.7	25.5	27.6	28.4	28	28.2	27.5	27.7	27.7	24.1	20.6	25.58
2012	20.4	22.8	26.2	27.2	29.1	28.2	27.5	28.1	28.3	27.3	24.2	19	25.69
2013	18.4	22.9	25.9	28.2	27.2	28.6	28.3	27.9	28.2	26.9	24.2	20.8	25.63

Source: BMD

## Environmental Monitoring

A primary environmental monitoring was carried out in the study area of 5 km radius around the project site during the period of June 2014 to July 2014 by Adroit Environmental Consultants Limited (AECL), Bangladesh. Monitoring was undertaken for micro-meteorology, ambient air quality, water quality, ambient noise levels and soil quality. Traffic volume count was also part of the primary monitoring. A comprehensive ecological and aquatic survey of the study area was undertaken by a team of professors from Dhaka University of Engineering and Technology and Jahangirnagar University, Bangladesh.

## Micro-Meteorology

An automated weather monitoring station with data logging facility has been set up at the project site for a period of eight weeks (within June 2014 to Aug 2014) to understand the climate of the project area. The parameters monitored include air temperature, wind speed, wind direction, relative humidity and rainfall. The summary of micro-meteorological observations for the period of eight weeks viz., from 17th June to 16th August 2014 is as given in the Table.

**Table 40: Meteorological Monitoring Data**

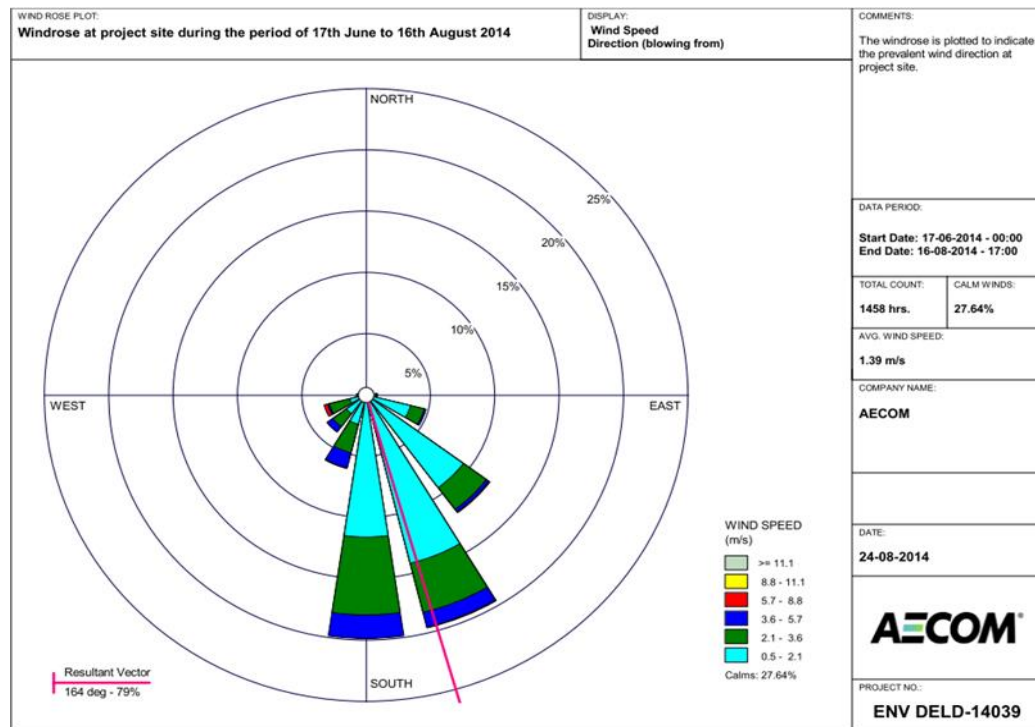
Parameter	Air Temperature °C	Relative Humidity %	Wind Speed m/s	Rainfall mm
Min	23.5	59.5	0.0	0.0
Max	35.3	95.6	6.8	54.2
Average	28.5	85.4	1.4	1.3

Source: ESIA Study of Karnafuly Dry Dock by AECOM

During the entire monitoring period, the air temperature at site was observed to be in the range of 23.5 to 35.3°C. The project site represents an average humidity of 85.4% with maximum rainfall of 54.2 mm at 5 am during the monitoring period. The Figure below represents the wind rose plotted against the daily wind direction and its speed. The direction



of the resultant unit vector represents the mean direction towards which the wind is blowing to, indicating that the during the monitoring period, the prevalent wind speed direction (about 79%) at the project site is South-South-East (SSE) with an average wind speed of 1.4 m/s.



**Figure 39: Wind rose at Project site during the monitoring period**

Source: ESIA Study of Karnafuly Dry Dock by AECOM, WR Plot - Lakes Environmental Software, pre-processed Met Data

#### 4.1.11. Ambient air quality

##### CAMS Data Analysis

The monthly average concentration data of various gaseous pollutants such as PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO has been obtained for the period of January to December 2013, from Continuous Air Monitoring Station (CAMS) set up at Chittagong, Bangladesh. The concentrations of SO<sub>2</sub> and NO<sub>2</sub> have been given in ppb (parts per billion by volume, i.e., volume of gaseous pollutant per 10<sup>9</sup> volumes of ambient air) and of CO are given in ppm (parts per million by volume, i.e., volume of gaseous pollutant per 10<sup>6</sup> volumes of ambient air).

In order to make a uniform representation of the concentration of the various gaseous pollutants, the concentrations given in ppb and ppm have been converted to µg/m<sup>3</sup> (micrograms of gaseous pollutant per cubic meter of ambient air) assuming an ambient pressure of 1 atmosphere at a temperature of 25 degrees Celsius. The general equation of conversion is,

$$\mu\text{g}/\text{m}^3 = (\text{ppb}) * (12.187) * M / (273.15 + ^\circ\text{C});$$

Where M is the molecular weight of the gaseous pollutant. Therefore, the concentrations of SO<sub>2</sub>, NO<sub>2</sub> and CO have been presented in unit of µg/m<sup>3</sup> along with concentration of PM<sub>2.5</sub> and PM<sub>10</sub> in the Table using the following conversion factors:

$$\text{SO}_2 \text{ 1 ppb} = 2.62 \text{ } \mu\text{g/m}^3$$

$$\text{NO}_2 \text{ 1 ppb} = 1.88 \text{ } \mu\text{g/m}^3$$

$$\text{CO 1 ppm} = 1111.11 \text{ } \mu\text{g/m}^3$$

**Table 41: Air Quality Data (Chittagong CAMS, Agrabad)**

Parameter Unit	PM <sub>2.5</sub> µg/m <sup>3</sup>	PM <sub>10</sub> µg/m <sup>3</sup>	SO <sub>2</sub> µg/m <sup>3</sup>	NO <sub>2</sub> µg/m <sup>3</sup>	CO µg/m <sup>3</sup>
BNAAQS	65	150	365	100 (Annual)	10000
Period of Monitoring	24 hr	24 hr	24 hr	24 hr	8 hr
Monthly Average					
Jan-13	178.0	277.6	15.7	39.3	1644.4
Feb-13	126.9	231.2	27.6	41.4	1266.7
Mar-13	100.9	193.8	21.2	28.2	1388.9
Apr-13	48.8	107.3	13.7	16.9	1266.7
May-13	4.8	59.0	12.4	21.5	1244.4
Jun-13	26.4	57.4	5.1	28.8	511.1
Jul-13	18.1	39.4	5.6	11.0	333.3
Aug-13	22.6	47.8	5.2	14.9	422.2
Sep-13	26.0	43.6	3.8	23.9	688.9
Oct-13	46.3	62.1	4.7	21.5	911.1
Nov-13	80.9	144.0	4.8	42.1	1122.2
Dec-13	147.0	213.0	8.8	58.7	1755.6

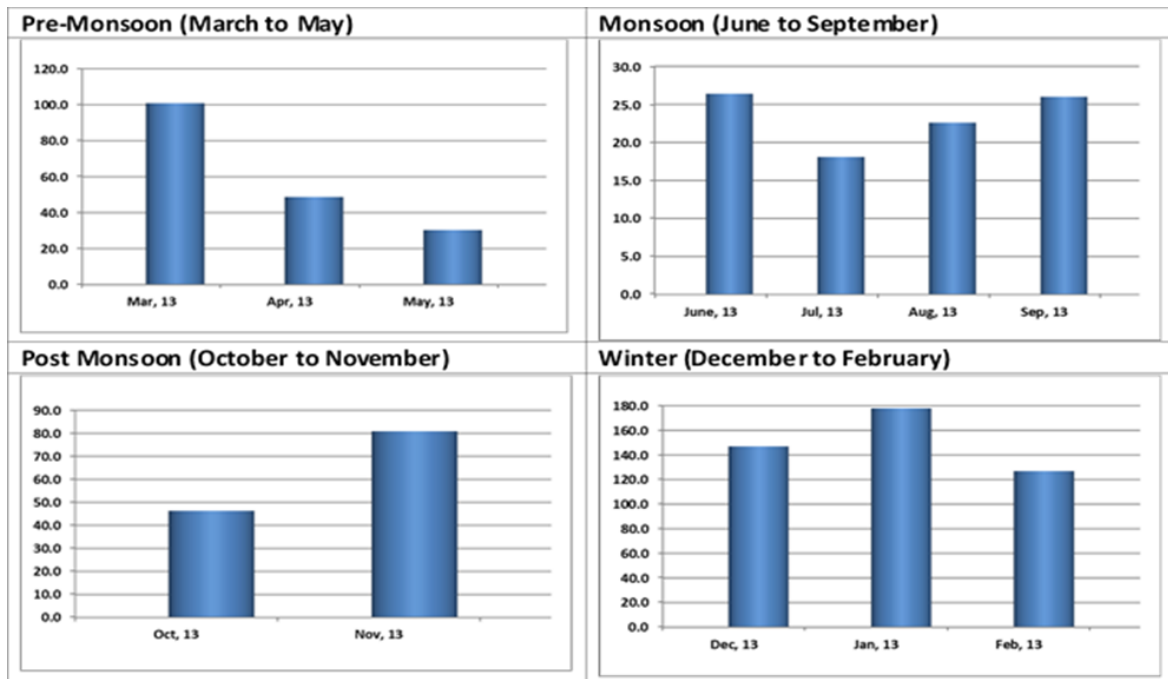
Source: ESIA Study of Karnafuly Dry Dock by AECOM

The values indicate that concentration of particulate matter exceeds the Bangladesh's National ambient air quality standard (BNAAQS) during the months of December to March whereas the values are within the prescribed standards during all other months of the year. However, the concentrations of sulphur dioxides and carbon mono-oxides are within the prescribed BNAAQS standard of 365 µg/m<sup>3</sup> and 10000 µg/m<sup>3</sup> throughout the year.

It is to be noted that the DoE have prescribed standard for annual average concentrations of NO<sub>x</sub>. Annual average air quality standards are more stringent than the 24 hourly standards because the 24 hourly standards have to take into consideration events of low dispersion such as low mixing height, winter season whereas the annual average concentrations represent the value averaged over a long period of time thereby balancing the events of occurrence of high concentrations. Hence, the NO<sub>x</sub> monitoring results from CAMS conducted for 24 hourly are not comparable to the standards.



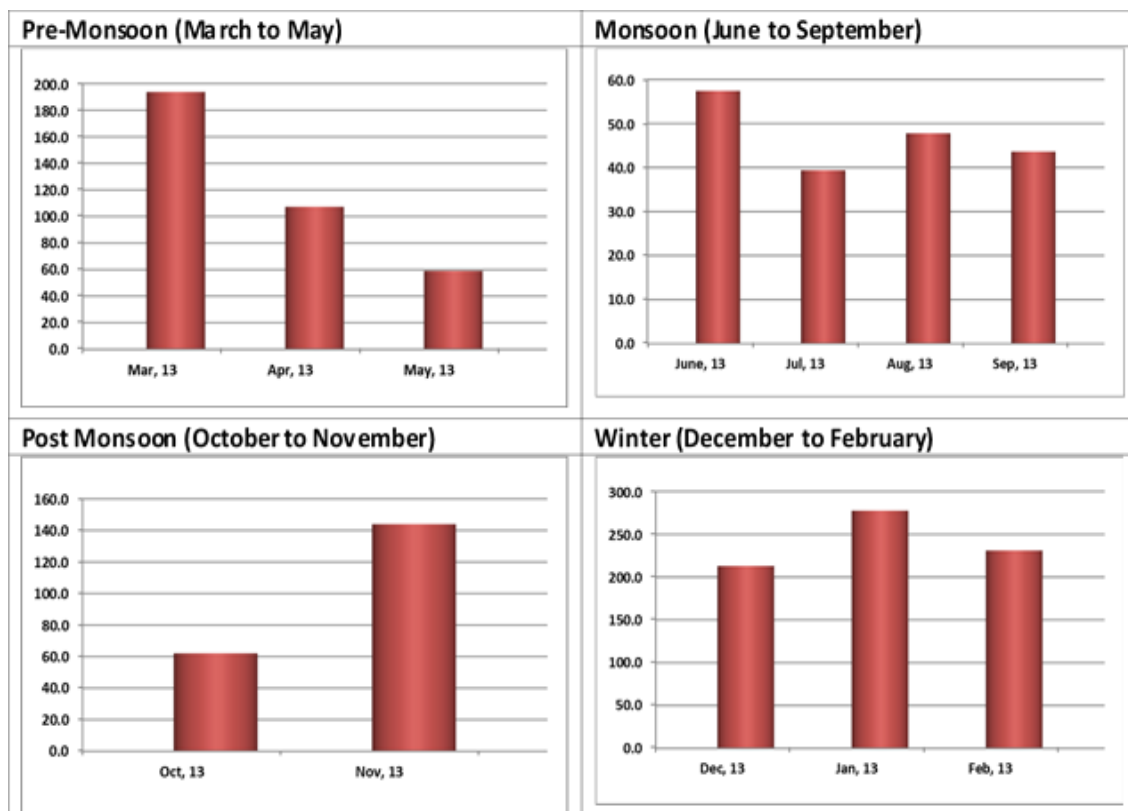
Description of the baseline environment of project area



**Figure 40:** Graphical representation of seasonal concentration of Particulate Matter (PM10)

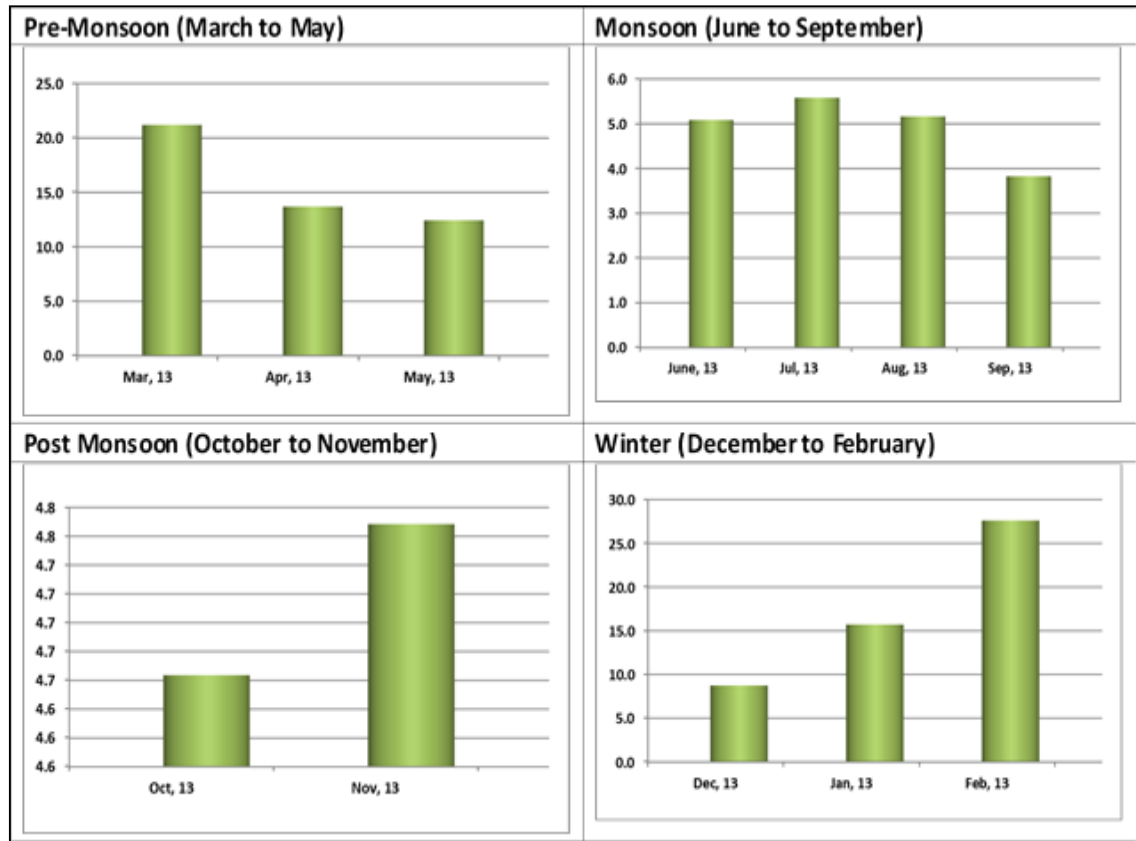
Source: ESIA Study of Karnafuly Dry Dock by AECOM

Note: DoE Limit: PM<sub>2.5</sub> (24 hourly) - 65 µg/m³, DoE Limit: PM<sub>10</sub> (24 hourly) - 150 µg/m³



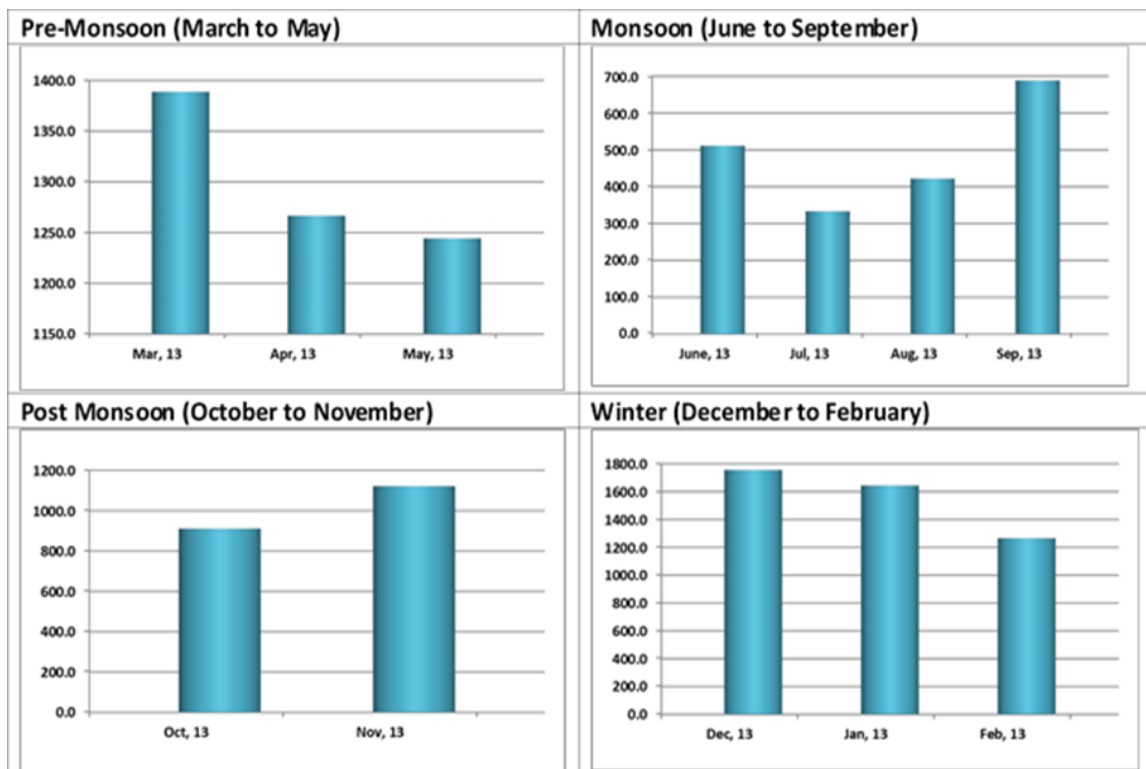
**Figure 41:** Graphical representation of seasonal concentration of Particulate Matter (PM<sub>2.5</sub>)

Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 42: Geographical representation of seasonal concentration of SO<sub>2</sub>**

Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 43: Graphical representation of seasonal concentration of Carbon Monoxide (CO)**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

## Conclusion

All the six gaseous pollutants namely particulate matter (2.5 & 10 micros sized), Sulphur Dioxide, Oxides of Nitrogen and Carbon Monoxide show an increasing trend in their concentration mostly during the winter month's viz., December to March due to the decrease in the average wind speed and precipitation levels.

## Primary Monitoring

Ambient Air Quality was carried out during the period of June to July at a frequency of twice a week at four locations. The air samples were analyzed as per standard methods. The monitored parameters, sampling frequency and their analytical method adopted are given in the Table below.

**Table 42: Monitored parameters, sampling frequency and analytical method**

Parameters	Sampling Frequency	Analytical Method
Particulate Matter (PM <sub>2.5</sub> )	24 hourly twice a week for 8	Fine particulate sampler (Gravimetric methods)
Particulate Matter (PM <sub>10</sub> )	24 hourly twice a week for 8 weeks	Respirable Dust Sampler (Gravimetric Method)
Suspended Particulate Matter	24 hourly twice a week for 8 (SPM)	
Sulphur dioxide (SO <sub>2</sub> )	24 hourly twice a week for 8 weeks	West-Gaeke Method
Oxides of Nitrogen (NO <sub>x</sub> )	24 hourly twice a week for 8 weeks	Jacob and Hochheiser Method
Carbon Monoxide (CO)	8 hourly twice a week	CO Meter

Source: AECL

The ambient air quality monitoring locations are described in the Table and shown in the Figure. The selection of the sampling locations was based on consideration of the size of the project site, predominant wind direction and meteorological data analysis of past years and topography of the study area.

**Table 43: Details of Ambient Air Monitoring Stations**

Sampling Locations	Location Code	Direction	Geographical Location	Approx. distance from the Project site (in km)
Badalpura	AAQ1	—	22°14'44.14" N 91°50'10.80" E	0.00
Patenga	AAQ2	NW	22°15'38.75" N 91°49'49.73" E	1.20
Doulatpur	AAQ3	NE	22°16'05.12" N 91°51'56.20" E	3.65
Anowara	AAQ4	SE	22°14'02.53" N 91°52'17.21" E	4.00

Source: AECL

Table below provides the monitored ambient air quality results, which are compared with BNAAQS specified by Department of Environment (DoE), Bangladesh as well as with the interim target – 1 limits specified by IFC/WB.

**Table 44: Observed Ambient Air Quality in the study area (in µg/m<sup>3</sup>)**

Parameters	Location Test Duration	Aspects					BNAAQS (µg/m <sup>3</sup> )	IFC/WB Interim Target-1 (µg/m <sup>3</sup> )
PM <sub>2.5</sub>	24	Minimum	27.0	26.0	26.0	25.0		
		Maximum	57.0	53.0	52.0	47.0		
		Average	41.9	35.8	36.1	36.3		

*Description of the baseline environment of project area*

Parameters	Location Test Duration	Aspects					BNAQS (µg/m <sup>3</sup> )	IFC/WB Interim Target-1 (µg/m <sup>3</sup> )
		98 <sup>th</sup> Percentile	55.5	50.3	50.5	46.4		
PM <sub>10</sub>	24	Minimum	56.0	55.0	53.0	46.0	150	150
		Maximum	117.0	128.0	103.0	103.0		
		Average	83.5	74.8	73.3	79.6		
		98 <sup>th</sup> Percentile	114.0	120.5	101.2	102.4		
SPM	24	Minimum	153.0	156.0	141.0	139.0	-	-
		Maximum	277.0	227.0	219.0	221.0		
		Average	201.9	185.5	182.6	189.5		
		98 <sup>th</sup> Percentile	273.1	223.1	217.2	219.5		
SO <sub>2</sub>	24	Minimum	17.0	18.0	14.0	17.0	365	125
		Maximum	34.0	35.0	26.0	25.0		
		Average	23.8	23.5	20.3	21.4		
		98 <sup>th</sup> Percentile	32.5	34.4	25.7	25.0		
NO <sub>x</sub>	24	Minimum	19.0	19.0	16.0	18.0	-	-
		Maximum	42.0	44.0	32.0	36.0		
		Average	29.3	31.2	24.7	26.3		
		98 <sup>th</sup> Percentile	41.1	43.7	31.1	35.1		
CO	8	Minimum	165.0	165.0	120.0	136.0	10000	-
		Maximum	370.0	390.0	288.0	290.0		
		Average	270.3	266.8	224.1	235.9		
		98 <sup>th</sup> Percentile	362.5	387.0	286.2	289.4		

*Source:* AECL Lab results

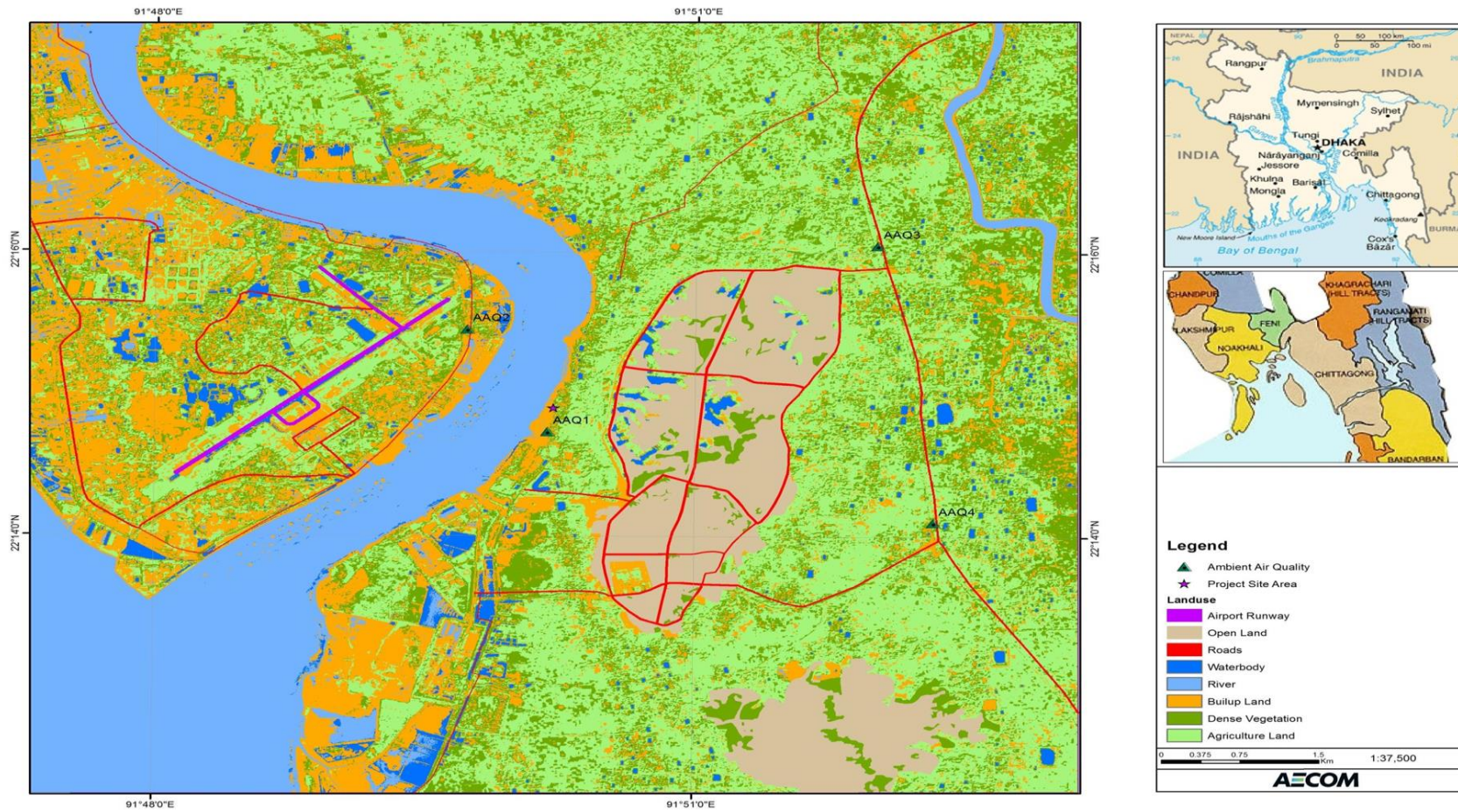
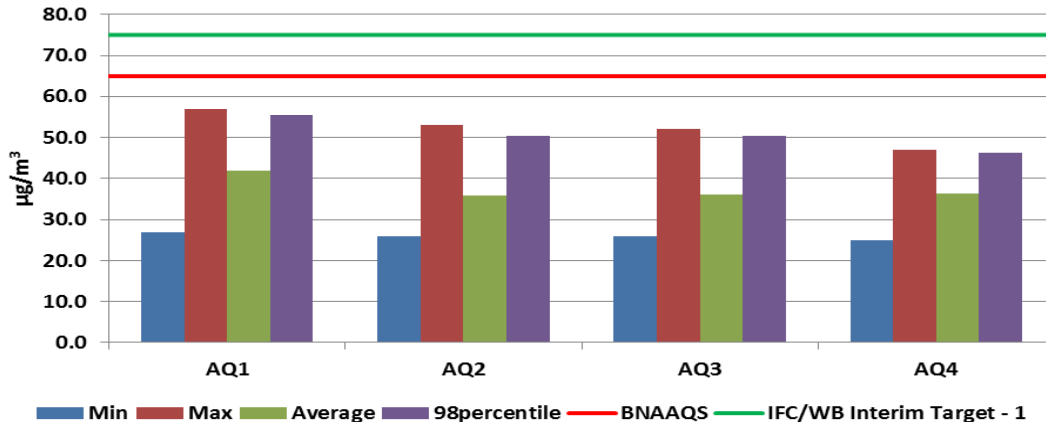
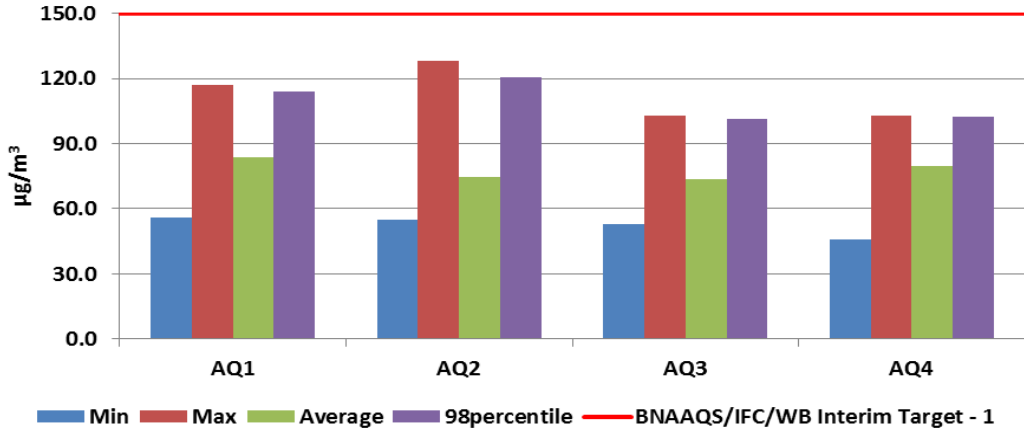


Figure 44: Ambient Air Quality Monitoring Locations

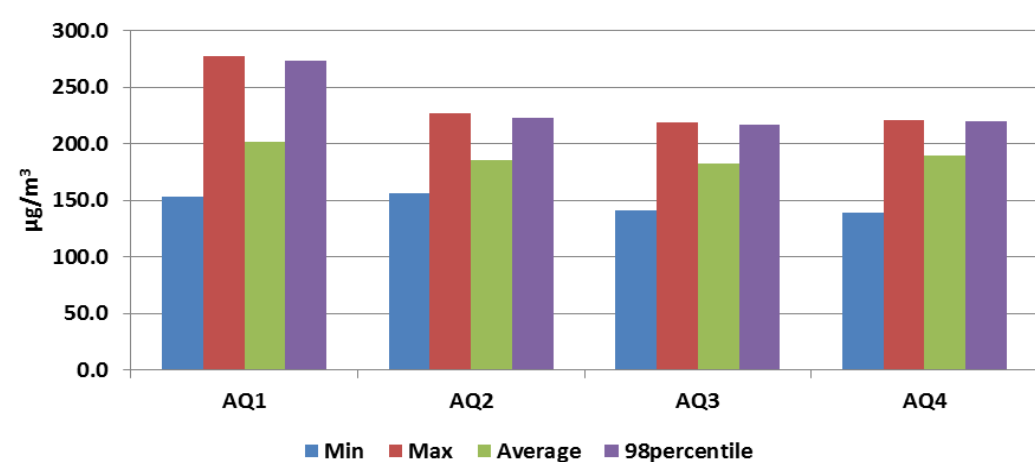
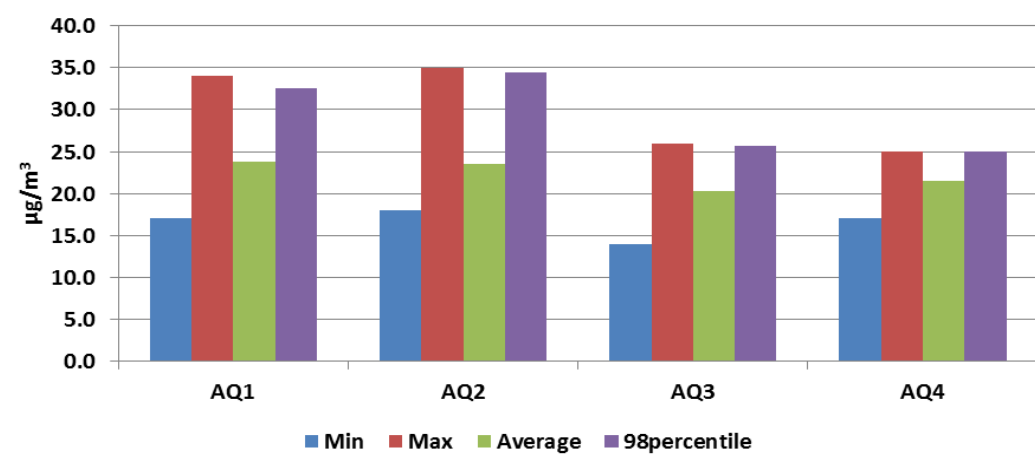
Source: ESIA Study of Karnafuly Dry Dock by AECOM

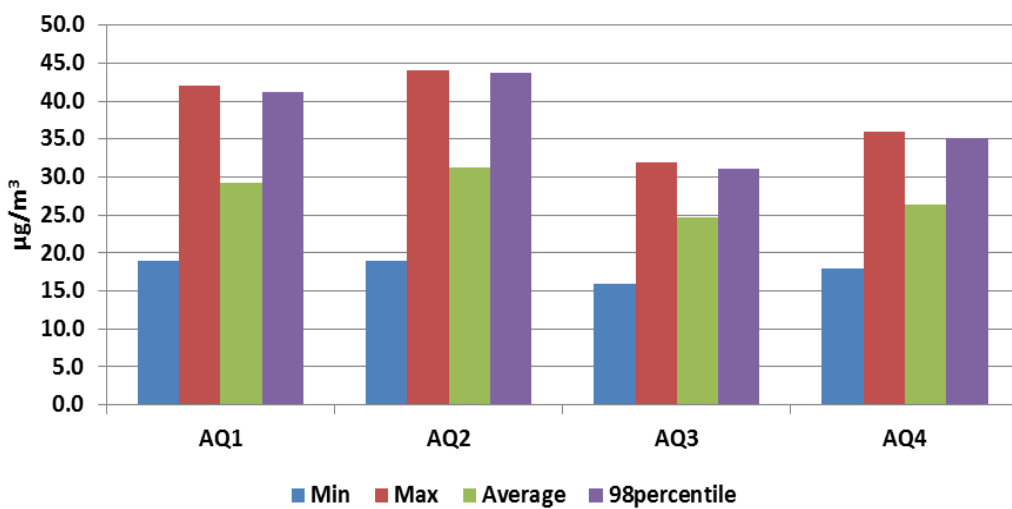
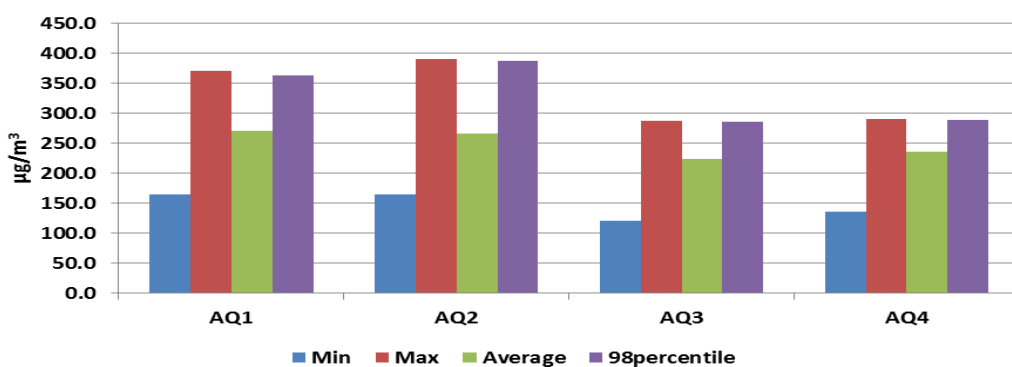


**Table 45: Summary of Analysis of Ambient Air Quality Monitoring**

S.N	Parameter	Observations & Inferences	Graphical Representation of the Monitored Gaseous Pollutants In the Study Area																									
1	Particulate Matter (PM <sub>2.5</sub> )	<p>During the monitoring period, concentration of PM<sub>2.5</sub> was observed to be minimum (25.0 µg/m<sup>3</sup>) at Anowara (AQ4) and maximum (57.0 µg/m<sup>3</sup>) at Badalpura (AQ1). The average and 98 percentile values of PM<sub>2.5</sub> ranged from 35.8 - 41.9 µg/m<sup>3</sup> and 46.4 - 55.5 µg/m<sup>3</sup> respectively.</p> <p>All the observed values were much below the BNAAQS (65 µg/m<sup>3</sup>) and IFC/WB Interim Target-1 (75 µg/m<sup>3</sup>) indicating minimum level of PM2.5 pollutants at all the locations.</p>	<p><b>Concentration of PM2.5 in the study area</b></p>  <table><caption>PM<sub>2.5</sub> Concentration Data (µg/m<sup>3</sup>)</caption><thead><tr><th>Location</th><th>Min</th><th>Max</th><th>Average</th><th>98percentile</th></tr></thead><tbody><tr><td>AQ1</td><td>25.0</td><td>57.0</td><td>41.9</td><td>55.5</td></tr><tr><td>AQ2</td><td>25.0</td><td>52.0</td><td>35.8</td><td>50.0</td></tr><tr><td>AQ3</td><td>25.0</td><td>52.0</td><td>35.8</td><td>50.0</td></tr><tr><td>AQ4</td><td>25.0</td><td>47.0</td><td>35.8</td><td>46.4</td></tr></tbody></table> <p>Legend: Min (Blue), Max (Red), Average (Green), 98percentile (Purple), BNAAQS (Red line), IFC/WB Interim Target - 1 (Green line)</p>	Location	Min	Max	Average	98percentile	AQ1	25.0	57.0	41.9	55.5	AQ2	25.0	52.0	35.8	50.0	AQ3	25.0	52.0	35.8	50.0	AQ4	25.0	47.0	35.8	46.4
Location	Min	Max	Average	98percentile																								
AQ1	25.0	57.0	41.9	55.5																								
AQ2	25.0	52.0	35.8	50.0																								
AQ3	25.0	52.0	35.8	50.0																								
AQ4	25.0	47.0	35.8	46.4																								
2	Particulate Matter (PM <sub>10</sub> )	<p>Concentration of PM<sub>10</sub>, during the monitoring period was observed to be in the range of 46 - 128 µg/m<sup>3</sup> at Anowara (AQ4) and Patenga (AQ2) respectively. The average and 98 percentile values of PM<sub>10</sub> ranged from 73.3 - 83.5 µg/m<sup>3</sup> and 101.2 - 120.5 µg/m<sup>3</sup> respectively.</p> <p>All the observed values were below 150 µg/m<sup>3</sup> (limit specified by both BNAAQS and IFC/WB Interim Target-1) indicating minimum level of PM<sub>10</sub> pollutants at all the locations.</p>	<p><b>Concentration of PM10 in the study area</b></p>  <table><caption>PM<sub>10</sub> Concentration Data (µg/m<sup>3</sup>)</caption><thead><tr><th>Location</th><th>Min</th><th>Max</th><th>Average</th><th>98percentile</th></tr></thead><tbody><tr><td>AQ1</td><td>46.0</td><td>118.0</td><td>83.5</td><td>120.5</td></tr><tr><td>AQ2</td><td>46.0</td><td>128.0</td><td>73.3</td><td>101.2</td></tr><tr><td>AQ3</td><td>46.0</td><td>105.0</td><td>73.3</td><td>101.2</td></tr><tr><td>AQ4</td><td>46.0</td><td>105.0</td><td>73.3</td><td>101.2</td></tr></tbody></table> <p>Legend: Min (Blue), Max (Red), Average (Green), 98percentile (Purple), BNAAQS/IFC/WB Interim Target - 1 (Red line)</p>	Location	Min	Max	Average	98percentile	AQ1	46.0	118.0	83.5	120.5	AQ2	46.0	128.0	73.3	101.2	AQ3	46.0	105.0	73.3	101.2	AQ4	46.0	105.0	73.3	101.2
Location	Min	Max	Average	98percentile																								
AQ1	46.0	118.0	83.5	120.5																								
AQ2	46.0	128.0	73.3	101.2																								
AQ3	46.0	105.0	73.3	101.2																								
AQ4	46.0	105.0	73.3	101.2																								



S.N	Parameter	Observations & Inferences	Graphical Representation of the Monitored Gaseous Pollutants In the Study Area																									
3	Suspended Particulate Matter (SPM)	<p>The test duration to determine concentration of SPM in the study area was 24 hours and neither BNAAQs nor IFC/WB has specified any limit for the same. Hence, the observed SPM values during the monitoring period cannot be compared.</p> <p>SPM concentration, during the monitoring period ranged from 139.0 µg/m<sup>3</sup> at Anowara (AQ4) to 227 µg/m<sup>3</sup> at both Badalpura and Patenga (AQ1 and AQ2). Average concentration of SPM ranged from 182.6 - 201.9 µg/m<sup>3</sup> while 98 percentile values ranged from 217.2 - 273.1 µg/m<sup>3</sup></p>	<p><b>Concentration of SPM in the study area</b></p>  <table><caption>SPM Concentration Data (Estimated from Chart)</caption><thead><tr><th>Location</th><th>Min (µg/m<sup>3</sup>)</th><th>Max (µg/m<sup>3</sup>)</th><th>Average (µg/m<sup>3</sup>)</th><th>98percentile (µg/m<sup>3</sup>)</th></tr></thead><tbody><tr><td>AQ1</td><td>150.0</td><td>275.0</td><td>200.0</td><td>270.0</td></tr><tr><td>AQ2</td><td>155.0</td><td>225.0</td><td>185.0</td><td>220.0</td></tr><tr><td>AQ3</td><td>140.0</td><td>215.0</td><td>180.0</td><td>215.0</td></tr><tr><td>AQ4</td><td>135.0</td><td>220.0</td><td>185.0</td><td>220.0</td></tr></tbody></table>	Location	Min (µg/m <sup>3</sup> )	Max (µg/m <sup>3</sup> )	Average (µg/m <sup>3</sup> )	98percentile (µg/m <sup>3</sup> )	AQ1	150.0	275.0	200.0	270.0	AQ2	155.0	225.0	185.0	220.0	AQ3	140.0	215.0	180.0	215.0	AQ4	135.0	220.0	185.0	220.0
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AQ4	135.0	220.0	185.0	220.0																								
4	Sulphur dioxide (SO <sub>2</sub> )	<p>The SO<sub>2</sub> concentration observed during the monitoring period ranged from 14.0 - 35.0 µg/m<sup>3</sup>. Doulatpur (AQ3) recorded the minimum concentration while the maximum concentration was recorded at Patenga (AQ2). The average concentration values ranged from 20.3 - 23.8 µg/m<sup>3</sup> while 98 percentile values ranged from 25.0 - 34.4 µg/m<sup>3</sup>.</p> <p>All the observed values were within the BNAAQs (365 µg/m<sup>3</sup>) and IFC/WB Interim Target – 1 (125 µg/m<sup>3</sup>) limits specified for Sulphur dioxide.</p>	<p><b>Concentration of SO<sub>2</sub> in the study area</b></p>  <table><caption>SO<sub>2</sub> Concentration Data (Estimated from Chart)</caption><thead><tr><th>Location</th><th>Min (µg/m<sup>3</sup>)</th><th>Max (µg/m<sup>3</sup>)</th><th>Average (µg/m<sup>3</sup>)</th><th>98percentile (µg/m<sup>3</sup>)</th></tr></thead><tbody><tr><td>AQ1</td><td>17.0</td><td>34.0</td><td>24.0</td><td>32.0</td></tr><tr><td>AQ2</td><td>18.0</td><td>35.0</td><td>23.0</td><td>34.0</td></tr><tr><td>AQ3</td><td>14.0</td><td>26.0</td><td>20.0</td><td>25.0</td></tr><tr><td>AQ4</td><td>17.0</td><td>25.0</td><td>21.0</td><td>25.0</td></tr></tbody></table>	Location	Min (µg/m <sup>3</sup> )	Max (µg/m <sup>3</sup> )	Average (µg/m <sup>3</sup> )	98percentile (µg/m <sup>3</sup> )	AQ1	17.0	34.0	24.0	32.0	AQ2	18.0	35.0	23.0	34.0	AQ3	14.0	26.0	20.0	25.0	AQ4	17.0	25.0	21.0	25.0
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S.N	Parameter	Observations & Inferences	Graphical Representation of the Monitored Gaseous Pollutants In the Study Area																									
5	Oxides of Nitrogen (NO <sub>x</sub> )	<p>The annual average air quality standards are more stringent than the 24 hourly standards since the 24 hourly standards have taken into consideration events of low dispersion such as low mixing height, winter season whereas the annual average concentrations represent the value averaged over a long period of time thereby balancing the events of occurrence of high concentrations. Both IFC/WB and DoE have prescribed guidelines/limits for annual average concentrations of NO<sub>x</sub>. Hence, the NO<sub>x</sub> monitoring results conducted for 24 hourly are not comparable to the guidelines/limits. The minimum and maximum NO<sub>x</sub> concentration observed was 16 µg/m<sup>3</sup> and 44 µg/m<sup>3</sup> at Doulatpur (AQ3) and Patenga (AQ2) respectively. The average values measured were in the range of 24.7 - 31.2 µg/m<sup>3</sup>. The 98 percentile values ranged from 31.1 - 43.7 µg/m<sup>3</sup>.</p>	<div><p>Concentration of NO<sub>x</sub> in the study area</p><table><caption>NO<sub>x</sub> Concentration Data (µg/m<sup>3</sup>)</caption><thead><tr><th>Location</th><th>Min</th><th>Max</th><th>Average</th><th>98percentile</th></tr></thead><tbody><tr><td>AQ1</td><td>19.0</td><td>42.0</td><td>29.0</td><td>41.0</td></tr><tr><td>AQ2</td><td>19.0</td><td>44.0</td><td>31.0</td><td>43.0</td></tr><tr><td>AQ3</td><td>16.0</td><td>32.0</td><td>25.0</td><td>31.0</td></tr><tr><td>AQ4</td><td>18.0</td><td>36.0</td><td>26.0</td><td>35.0</td></tr></tbody></table></div>	Location	Min	Max	Average	98percentile	AQ1	19.0	42.0	29.0	41.0	AQ2	19.0	44.0	31.0	43.0	AQ3	16.0	32.0	25.0	31.0	AQ4	18.0	36.0	26.0	35.0
Location	Min	Max	Average	98percentile																								
AQ1	19.0	42.0	29.0	41.0																								
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AQ3	16.0	32.0	25.0	31.0																								
AQ4	18.0	36.0	26.0	35.0																								
6	Carbon Monoxide (CO)	<p>The CO concentration observed during the monitoring period ranged from 120 - 390 µg/m<sup>3</sup> at Doulatpur (AQ3) and Patenga (AQ2) respectively. The average concentration values ranged from 224.1 - 270.3 µg/m<sup>3</sup>. The 98 percentile values ranged from 286.2 - 387.0 µg/m<sup>3</sup>. All the observed CO values were found to be less than the prescribed 8 hour BNAAQS (10,000 µg/m<sup>3</sup>) at all the locations</p>	<div><p>Concentration of CO in the study area</p><table><caption>CO Concentration Data (µg/m<sup>3</sup>)</caption><thead><tr><th>Location</th><th>Min</th><th>Max</th><th>Average</th><th>98percentile</th></tr></thead><tbody><tr><td>AQ1</td><td>165.0</td><td>370.0</td><td>270.0</td><td>365.0</td></tr><tr><td>AQ2</td><td>165.0</td><td>390.0</td><td>265.0</td><td>385.0</td></tr><tr><td>AQ3</td><td>120.0</td><td>285.0</td><td>225.0</td><td>280.0</td></tr><tr><td>AQ4</td><td>135.0</td><td>290.0</td><td>235.0</td><td>285.0</td></tr></tbody></table></div>	Location	Min	Max	Average	98percentile	AQ1	165.0	370.0	270.0	365.0	AQ2	165.0	390.0	265.0	385.0	AQ3	120.0	285.0	225.0	280.0	AQ4	135.0	290.0	235.0	285.0
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Note: BNAAQS – 10000 µg/m<sup>3</sup>

## Implication

Long term data and primary baseline studies indicate that the ambient air quality of the area is generally good with most of the parameters within the prescribed standards except for particulate matter (PM) levels. Project related construction activities are likely to add on to the existing PM and dust levels in the area. During project operations, no major air emissions are envisaged however, use of primers, paints, coatings, abrasive blasting, use of DG sets, etc. may result in generation of particulate matter and dust.

### 4.1.12. Surface and ground water quality

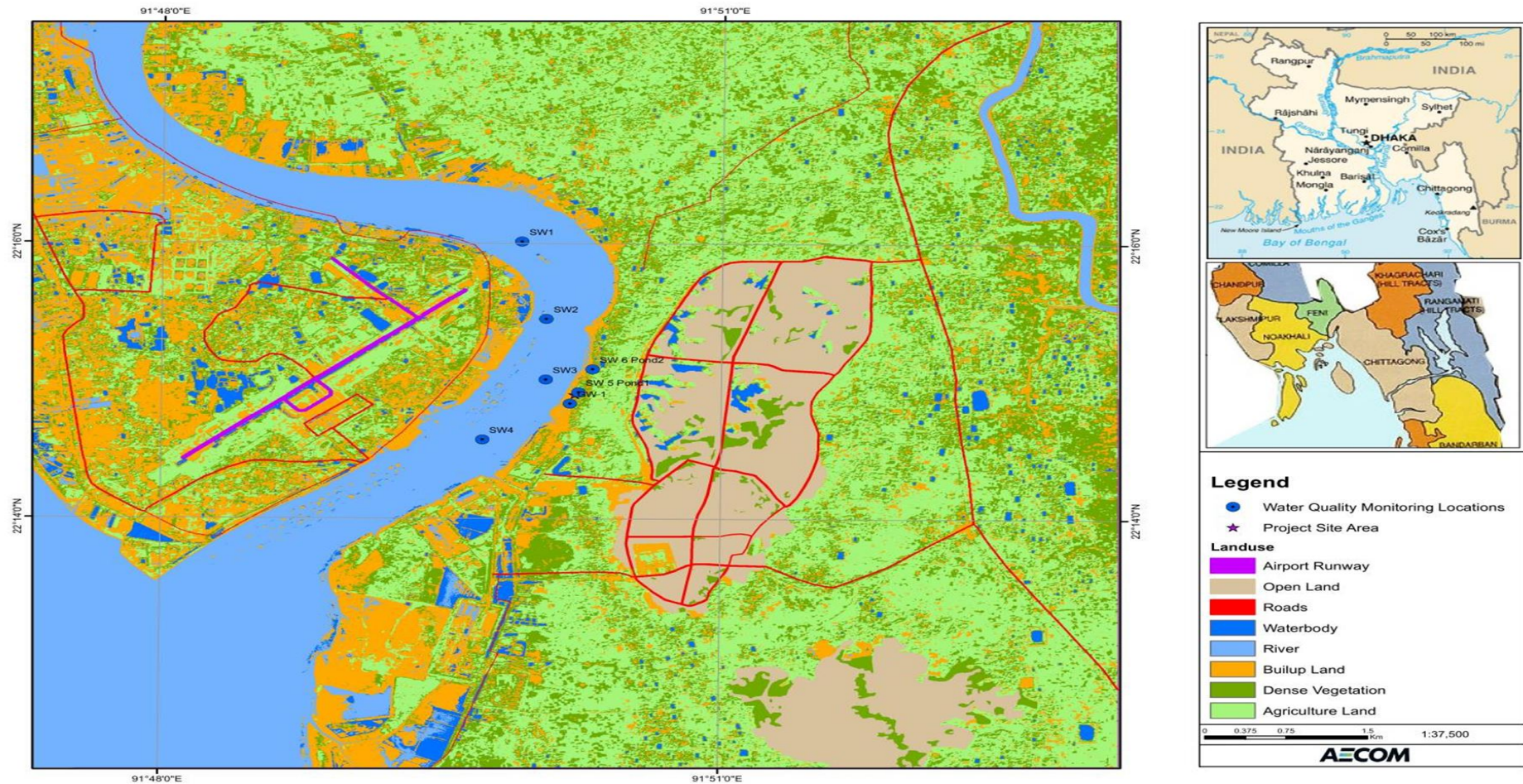
#### Primary Monitoring

Seven water samples were collected to assess the water quality of the study area. Samples of ground and surface water were examined for physico-chemical, heavy metals and biological parameters as per standard testing procedures. Four out of total six surface water samples were collected from various location of River Karnafuly along the project site and other two surface water samples were collected from stagnant pond water within the project village. One ground water sample was collected from tube well within the project site. Location details of the sampling locations are given in the following Table and Figure.

**Table 46: Details of Water Quality Monitoring Locations**

No.	Sampling Locations	Location Code	Geographical Location	Sample
1.	River Karnafuly (Upstream of the project site)	SWQ 1	22°16'00.78"N 91°49'55.49"E	Surface Water
2.	River Karnafuly (Upstream of the project site)	SWQ 2	22°15'27.17"N 91°50'03.53"E	Surface Water
3.	River Karnafuly (Along the project site)	SWQ 3	22°15'00.70"N 91°50'03.48"E	Surface Water
4.	River Karnafuly (Downstream the project site)	SWQ 4	22°14'34.43"N 91°49'43.28"E	Surface Water
5.	Pond (at Badalpura Village)	SWQ 5	22°14'55.20"N 91°50'14.10"E	Surface Water
6.	Pond (at outer boundary of Badalpura Village)	SWQ 6	22°15'05.20"N 91°50'18.60"E	Surface Water
7.	Ground Water (from project site)	GWQ 1	22°14'50.24"N 91°50'11.43"E	Ground Water

Source: AECL



Source: ESIA Study of Karnafuly Dry Dock by AECOM



Tables below present the results of analysis of the surface and ground water samples, which are compared with Standards for Inland surface and drinking water as prescribed under Schedule-3 of ECR, 1997.

**Table 47: Results of Inland Surface Water Quality Analysis**

S. N.	Parameters	River Karnafuly				Pond Water	
		SWQ 1	SWQ 2	SWQ 3	SWQ 4	SWQ 5	SWQ 6
1.	pH	7.0	7.0	7.0	7.0	6.0	6.0
2.	Temperature (in ° C)	24	26	23	24	25	24
3.	Conductivity (in µs/cm)	1670	1560	1710	1825	825	735
4.	Turbidity (in NTU)	88	44.8	32	37.5	43.1	10.4
5.	Color	Colorless	Colorless	Colorless	Colorless	Slight	Slight Orange
6.	Alkalinity (in mg/l)	60	60	60	70	20	80
7.	TDS (in mg/l)	810	780	840	870	420	390
8.	TSS (in mg/l)	67	66	69	58	19	16
9.	Salinity (in mg/l)	8500	8200	8400	8600	<100	<100
10.	Oil and Grease (in	0.06	0.05	0.08	0.03	0.034	0.25 mg/l)
11.	DO (in mg/l)	4.5	4.7	4.5	4.6	4.4	5.1
12.	Chlorides (in mg/l)	4120	3976	4060	4250	29	24
13.	Total Hardness (in	700	1360	1320	1200	180	70 mg/l)
14.	Calcium (in mg/l)	90.6	92.9	86.6	97.6	9.7	9.4
15.	Magnesium (in mg/l)	23.0	23.0	23.0	23.3	3.4	2.9
16.	Sulphate (in mg/l)	533	800	666	533	8	3
17.	Fluorides (in mg/l)	0.9	0.5	<0.2	0.3	0.8	1
18.	Nitrate (in mg/l)	35.36	35.36	33.15	37.57	45.96	42.43
19.	Iron (in mg/l)	1.43	0.86	1.11	0.95	2.43	2.6
20.	COD (in mg/l)	22.9	14.8	17.2	21.2	36.11	28.29
21.	BOD (in mg/l)	5.3	4.8	3.9	7.2	8.4	6.4
22.	Ammonia (in mg/l)	0.86	0.78	0.94	0.74	2.92	7.3
23.	Phosphate (in mg/l)	<0.07	<0.07	<0.07	<0.07	0.24	0.4
24.	Copper (in mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25.	Mercury (in mg/l)	BDL	BDL	BDL	BDL	<0.01	<0.01
26.	Barium (in mg/l)	0.031	0.026	0.024	0.051	0.074	0.084
27.	Cadmium (in mg/l)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
28.	Arsenic (in mg/l)	0.007	0.005	<0.003	<0.003	<0.003	<0.003
29.	Lead (in mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
30.	Zinc (in mg/l)	0.01	0.009	<0.005	<0.05	<0.005	<0.005
31.	Chromium (in mg/l)	0.08	0.05	0.08	0.08	0.09	<0.02
32.	Manganese (in mg/l)	0.1	0.1	0.1	0.1	<0.1	0.2
33.	Total Coliform (in mg/l)	36	10	38	34	32	>160
34.	Faecal Coliform (in	10	6	16	12	4	>120 mg/l)
35.	Chlorophyll (in mg/l)	16.02	26.7	18.6	16.02	93.45	37.38

Source: AECL Lab Results

**Table 48: Results of Ground Water Quality Analysis**

S.N.	Parameters	(Drinking Water)	GWQ 1
1.	pH	6.5 – 8.5	6.0
2.	Temperature (in ° C)	20-30° C	22
3.	Conductivity (in µs/cm)	--	800
4.	Turbidity (in NTU)	10	1.5
5.	Color	15 Hazen	Colorless
6.	Alkalinity (in mg/l)	--	40
7.	TDS (in mg/l)	1000 mg/l	430

S.N.	Parameters	(Drinking Water)	GWQ 1
8.	TSS (in mg/l)	10 mg/l	4
9.	Salinity (in mg/l)	--	500
10.	Oil and Grease (in mg/l)	0.01 mg/l	<0.01
11.	Chlorides (in mg/l)	150-600 mg/l	237
12.	Total Hardness (in mg/l)	200-500 mg/l	240
13.	Calcium (in mg/l)	75 mg/l	27.5
14.	Magnesium (in mg/l)	30-35 mg/l	9.8
15.	Sulphate (in mg/l)	400 mg/l	31
16.	Fluorides (in mg/l)	1.0 mg/l	<0.2
17.	Nitrate (in mg/l)	10 mg/l	57.46
18.	Iron (in mg/l)	0.3-1.0 mg/l	<0.05
19.	COD (in mg/l)	4 mg/l	1.2
20.	BOD (in mg/l)	0.2 mg/l	0.6
21.	Ammonia (in mg/l)	0.5 mg/l	1.14
22.	Phosphate (in mg/l)	6 mg/l	<0.07
23.	Copper (in mg/l)	1 mg/l	<0.01
24.	Mercury (in mg/l)	0.001 mg/l	BDL
25.	Barium (in mg/l)	--	0.017
26.	Cadmium (in mg/l)	0.005 mg/l	<0.002
27.	Arsenic (in mg/l)	0.05 mg/l	<0.003
28.	Lead (in mg/l)	0.05 mg/l	<0.05
29.	Zinc (in mg/l)	5 mg/l	<0.005
30.	Chromium (in mg/l)	0.05 mg/l	<0.02
31.	Manganese (in mg/l)	0.1 mg/l	0.3
32.	Total Coliform (in n/100 ml)	0	40
33.	Faecal Coliform (in n/100 ml)	0	26
34.	Chlorophyll (in mg/l)	--	<10.0

Source: AECL Lab Results

## Inference

The summary of inferences of the analysis of the inland surface water and ground water samples results are presented in the following Table.

**Table 49: Summary of Analysis**

Parameters	Observations & Inferences
<b>Inland Surface Water</b>	<p><b>River Karnafuly:</b></p> <ol style="list-style-type: none"> <li>Four samples from various locations of River Karnafuly (2 from upstream, 1 adjacent to the project site and 1 sample from downstream) were collected and analyzed for various water parameters;</li> <li>The pH value of the river samples was observed to maintain a constant value of 7.0 indicating neutral balance;</li> <li>BOD values in the samples ranged from 3.9 to 7.2 mg/l indicating presence of organic waste in the river water samples;</li> <li>The Dissolved Oxygen in all the water samples were observed to be in the range of 4.5 – 4.7 mg/l suggesting the aquatic life in these water samples are under stress;</li> <li>Total and Fecal coliforms numbers were observed in higher numbers in the water samples collected from downstream location and along the project site. Presence of Total and Fecal coliforms numbers in the water samples indicates the Fecal contamination which can be sourced to wastes from humans and other animals either through improper discharge of sewage from neighboring human settlement into river water or discharge of sewage and wastes from boats and other river vessels navigating in this River;</li> </ol>



Parameters	Observations & Inferences
	<p>6. The river water samples were observed to be very turbid with turbidity in the range of 32-88 NTU indicating silt and clay deposition or particulates from sewage wastes;</p> <p>7. Conductivity value in the river water samples ranged from 1560 to 1825 <math>\mu\text{S}/\text{cm}</math>;</p> <p>8. Conductivity being measurement of the ability of an aqueous solution to carry an electrical current, indicates presence of ions in the water samples;</p> <p>9. The Chloride content in the river samples ranged from 3976-4250 mg/l;</p> <p>10. Literature reviews suggests that criteria for protection of aquatic life requires levels of Chlorides in the range of 600 mg/l (for long-term exposure) to 1200 mg/l (for short-term exposure) which implies that River Karnafuly does not support healthy aquatic species;</p> <p>11. Hardness in these water samples ranged from 700-1360 mg/l implying water from River Karnafuly to be very hard water;</p> <p>12. Calcium content in the water samples were observed to be in range of 86.6-97.6 mg/l; Calcium is also one of the contributors to hardness content thus, verifying the hardness values in these samples;</p> <p>13. Presence of Calcium in water samples can also be sourced to discharge of untreated sewage into River water;</p> <p>14. Sulphate content, a major contributor of Hardness in these water samples ranged from 533-800 mg/l;</p> <p>15. Presence of Sulphate again can be sourced to discharge of untreated sewage into River water;</p> <p>16. High content of Nitrates was observed in the water samples from River Karnafuly in the range of 33.1-37.5 mg/l;</p> <p>17. The major routes of entry of nitrogen into River Karnafuly can be municipal wastewater, septic tanks discharges and animal wastes (including birds and fish) etc.;</p> <p>18. Excessive concentrations of nitrogen containing compounds in water affects the aquatic life drastically;</p> <p>19. The water samples also show presence of Ammonia in all the samples indicating contamination due to bacteria, sewage and animal waste;</p> <p>20. Ammonia is reported to be toxic to fresh water organisms at concentrations ranging more than 0.5 mg/l;</p> <p>21. Toxic concentration of Ammonia is known to affect the growth rates of fishes including changes in tissues of gills;</p> <p>22. Iron content was observed to be present in the water samples in the range of 0.9-1.4 mg/l at two samples (both up and down stream samples);</p> <p>23. Presence of Iron concentration in water gives a bit of astringent taste to it and Iron in the form of Ferrous <math>\text{Fe}^{2+}</math> and Ferric <math>\text{Fe}^{3+}</math> ions are of concern for the aquatic environment;</p> <p>24. Concentration of heavy metals such as Arsenic and Chromium were observed to be present in the River samples indicating possible contamination due to heavy metals;</p> <p>25. Samples from River Karnafuly shows presence of all the parameters which indicate major contamination due to untreated sewage impacting the health of aquatic life;</p> <p>26. Therefore, based on the best practice classification of Inland Water samples (as per ECR, 1997), the water samples from River Karnafuly cannot be classified into any of the class of Inland Water.</p> <p><b>Pond Water:</b></p> <p>1. Pond water samples from two locations were collected and analyzed for various parameters; It was confirmed by the locals that they did not use the pond water for drinking purpose;</p> <p>2. The pH value of the river samples was observed to maintain a constant value of 6.0 indicating slightly basic characteristics;</p> <p>3. BOD values in the samples ranged from 6.4-8.4 mg/l indicating presence of organic waste in the water samples;</p> <p>4. The Dissolved Oxygen in all the water samples were observed to be in the range of 4.4-5.1 mg/l suggesting the aquatic life in these water samples are under stress;</p>

Parameters	Observations & Inferences
	<p>5. Presence of Total and Fecal coliforms numbers in the water samples indicates the Fecal contamination indicative of contamination due to wastes from humans and other animals through improper discharge of sewage;</p> <p>6. The pond water samples were observed to be very turbid due to presence of organic matter in the form of microorganism or sewage runoff;</p> <p>7. Iron content in the pond water samples were more than 2.0 mg/l indicating presence of Iron in the form of ferric iron (<math>Fe^{3+}</math>) which is insoluble upon exposure to air and thus causing slightly orange color in the water samples;</p> <p>8. The pond water samples were observed to contain high concentration of Ammonia and Nitrates;</p> <p>9. Presence of high Ammonia and Nitrate contents in water samples indicate contamination due to Human and animal waste, dead plant and food waste materials;</p> <p>10. The ponds within the vicinity of the project influenced village serves no purpose to the locals, these can be considered as reasonably deep depression causing stagnation of rain water and collection of sewage runoff which is indicated in the analysis of these samples;</p> <p>11. Therefore, based on the best practice classification of Inland Water samples (as per ECR, 1997); the pond water samples (SW5 and SW6) cannot be classified into any of the class of Inland Water.</p>
Ground Water	<p><b>Tube well at project site:</b></p> <p>1. Ground water at project site serves as drinking and other domestic usages;</p> <p>2. pH of the ground water sample was observed to slightly below the range prescribed for drinking water as per DoE Bangladesh;</p> <p>3. Chloride content was observed to be exceeding the desirable limit of 150 mg/l but was found to be within the permissible limit of 600 mg/l;</p> <p>4. Chloride though not harmful to humans, has a tendency to impart salty taste in water (Salinity content in the sample was observed to be 500 mg/l). Chlorides can corrode metals and affect the taste of food products;</p> <p>5. The Total Hardness content in the water sample classifies the water sample as hard water. Hard water is undesirable in drinking water mostly due to economic and aesthetic reasons;</p> <p>6. Presence of Ammonia (as <math>NH_3</math>) content in the water sample is an indicator of possible contamination due to bacteria, sewage and animal waste;</p> <p>7. The Ammonia content in the water sample was observed to very high and exceeding the DoE limit of 0.5 mg/l;</p> <p>8. Presence of Ammonia in drinking water causes nitrification which can be associated with the formation of Nitrates (<math>NO_3</math>) and Nitrites (<math>NO_2</math>);</p> <p>9. Possible Ammonia contamination can also arise from cement mortar lined pipe used for water distribution;</p> <p>10. Nitrate (as <math>NO_3</math>) content in the ground water sample was observed to present and in very high concentration indicating potential nitrate contamination;</p> <p>11. The Nitrate contamination in this sample can be linked to Human and animal waste, dead plant and food waste materials which can percolate directly into the shallow water table at site;</p> <p>12. High Nitrate content in drinking water can cause digestive disturbances in people which was also reported by the locals during consultations;</p> <p>13. Although Ammonia in drinking-water is not of immediate health relevance, it can cause failure of filters for the removal of Manganese and cause taste and odor problems;</p> <p>14. Biological Oxygen Demand (BOD) concentration is usually not found in ground water, however the BOD content exceeds the DoE prescribed limits for drinking water thus indicating presence of organic matter in the ground water;</p> <p>15. Manganese content in the water sample was observed to exceed the DoE Limit of 0.1 mg/l;</p> <p>16. Although Manganese in ground water can occur naturally by weathering of Manganese bearing minerals and rocks, effluent and sewage contamination can also cause Manganese contamination of ground water;</p>

Parameters	Observations & Inferences
	<p>17. High concentration of Manganese in water sample can cause staining of plumbing fixtures and laundry;</p> <p>18. The presence of Total and Fecal coliforms numbers in the ground water samples indicates the water sample is contaminated with Fecal matter of humans and other animals which includes many other pathogens and disease producing bacteria and viruses;</p> <p>19. The presence of fecal contamination is an indicator that a potential health risks such as typhoid fever, viral and bacterial gastroenteritis exists for individuals exposed to this water;</p> <p>20. Presence of Ammonia, Nitrate, BOD, Manganese and Fecal content in the ground water sample at this site indicate contamination due to percolation of sewage and domestic waste into ground water;</p> <p>Therefore, it is recommended to treat the water in a RO system before using for drinking and other domestic purpose.</p>

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The graphical representation of the concentration of various parameters in the water samples is illustrated in the Figures below:

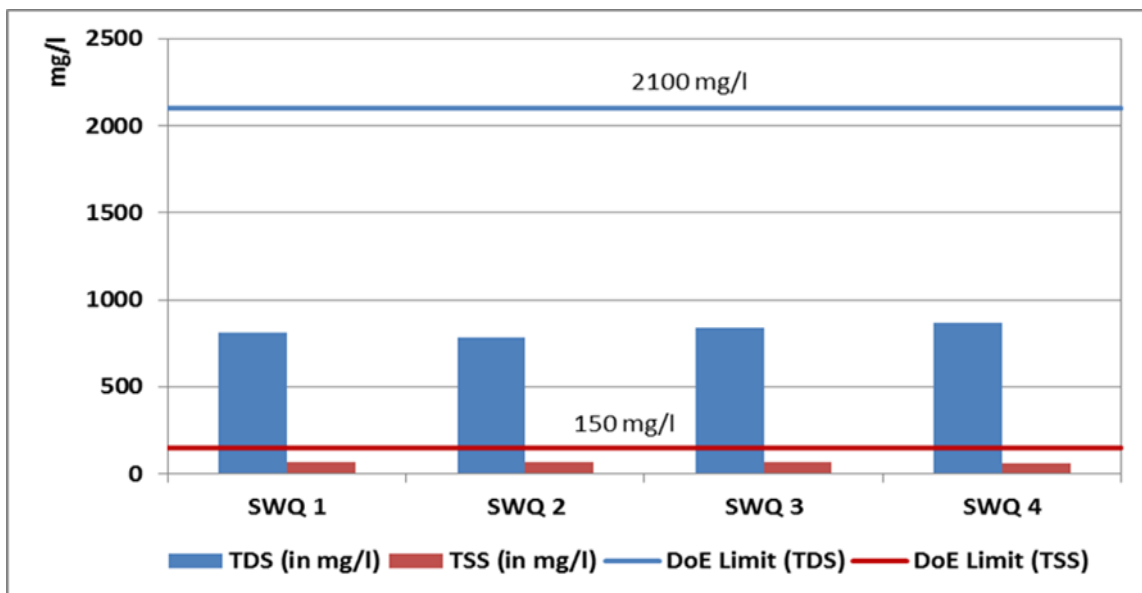
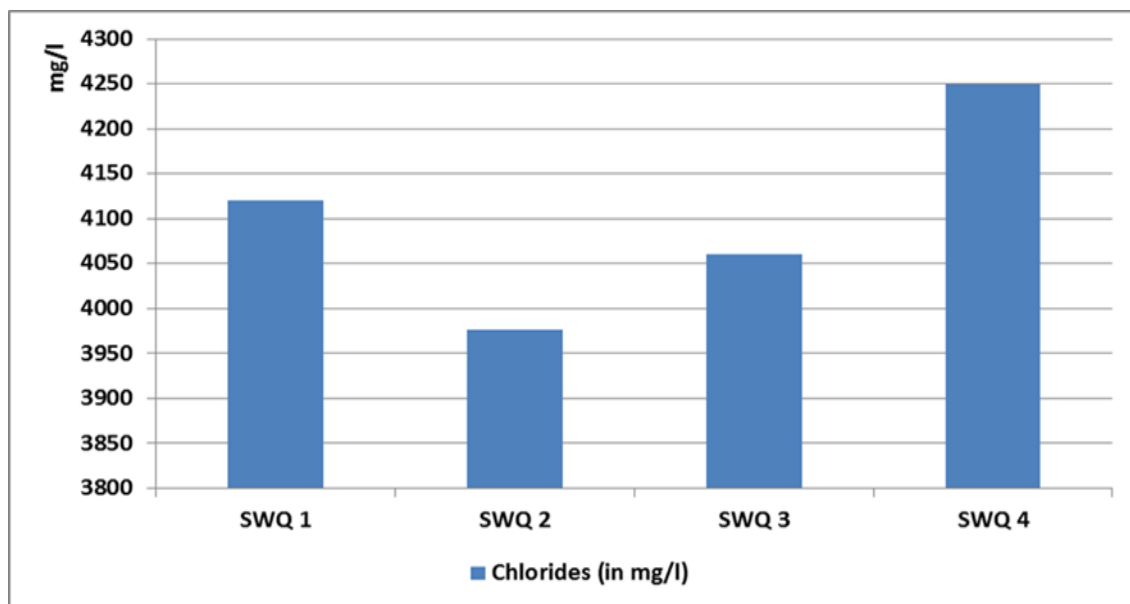


Figure 46: Graphical representation of TDS and TSS in River Samples

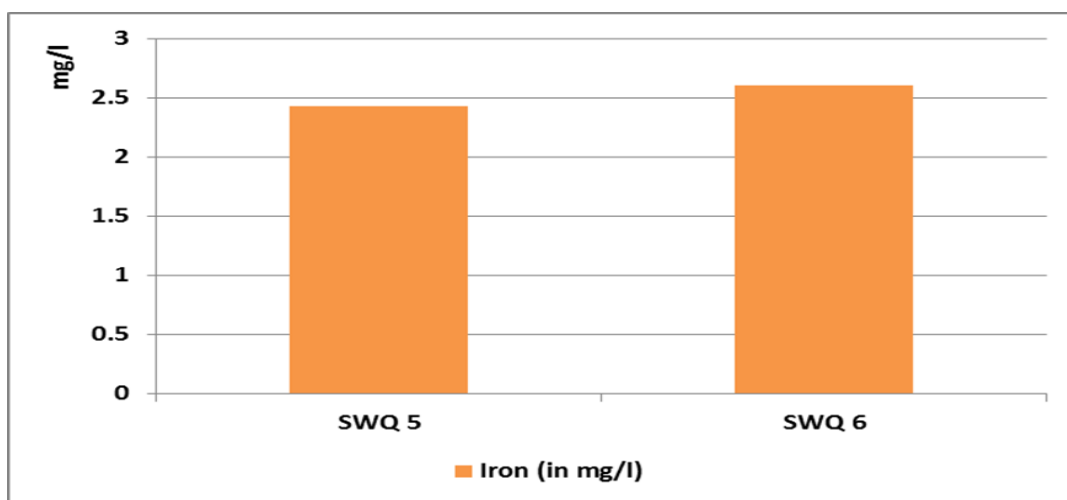
Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 47:** Graphical representation of concentration of Chlorides in River samples

Source: ESIA Study of Karnafuly Dry Dock by AECOM

**Note:** 600 mg/l- DoE Limit (Chloride)/Protection criteria for aquatic life (Long term exposure) 1200 mg/l- Protection criteria for aquatic life (Short term exposure)



**Figure 48:** Graphical representation of Iron content in the pond water Samples

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Implication

Testing of water samples collected from the Karnafuly River and samples taken from bore well at project site during primary baseline monitoring indicate major contamination due to untreated sewage and wastewater discharge from industrial operations along the river banks. Based on the best practice classification of Inland Water samples (as per ECR, 1997), the water samples from River Karnafuly cannot be classified into any of the class of Inland Water. Therefore, appropriate mitigation measures need to be adopted by KDDSEZL.

#### 4.1.13. Soil and sediment quality

##### Primary Monitoring

The soil quality of the study area and Karnafuly river sediment quality was evaluated and samples from three locations were collected and analyzed to determine the same. According to the general soil map of Bangladesh, the study area is majorly covered with Grey Piedmont Soil with patches of deep brown and red soils of low hills. The project site is presently reclaimed with dredged soil sediments which were observed to be grey in color. The details of the soil and sediment sampling locations are given in the Table and Figure below.

**Table 50: Details of the Soil sampling locations**

Sample Code	Geographical Co-ordinates	Name of the Location
<b>Soil Samples</b>		
SoQ-1	22°15'10.41"N 91°50'20.97"E	Shamirpura village (north of site)
SoQ-2	22°13'35.55"N 91°49'54.33"E	KEPZ site (south east of project site)
SoQ-3	22°14'43.76"N 91°50'11.79"E	Badalpura village (east of site)
<b>Sediment Samples</b>		
SeQ-1	22°15'35.91"N 91°50'25.40"E	Karnafuly river along project site
SeQ-2	22°15'00.46"N 91°50'11.23"E	
SeQ-3	22°14'43.70"N 91°50'01.09"E	

Source: AECL



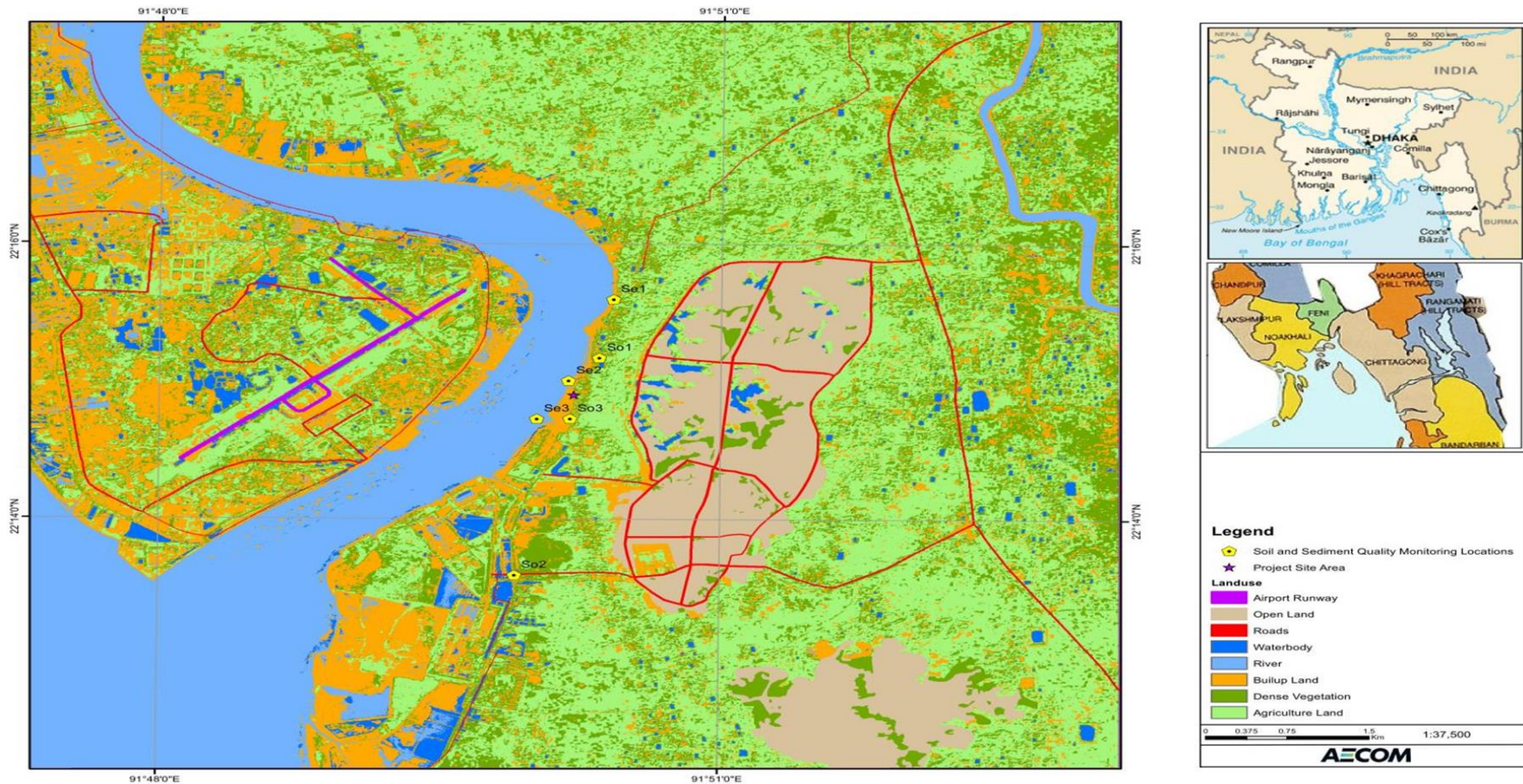


Figure 49: Soil and Sediment Quality Monitoring Locations

Source: ESIA Study of Karnafuly Dry Dock by AECOM



The soil samples were analyzed for various physical and chemical parameters of soil and the results of the soil quality analysis are given in the Table below.

**Table 51: Results of the Soil Quality Analysis**

S. N	Parameters	SoQ-1	SoQ-2	SoQ-3
1.	Particle Size Distribution			
	I) Sand, %	52	80	50
	II) Silt, %	18	05	20
	III)Clay, %	30	15	30
2.	pH	5.5	5.6	5.2
3.	Electrical Conductivity, $\mu\text{S}/\text{cm}$	28.5	20.1	52.5
4.	Cation Exchange Capacity, $\text{cmol}/\text{kg}$	4.8	2.9	6.8
5.	Nitrites, $\text{mg}/\text{kg}$	0.9	Nil	1.5
6.	Nitrates, $\text{mg}/\text{kg}$	12.4	7.4	12.4
7.	Phosphates, $\text{mg}/\text{kg}$	8.8	3.3	15.6
8.	Iron (Fe), %	1.3	1.3	1.4
9.	Manganese (Mn), $\text{mg}/\text{kg}$	228	180	209
10.	Copper (Cu), $\text{mg}/\text{kg}$	4.8	4.2	6.4
11.	Zinc (Zn), $\text{mg}/\text{kg}$	28.6	59.2	50.3
12.	Lead (Pb), $\text{mg}/\text{kg}$	8.0	5.8	8.8
13.	Cadmium (Cd), $\text{mg}/\text{kg}$	0.2	0.2	0.3
14.	Chromium (Cr), $\text{mg}/\text{kg}$	7.6	6.0	7.6
15.	Nickel (Ni), $\text{mg}/\text{kg}$	9.6	8.8	11.1
16.	Barium (Ba), $\text{mg}/\text{kg}$	88.0	50.0	100.8
17.	Arsenic (As), $\text{mg}/\text{kg}$	1.2	1.1	1.2
18.	TOC (Total Organic Carbon), $\text{mg}/\text{kg}$	4.6	5.3	3.7
19.	TPH (total petrochemical hydrocarbon), $\text{mg}/\text{kg}$	1.7	2.1	0.9
20.	Mercury (Hg), $\text{mg}/\text{kg}$	0.014	0.024	0.034
21.	Permeability or Hydraulic Conductivity, $\text{cm}/\text{s}$	$1.54 \times 10^{-3}$	$4.65 \times 10^{-3}$	$2.43 \times 10^{-3}$
22.	Porosity, %	15	18	16

Source: AECL Lab Results

**Table 52: Results of the Sediment Quality Analysis**

S. N	Parameters	SoQ-1	SoQ-2	SoQ-3
1.	Particle Size Distribution			
	I) Sand, %	5	8	27
	II) Silt, %	80	80	58
	III)Clay, %	15	12	15
2.	pH	6.8	6.9	6.9
3.	Electrical Conductivity, $\mu\text{S}/\text{cm}$	1720	1655	1637
4.	Nitrites, $\text{mg}/\text{kg}$	Nil	0.9	3.5
5.	Nitrates, $\text{mg}/\text{kg}$	4.4	7.4	13.3
6.	Phosphates, $\text{mg}/\text{kg}$	14.1	3.2	2.6
7.	Chlorides, %	0.2	0.2	0.2
8.	Iron (Fe), %	2.2	2.3	3.0
9.	Manganese (Mn), $\text{mg}/\text{kg}$	328	582	522
10.	Copper (Cu), $\text{mg}/\text{kg}$	16.1	15.6	19.8
11.	Zinc (Zn), $\text{mg}/\text{kg}$	54.2	55.6	59.3
12.	Lead (Pb), $\text{mg}/\text{kg}$	8.0	5.8	8.8
13.	Cadmium (Cd), $\text{mg}/\text{kg}$	0.7	0.5	0.6
14.	Chromium (Cr), $\text{mg}/\text{kg}$	20.4	21.6	22.1
15.	Nickel (Ni), $\text{mg}/\text{kg}$	26.4	35.9	38.3
16.	Barium (Ba), $\text{mg}/\text{kg}$	209.8	145.4	212.0

S. N	Parameters		SoQ-1	SoQ-2	SoQ-3
17.	Arsenic (As), mg/kg		2.2	2.4	2.1
18.	TPH (Total Petrochemical Hydrocarbon), mg/kg		0.5	0.6	0.4
19.	Mercury (Hg), mg/kg		<0.001	0.04	0.014
20.	Bulk Density, g/cm <sup>3</sup>		1.3	1.4	1.4
21.	Water Holding Capacity, % by Volume	At Field Capacity	33	31	33
		Maximum	48	48	45

Source: AECL Lab Results

Bangladesh does not have any specific concentration based soil contamination standards. In absence of any existing standards for safe heavy metal contents, Dutch standards have been considered for the purpose of analysis. The Table below presents the soil remediation intervention values as per Dutch standards.

**Table 53: Soil Remediation Intervention Values as per Dutch Standards**

Parameter	Intervention Values (mg/kg dry matter)
Zinc	720
Arsenic	76
Lead	530
Cadmium	13
Copper	190
Mercury	36

Source: Soil Remediation Circular 2009, Minister of Housing, Spatial Planning and Environment, Netherlands

## Inference

The summary of inference of the analysis of the soil and sediment sampling results are presented in the following the Table.

**Table 54: Summary of Analysis**

S.N.	Aspect	Observations & Inferences
1.	Soil Quality	<ol style="list-style-type: none"> <li>1. pH of the soils samples ranged from 5.2-5.6, showing moderately acidic in nature; Electrical conductivity of the soil samples range from 20.1-52.5 <math>\mu\text{S}/\text{cm}</math> indicating highly saline soils which can be injurious to crops;</li> <li>2. Cation Ion Exchange capacity values ranged from 2.9 to 6.8 <math>\text{cmol}/\text{kg}</math>;</li> <li>3. Zinc and Arsenic values range between 28.6 to 59.2 <math>\text{mg}/\text{kg}</math> and 1.1 to 1.2 <math>\text{mg}/\text{kg}</math> respectively;</li> <li>4. Copper and Lead values range between 4.2 to 6.4 <math>\text{mg}/\text{kg}</math> and 5.8 to 8.8 <math>\text{mg}/\text{kg}</math> respectively;</li> <li>5. Cadmium values were observed to be in the range of 0.2 to 0.3 <math>\text{mg}/\text{kg}</math>;</li> <li>6. The total organic carbon was observed to be very low in the range of 3.7 to 5.3 <math>\text{mg}/\text{kg}</math>;</li> <li>7. Iron content in the soil samples ranged from 1.3 to 1.4%;</li> <li>8. The observed values for metals viz., Zinc, Arsenic, Lead, Cadmium, Copper and Mercury are much below the soil remediation intervention values specified in Soil Remediation Circular 2009.</li> </ol>
2.	Sediment Quality	<ol style="list-style-type: none"> <li>1. pH of the sediment samples ranged from 6.8-6.9, showing Normal characteristics;</li> <li>2. Although the Bulk density values of the sediment samples ranged from 1.3 to 1.4 <math>\text{g}/\text{cm}^3</math> indicating ideal bulk density for plant growth with Silty soil texture, the Electrical conductivity of the sediment samples ranging from 1655 to 1720 <math>\mu\text{S}/\text{cm}</math> indicating high salinity;</li> <li>3. Zinc and Arsenic values range between 54.2 to 59.3 <math>\text{mg}/\text{kg}</math> and 2.1 to 2.4 <math>\text{mg}/\text{kg}</math> respectively;</li> </ol>

S.N.	Aspect	Observations & Inferences
		<p>4. Copper and Lead values range between 15.6 to 19.8 mg/kg and 5.8 to 8.8 mg/kg respectively;</p> <p>5. Cadmium values were observed to be in the range of 0.5 to 0.7 mg/kg; 6. Iron content was found to be in the range of 2.2 to 3.0 %;</p> <p>6. The observed values for metals viz., Zinc, Arsenic, Lead, Cadmium, Copper and Mercury are much below the soil remediation intervention values specified in Soil Remediation Circular 2009.</p>

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The Texture Triangle below illustrates the texture of soil and sediment samples collected;

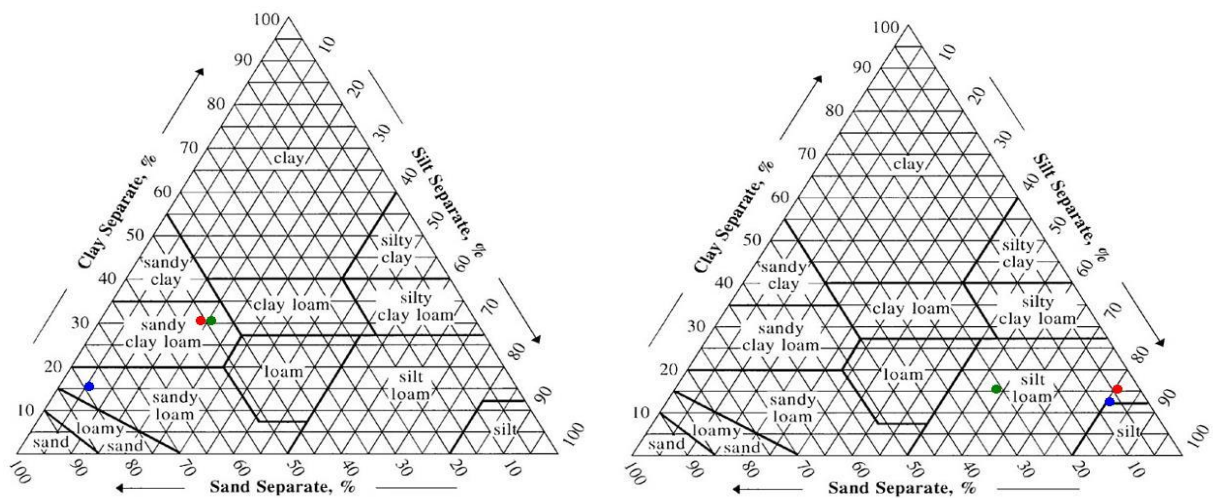


Figure 50: Soil and Sediment Samples Texture Triangle

### Implication

Primary baseline assessment of soil and sediment quality in and around the project area and review of related secondary studies do not indicate any type of contamination. However improper management of activities related to the proposed development such as reclamation of project site, operation of machinery and equipment, generation of solid and hazardous waste, etc. is likely to result in contamination of soil quality in the area.

#### 4.1.14. Noise quality

##### Primary Monitoring

Sound pressure levels (SPL) measurements were recorded at four locations. The readings were taken using Lutron Sound Level Meter (Model – 4010) an ANSI-2 standardized device; continuously for 24 hours for every hour for 24 hours. The day noise levels have been monitored during 6 am to 9 pm and night noise levels during 9 pm to 6 am at all the sampling locations within the study area. The sampling locations can be categorized as Industrial area since the study area is surrounded by many operational industries. Therefore, the results of the ambient noise level monitoring presented in the Table are compared with DoE noise

limits for day time and night time for residential area. The details of noise monitoring locations are provided in the Table and shown in the Figure below.

**Table 55: Details of the noise quality monitoring locations**

Sample Code	Geo-graphical Coordinates	Sampling Location
NQ-1	22°14'49.18"N 91°50'10.22"E	Badalpura (Within the project site)
NQ-2	22°15'38.75"N 91°49'49.73"E	Patenga (200 m from Patenga Road)
NQ-3	22°16'05.12"N 91°51'56.20"E	Daulatpur (150 m from Chittagong-Anwara Road)
NQ-4	22°13'56.05"N 91°52'05.99"E	Anwara (15 m Anwara Village Road)

*Source: AECL*



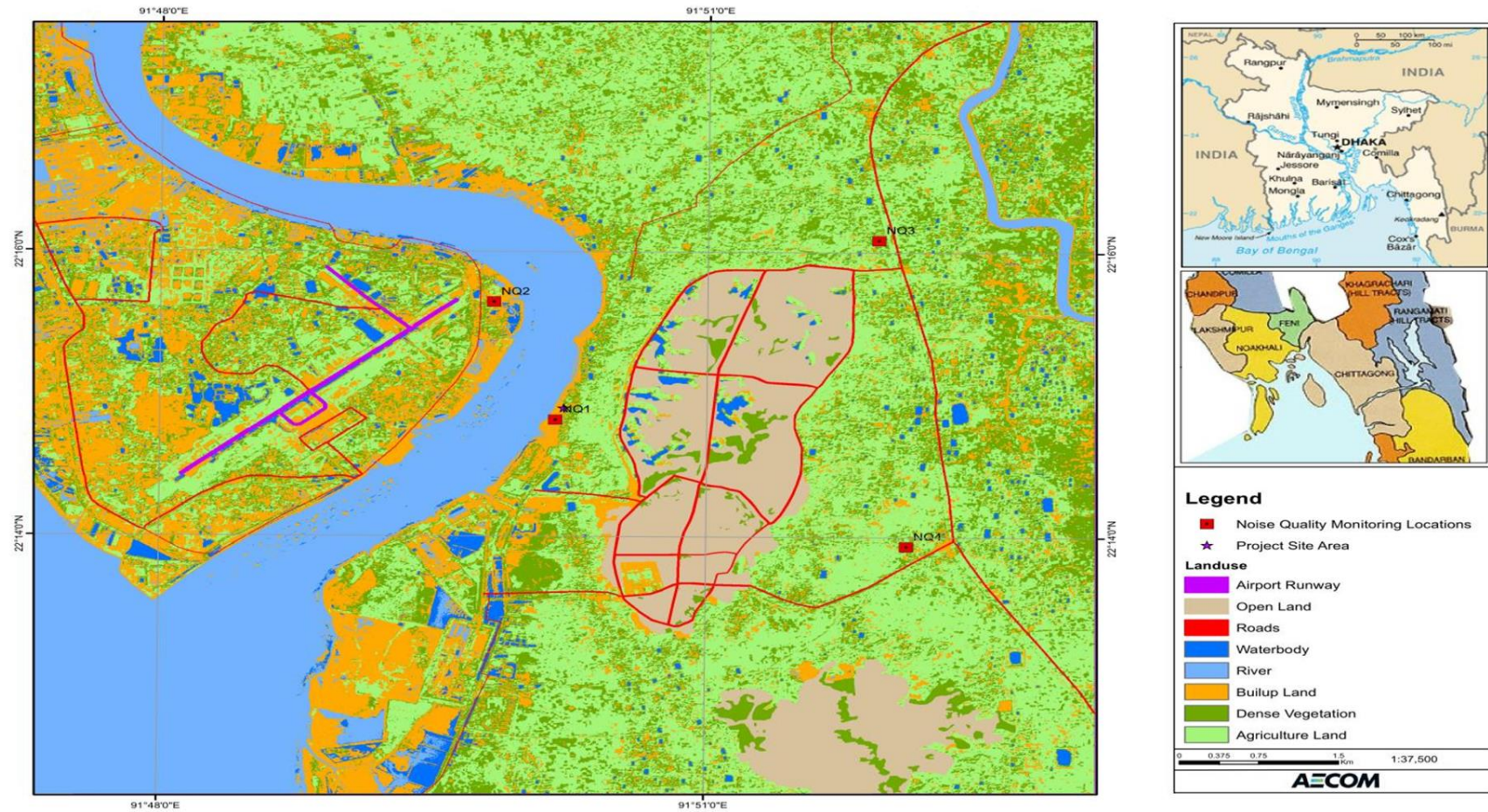


Figure 51: Noise Quality Monitoring Locations

Source: ESIA Study of Karnafuly Dry Dock by AECOM

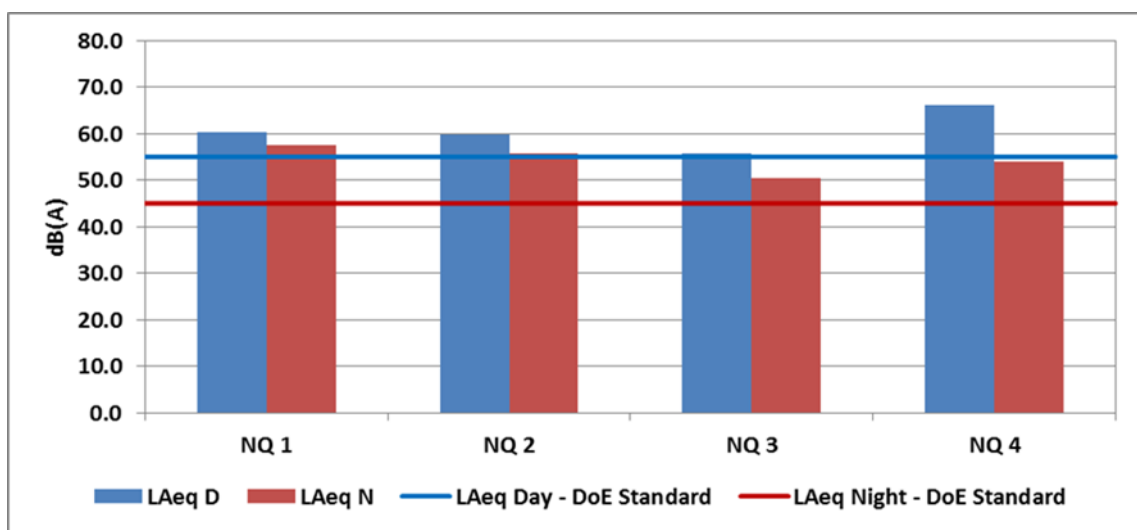
**Table 56: Results of Noise level monitoring**

Location Code	DoE Standard(Residential Area)	NQ-1	NQ-2	NQ-3	NQ-4
LAeq Day dB (A)	55	60.2	59.7	55.8	66.1
LAeq Night dB (A)	45	57.5	55.6	50.3	53.8

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Inference

It is observed that the noise levels at the receptor locations ranged from 55.8 to 66.1 dB (A) during the daytime and 50.3 to 57.5 dB (A) during night time. The baseline noise levels at all the sampling locations were found to exceed the prescribed noise standards of DoE for Residential Area. The day and night time noise levels are graphically presented in the Figure below.



**Figure 52: Noise Levels monitored in the study area**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The day and night time monitored noise levels exceeds the prescribed standards at the project site owing to the temporary small ship building and construction works being taken place by Karnafuly Ship Builders within the project land.

All the other monitoring locations are located within the vicinity of the major communication roadways in the study area which witnesses a huge number of heavy vehicle traffic majorly during the night time and other commercial vehicles during the day time due to the presence of number of Factories and Industries may also be leading to increase in baseline noise levels which exceeds the prescribed norms for residential area.

#### 4.1.15. Traffic volume

##### Existing Traffic on Karnafuly River

The width of the navigational channel on the Karnafuly River (5.49 m contour) varies from place to place along the channel. A minimum of about 250m channel width is maintained by the Chittagong Port Authority.

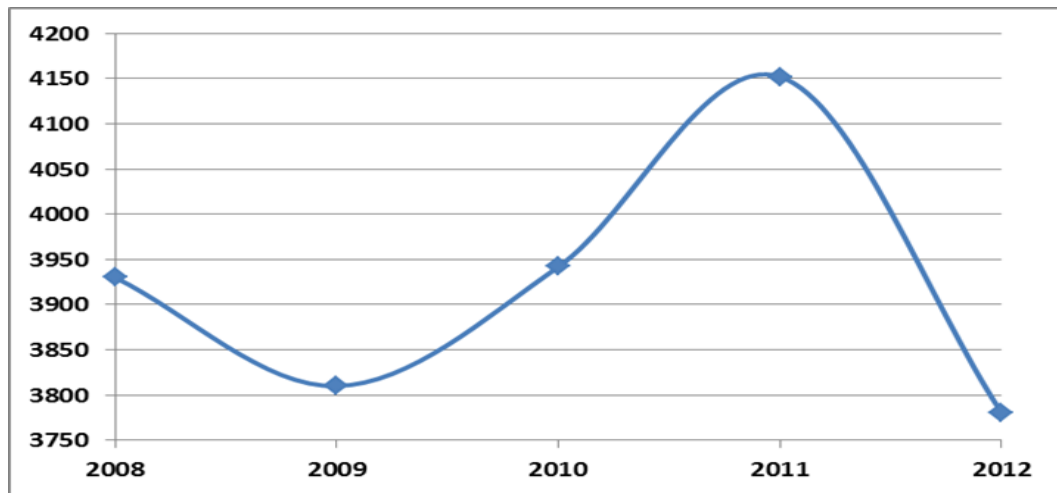


According to river vessel traffic data in Karnafuly river during the past five years, the number of incoming and outgoing vessels of draft between 8 m to 9.2 m range from 3780 (in year 2012) to 4152 (in year 2011). The number of incoming and outgoing vehicles in River Karnafuly is detailed in the Table below. The river traffic data illustrates a sudden decrease in the number of vehicles from year 2011 to year 2012 (the lowest number in past 5 years); hence indicating a decreasing trend in the river traffic.

**Table 57: River traffic details of Karnafuly River**

S.N.	Year	Incoming	Outgoing	Total Vehicles
1.	2008	1983	1952	3930
2.	2009	1961	1894	3810
3.	2010	1979	1963	3942
4.	2011	2082	2070	4152
5.	2012	1875	1865	3780

Source: Chittagong Port Authority's naval department



**Figure 53: River Traffic Trend in Karnafuly River**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Primary Survey for River Traffic

River traffic survey was carried out along Karnafuly River for 24 hours once a month during the monitoring period at two locations to access the existing river traffic characteristics with respect to type and number of vessels travelling in River Karnafuly via project site. The details of the river traffic monitoring location have been provided in the following Table.

**Table 58: Traffic monitoring locations**

S.N	Traffic monitoring location	Location	Geo-graphical Co-ordinates	Date of Monitoring
1.	At project site	RTM1	22°14'48.31"N 91°50'09.01"E	17-07-'14 & 18-08-'14
2.	Near KDDSEZL's cold storage building	RTM2	22°19'22.24"N 91°49'23.66"E	16-07-'14 & 17-08-'14

Source: ESIA Study of Karnafuly Dry Dock by AECOM

River traffic count has been sub-divided into the following categories:

- I. Oil Tankers;
- II. Goods Ships;

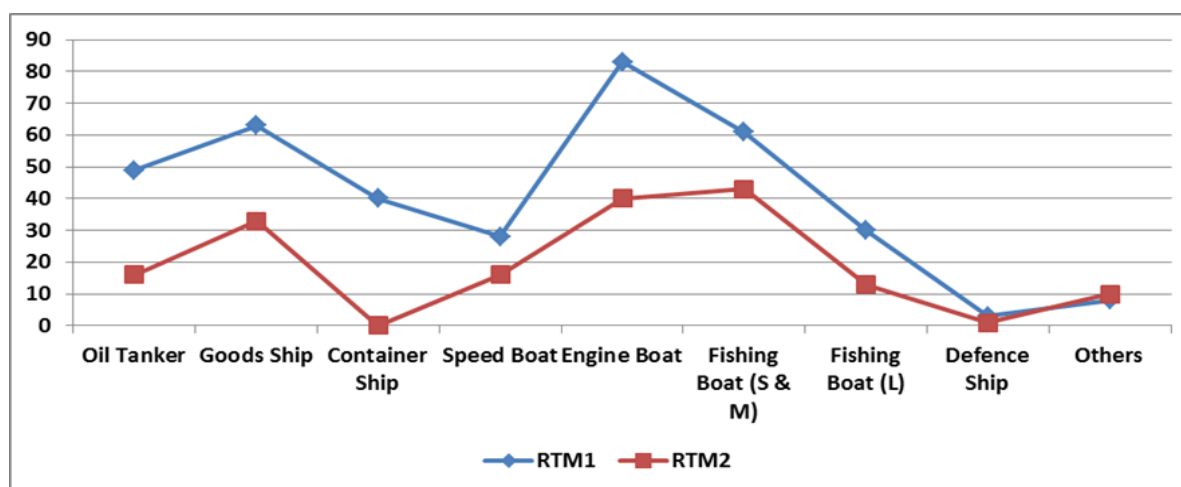
- III. Container Ships;
- IV. Speed Boats;
- V. Engine Boats;
- VI. Small and Medium Sized Fishing Boats; vii. Large Fishing
- VII. Defense Ships; and ix. Others

The average river traffic count at the monitoring locations has been tabulated in the Table below and represented individually for both upstream and downstream of the monitoring locations in the Figures.

**Table 59: Average river traffic count at the river traffic monitoring locations**

S.N.	Categories of River Vessels	RT		RT	
		Upstream	Downstream	Upstream	Downstream
1.	Oil Tanker	49	36	16	10
2.	Goods Ship	63	61	33	28
3.	Container Ship	40	35	0	0
4.	Speed Boat	28	23	16	17
5.	Engine Boat	83	74	40	41
6.	Fishing Boat (Small + Medium)	61	43	43	23
7.	Fishing Boat (Large)	30	17	13	5
8.	Defense Ship	3	3	1	2
9.	Others	8	8	10	13

Source: AECL Survey Results



**Figure 54: Average upstream river traffic count at the river traffic monitoring locations**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Observations

The river traffic monitoring locations were selected on the basis of location of the project site. One of the monitoring locations being the project site was considered to determine the upstream and downstream count of the river vessels coming from and going towards Bay of Bengal. The other location located near project area cold storage office was considered to determine the upstream and downstream count of river vessels mostly coming from and going towards Chittagong Port. The monitoring of the river vessel count was undertaken for 24 hours once a month during the monitoring period and averaged out for both the location.

It is observed that at upstream of RTM1; the engine boats carrying local passengers were the highest in number and at upstream of RTM2; the small and medium sized fishing boats were the highest. Similarly, the engine boats carrying local passengers were highest in number at downstream of both the monitoring locations. It was observed that the oil tankers and goods ships were in prominent numbers at both up and down stream of RTM1 than at RTM2. Also, no container ships were observed at both up and down stream of monitoring location RTM2.

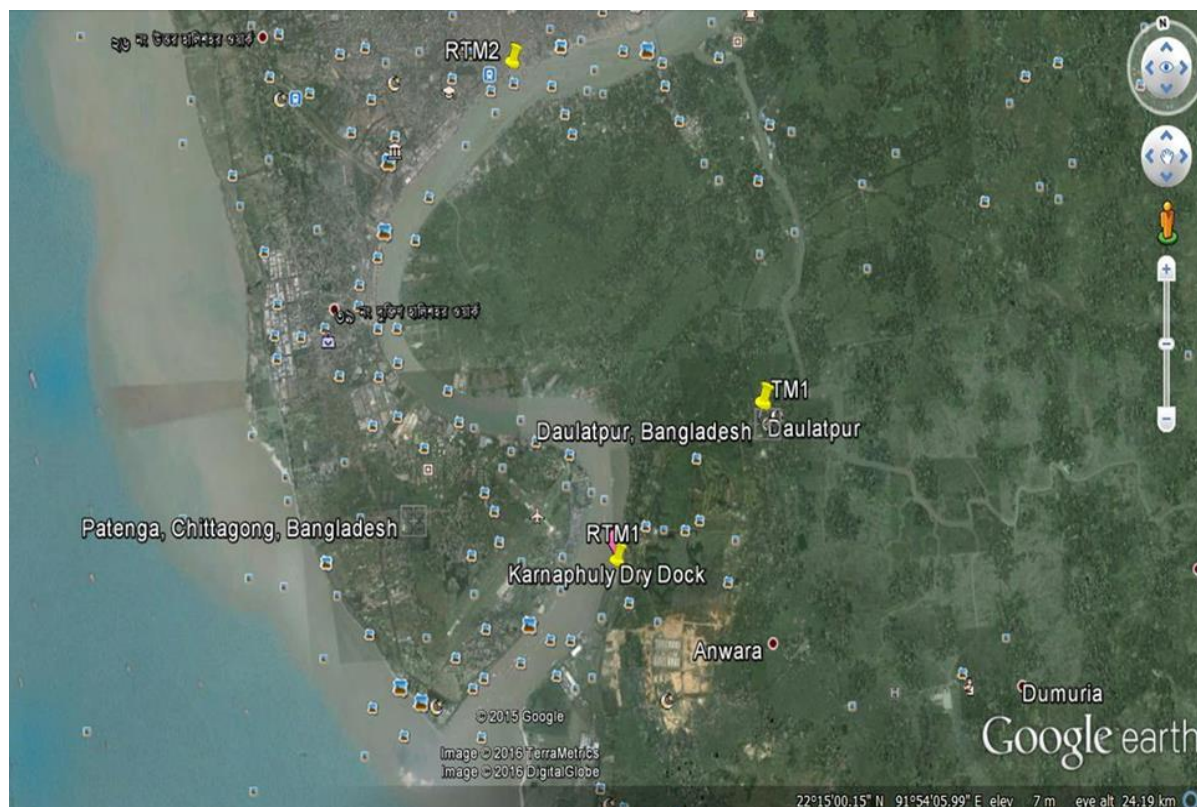
### Primary Survey for Road Traffic

Road traffic survey was carried out within the study area for 24 hours once during the monitoring period to assess the existing traffic characteristics with respect to type, category and number of vehicles plying on the road connecting the project site. The details of the traffic monitoring location have been provided in the following Table and shown in Figure.

**Table 60: Traffic monitoring locations**

Traffic monitoring location	Location ID	Geo-graphical Co-ordinates	Date of Monitoring
Chittagong – Anwara Road (Z1018)	TM 1	22°16'2.86"N 91°52'0.42"E	16-08-2014

*Source: ESIA Study of Karnaphuly Dry Dock by AECOM*



**Figure 55: River and Road Traffic Monitoring Locations**

Traffic counted has been subdivided into four categories/classes viz.:

- I. Trucks/Lorries;
- II. Bus/Minibus;
- III. Car/Jeep/Microbus; and
- IV. Motorcycle/Auto rickshaw

Since the vehicles are of different types, a factor needs to be accounted for each of them in order to express them at par in single unit terms. The factors, commonly known as Passenger Car Unit (PCU) factors that have been adopted are shown in the following Table.

**Table 61: Passenger Car Unit (PCU) factors in Bangladesh**

Vehicle Type	PCU Factor
Car	1.0
Bus	3.0
Truck	3.0
Auto Rickshaw	0.5
Bicycle	0.3
Rickshaw	1.0
Motor Cycle	0.3
Tempo	1.0
Bullock Card	4.0

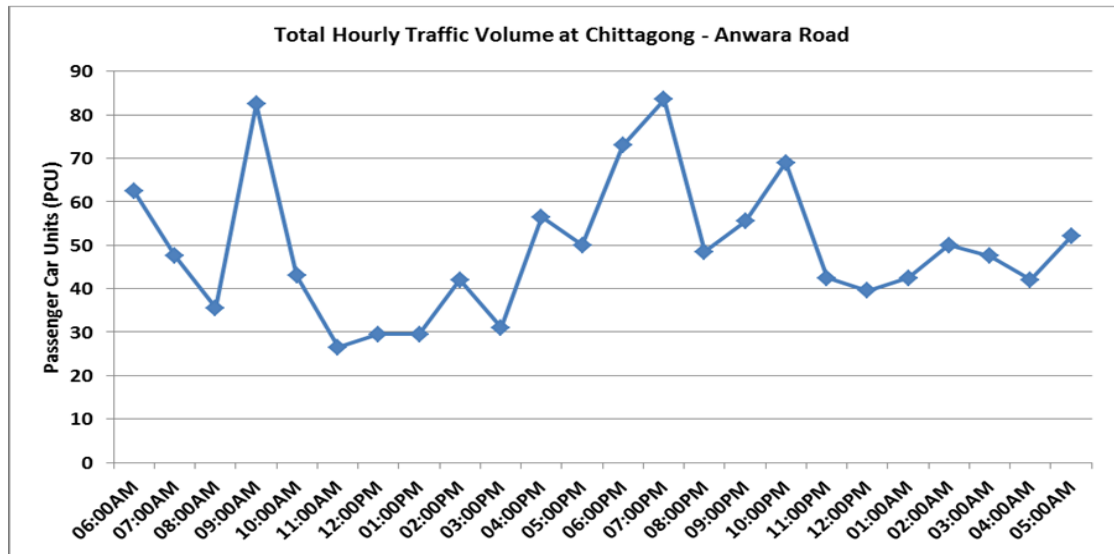
Source: Transport Research Laboratory (UK) Overseas Road Note 13

The traffic volume counts have been tabulated in the Table. The hourly traffic volume has been illustrated in the Figure.

**Table 62: Hourly Traffic Volumes at TM1**

Time	Truck/Lorries PCU / 10 min	Bus/Minibus PCU/10 min	Car/Jeep PCU/10 min	Motor-cycles/Auto PCU / 10 min	Total Hourly Traffic PCU / 10 min
06:00AM	39	9	4	10.5	62.5
07:00AM	21	12	3	11.5	47.5
08:00AM	12	9	1	13.5	35.5
09:00AM	18	36	7	21.5	82.5
10:00AM	12	15	1	15	43
11:00AM	-	6	4	16.5	26.5
12:00PM	3	12	2	12.5	29.5
01:00PM	6	3	3	17.5	29.5
02:00PM	3	21	7	11	42
03:00PM	3	9	7	12	31
04:00PM	6	36	6	8.5	56.5
05:00PM	-	24	5	21	50
06:00PM	-	33	6	34	73
07:00PM	3	36	11	33.5	83.5
08:00PM	6	12	13	17.5	48.5
09:00PM	3	33	7	12.5	55.5
10:00PM	9	21	7	32	69
11:00PM	18	3	4	17.5	42.5
12:00PM	24	6	2	7.5	39.5
01:00AM	39	-	-	3.5	42.5
02:00AM	48	-	1	1	50
03:00AM	45	-	1	1.5	47.5
04:00AM	36	3	2	1	42
05:00AM	42	6	1	3	52

Source: ESIA Study of Karnafuly Dry Dock by AECOM

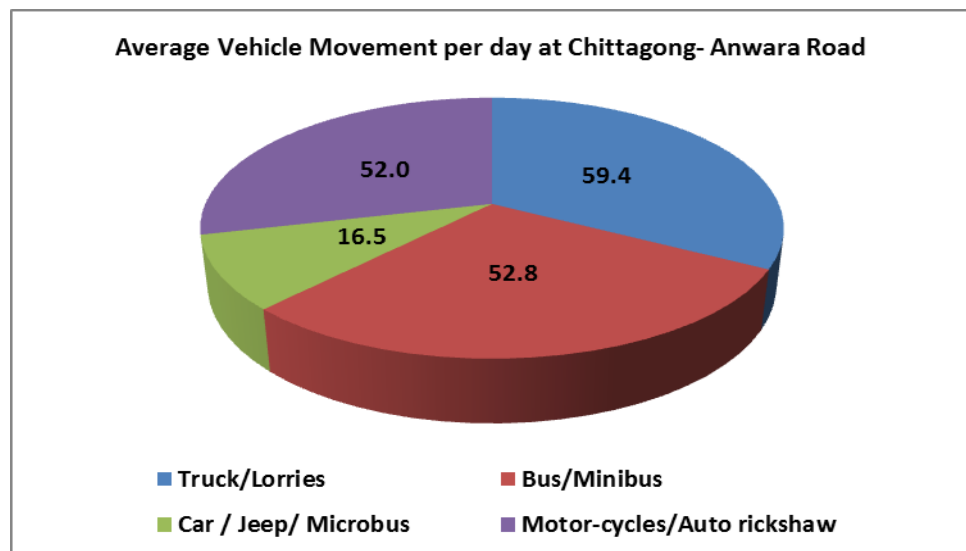


**Figure 56: Hourly traffic volume at Chittagong-Anwara Road**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Inference

The composition of vehicles at this stretch indicates that of the total vehicles observed, 59.4% of the vehicles were Trucks/lorries. Buses and minibuses constituted 52.8% of the observed traffic volume whereas Car/jeep/microbus and motor cycles/auto rickshaws comprised 16.5% and 52% respectively as illustrated in the Figure. Daily traffic volume at the highway was found to be 1181 PCU.



**Figure 57: Average Vehicle Movement at Chittagong-Anwara Road**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Implication

The project site is located on the bank of river with adequate space for movement of vessel and berthing. The river Karnafuly has adequate draft to allow vessels to directly deliver construction material to site. The site also has access through Chittagong – Anwara - Banskhali road which will also be used for transportation of construction materials.

Operation of the dry dock will involve vessels coming in for repair and maintenance at the facility, it will not significantly add to the existing river traffic volume on Karnafuly. However, the vessels coming to the dry dock are likely to affect the navigation on the river and create navigational issues for other vessels heading to or from the Chittagong Port.

## **4.2. Biological environment**

### **4.2.1. Ecological survey**

A baseline ecological survey was undertaken in the study area to evaluate the ecological status of the area and identify species of concern as per Red Data Book. The approach to the ecological survey was as follows:

- Field visits were undertaken for the ecological survey of the vegetation in the study area;
- Literature review to assess previous studies on vegetation and ecology of the region, based upon which a list of flora and fauna was compiled; and
- The diversity of the vegetation and its distribution was determined after field survey and data collection.

The study area can be characterized by presence of hilly and typical coastal mangrove habitats.

### **Methodology for on-Site Data Collection**

Diverse ecological habitats such as, fallow land, road site/embankments were selected for ecological sampling and data collection. Three random sites within 2 km of the project area were identified as sampling locations representing different ecosystems for the ecological survey.

At each site, study of floral diversity was carried out using the standard quadrat method (as per Braun-Blanquet, 1932; Raunkiaer, 1934). The quadrat size of 2 m × 2 m for herbs and grasses, 5 m × 5 m for shrubs and 10 m × 10 m for trees were standardized on the basis of species-area-curve method (Cain, 1938). At each site, faunal diversity was studied through direct evidence, in the form of visual sightings, and indirect evidence, such as calls, nests, burrows, droppings, scats, moults, tracks, etc. In the case of fauna, only occurrence at a given site was noted, without seeking to enumerate the individuals sighted. The floristic profiles of the survey area were assessed in terms of percentage frequency and abundance of each of the floral species identified. In each of the selected sampling locations, at least 20 quadrats were randomly applied in diversified habitats. Following formula was used for calculating the percentage frequency and abundance density of the floral species encountered in the 20 quadrats studied:

**Abundance:** Number of individuals per quadrat of occurrence.

$$\text{Abundance of Species A} = \frac{\text{Number of individuals of Species A in total quadrats studied}}{\text{Number of quadrats of occurrence of Species A}}$$

**Frequency:** This is described as the % of quadrats occupied by a given species.



$$\% \text{ Frequency of Species A} = \frac{\text{Number of quadrats of occurrence of Species A}}{\text{Total number of quadrats studied}}$$

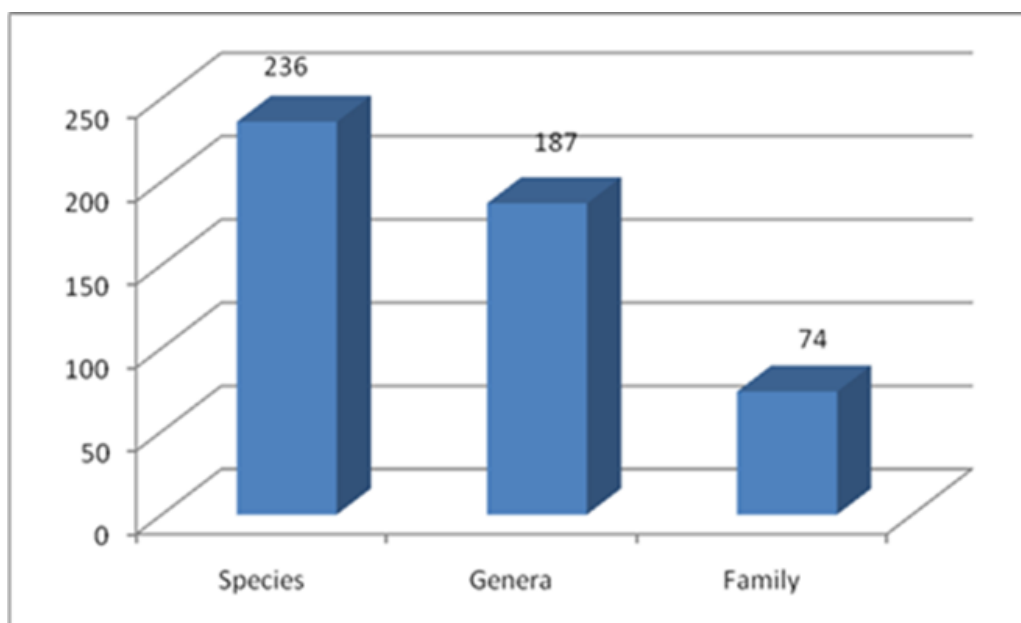
DAFOR scale (described in Shukla and Chandal, 1993; and Kent and Coker, 1992) was applied for the determination existing status of the recorded species, such as Dominant (D), Abundant (A), Frequent (F), Occasional (O) and Rare (R). Shannon-Weiner Diversity Index and Jackknife Species Richness were calculated by the following Kent and Coker (1992).

According to IUCN Red List Categories, the threatened categories (i.e., Critically Endangered, Endangered and Vulnerable) species of plants were highlighted from available data and field observation.

### Ecological Survey Findings

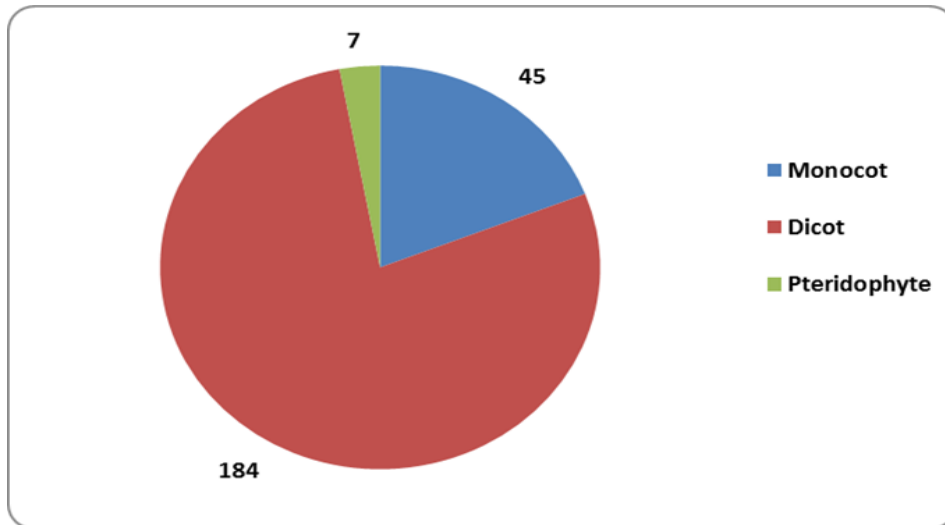
The floral and faunal diversity analysis of the study area based on the primary survey has been presented below:

- A total of 236 vascular plant species belonging to 187 genera under 74 families have been recorded from the proposed project area where the maximum 184 (77.96%) plant species belonged to the dicotyledonous group, followed by 45 (19.07%) and 7 (2.97%) plant species belonged to the monocotyledonous and pteridophyte (Fern) group, respectively;
- Among the habit categories, 120 (50.85%) species were herbs, 67 (28.39%) species were trees, 35 (14.83%) species were shrubs and 14 (5.93%) plant species were climbers;
- Out of 236 plant species, 207 (87.77%) species were observed in T habitat and rest of the 29 (12.23%) plant species were harbored in the A or wetland habitat;
- There are 15 (5.93%) species were recorded as mangrove and mangrove associated plant from the mangrove habitat and rest of 221 (94.07%) plant species were recorded as non-mangrove in the proposed project area.



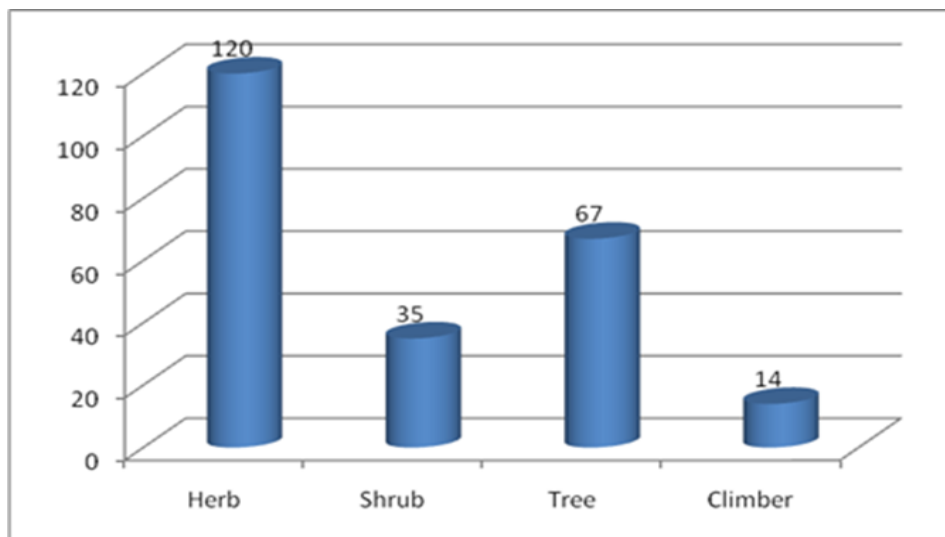
**Figure 58: Total Vascular plant species recorded**

Source: ESIA Study of Karnafuly Dry Dock by AECOM



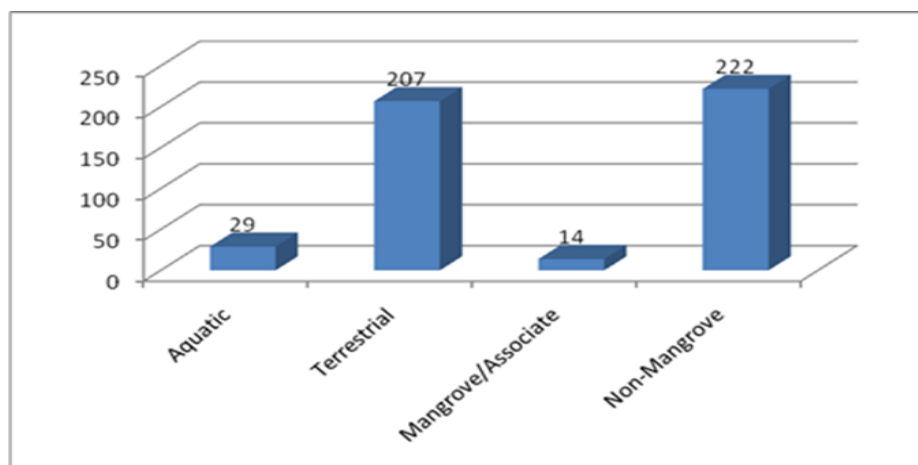
**Figure 59: Group wise classification of the vascular plant species recorded**

Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 60: Growth Habit wise classification of the Vascular plant species recorded**

Source: ESIA Study of Karnafuly Dry Dock by AECOM



**Figure 61: Habitat wise classification of the Vascular plant species recorded**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

### Floristic Diversity of the Study Area

Based on the primary ecological survey, the Shannon-Weiner Diversity Index (Diversity value) of the study area was calculated to be 4.833 which imply good phytodiversity of the study area.

According to the DAFOR scale, based on the data recorded from the study area it is seen that there are, 2 abundant species, 6 frequent species, 31 occasional species and 196 rare plant species. The study of the habits and habitats of the recorded plant species in the study area indicate a highly ecological diversified area. A total of 15 mangrove species were recorded from the study area. Out of the total 236 recorded plant species in the study area, 12 plant species were found to be in the Red List category out of which one 1 belonged to Mangrove species namely, *Avicennia officinalis* L. var. *alba* Blume.

However, *Avicennia officinalis* L. var. *alba* Blume is categorized to be a Least Concern species as per IUCN Red List Categories (2013), because this species is abundant and widespread in most of the mangrove habitats of Bangladesh. Also, the importance of this particular mangrove species is due to the fact that it grows only in the inter-tidal salt tolerant marshy habitat and exhibits negatively geotropic pneumatophores with thick and leathery leaves. The Table below presents the list of various floral biodiversity identified during the field visit.

**Table 63: Observed floral species in the study area**

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
<b>Tree</b>							
1.	<i>Acacia auriculiformis</i> A. Cunn. Ex Benth. & Hook.	Earleaf Acacia	Sonajhuri	T	NM	13.33	1.25
2.	<i>Acacia catechu</i> (L. f.) Willd.	Kutch Tree	Khair	T	NM	3.33	1
3.	<i>Aegle marmelos</i> (L.) Corr.	Bengal Quince	Bel	T	NM	10	1
4.	<i>Albizia procera</i> (Roxb.) Benth.	White Siris	Sada Koroi	T	NM	16.67	1.6
5.	<i>Alstonia scholaris</i> (L.) R. Br.	Blackboard Tree	Chatim	T	NM	10	1
6.	<i>Anacardium occidentale</i> L.	Cashew Tree	Kajubadam	T	NM	10	1.67
7.	<i>Annona reticulate</i>	Custard Apple	Aata	T	NM	3.33	2
8.	<i>Areca catechu</i> L.	Betel nut Palm	Supari	T	NM	20	2.5
9.	<i>Artocarpus heterophyllus</i> Lamk.	Jack fruit Tree	Kathal	T	NM	16.67	1.4
10.	<i>Avicennia officinalis</i> L. var. <i>alba</i> Blume	-	-	A	M/A	16.67	2.2
11.	<i>Avicennia officinalis</i> L. var. <i>nigra</i> Cowan	-	-	A	M/A	30	6
12.	<i>Azadirachta indica</i> A. Juss.	Neem Tree	Nim	T	NM	23.33	1.43
13.	<i>Bambusa tulda</i> Roxb.	Bengal Bamboo	Baas	T	NM	10	1.33
14.	<i>Barringtonia acutangula</i> (L.) Gaertn.	-	-	A	NM	6.67	1
15.	<i>Bombax ceiba</i> L.	Silk cotton Tree	Shimul-Tula	T	NM	10	1
16.	<i>Borassus flabellifer</i> L.	Palmyra palm	Taal	T	NM	6.67	1.5
17.	<i>Bridelia retusa</i> (L.) A. Juss.	Spinous Kino Tree	Geio	T	NM	10	1.33
18.	<i>Bridelia stipularis</i> (L.) Blume	-	Harinhara	T	NM	10	1
19.	<i>Cassia fistula</i> L.	Golden Shower	Sonalu	T	NM	6.67	1.5
20.	<i>Casuarina equisetifolia</i> Forst.	Beach casuarina	-	T	NM	10	2.33
21.	<i>Ceiba pentandra</i> (L.) Gaertn.	Java cotton	Sirmai Tula	T	NM	6.67	1.5
22.	<i>Citrus grandis</i> (L.) Osbeck.	Forbidden Fruit	Jambura	T	NM	13.33	0.75
23.	<i>Cocos nucifera</i> L.	Coconut tree	Narokel	T	NM	16.67	1.4
24.	<i>Dalbergia sissoo</i> Miq.	Indian rosewood	Shisham	T	NM	13.33	2
25.	<i>Diospyros montana</i> Roxb.	Mottled Ebony	Bangab	T	NM	3.33	2
26.	<i>Diospyros peregrina</i> Guerke	Indian Persimmon	Deshi gab	T	NM	3.33	1
27.	<i>Dysoxylum excelsum</i> Blume	-	-	T	NM	6.67	1.5
28.	<i>Erythrina ovalifolia</i> Roxb.	Coral Bean	O harikekra	A	NM	10	1
29.	<i>Eucalyptus camaldulensis</i> Dehnhardt	Murray red gum	-	T	NM	10	2.33

Description of the baseline environment of project area

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
30.	<i>Feronia limonia</i> (L.) Swingle	Wood Apple	Kait, Kadbhel	T	NM	10	1.33
31.	<i>Ficus benghalensis</i> L.	Banayan Tree	Baut	T	NM	13.33	1.25
32.	<i>Ficus racemosa</i> L.	Cluster Fig Tree	Dumur	T	NM	10	1
33.	<i>Ficus religiosa</i> L.	Sacred Fig Tree	Asvattha	T	NM	10	1.33
34.	<i>Ficus rumphii</i> Blume	Banayan Tree	Baut	T	NM	6.67	1
35.	<i>Gmelina arborea</i> Roxb.	Beechwood	Gamari	T	NM	10	1.33
36.	<i>Grewia nervosa</i> (Lour.) Panigr.	-	Patka	T	NM	16.67	2.6
37.	<i>Holarrhena antidysenterica</i> (L.) Wall. ex Decne	-	Kurchi	T	NM	16.67	2.4
38.	<i>Hopea odorata</i> Roxb.	-	Telsur	T	NM	10	1.33
39.	<i>Lagerstroemia speciosa</i> (L.) Pers.	Queen's Crepe	-	T	NM	10	1.33
40.	<i>Lannea coromandelica</i> (Houtt.) Merr.	Mehendi	Jiga	T	NM	13.33	1.5
41.	<i>Leucaena leucocephala</i> (Lamk.) de Wit.	River Tamarind	-	T	NM	10	2.33
42.	<i>Litsea glutinosa</i> (Lour.) Robinson	Indian laurel	Kukurchita	T	NM	10	1.67
43.	<i>Litsea monopetala</i> (Roxb.) Pers.	Grey Mango Laurel	Bara Kukurchita	T	NM	10	1.33
44.	<i>Maesamentacea</i> (Roxb.) A. DC.	-	-	T	NM	10	1.33
45.	<i>Mangifera indica</i> L.	Mango	Aam	T	NM	16.67	1
46.	<i>Melia azadirach</i> L.	African lilac tree	Bakarjam	T	NM	10	1.67
47.	<i>Moringa oleifera</i> Lamk.	Horseradish tree	sohjna	T	NM	6.67	2.5
48.	<i>Oroxylum indicum</i> (L.) Kurz	Tree of Damocles	Sona	T	NM	3.33	2
49.	<i>Phoenix sylvestris</i> Roxb.	Wild Date Plum	Khajur	T	NM	10	1.67
50.	<i>Pongamia pinnata</i> (L.) Pierre	Hongay oil tree	Karach gaach	A	NM	10	1.33
51.	<i>Psidium guajava</i> L.	Common Gauva	Piyara	T	NM	13.33	1.5
52.	<i>Samanea saman</i> (Jacq.) Merr.	Raintree	-	T	NM	10	1
53.	<i>Sapium indicum</i> Willd.	-	Batul	T	M/A	6.67	3.5
54.	<i>Sennasiamea</i> (Lamk.) Irwin & Barneby	-	Minuri	T	NM	10	2.33
55.	<i>Sonneratia apetala</i> Buch. -Ham.	-	-	A	M/A	13.33	3.5
56.	<i>Sonneratia caseolaris</i> (L.) Engl.	mangrove apple	-	A	M/A	10	2
57.	<i>Sterculia villosa</i> Roxb. ex Smith	-	-	T	NM	6.67	1.5
58.	<i>Streblus asper</i> Lour.	Sandpaper Tree	Shaora	T	NM	10	1.67
59.	<i>Suregada multiflora</i> (A. Juss.) Baill.	False Lime	Ban Lebu	T	NM	3.33	2
60.	<i>Syzygium cumini</i> (L.) Skeels	black plum	Jamun	T	NM	13.33	1.5
61.	<i>Syzygium fruticosum</i> DC.	-	-	T	NM	6.67	1.5

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
62.	<i>Syzygiummalaccense</i> (L.) Merr. & Perry	Malay apple	-	T	NM	6.67	1.5
63.	<i>Tamarindusindica</i> L.	Tamarind	Tetul	T	NM	10	1
64.	<i>Tectonagrandis</i> L. f.	Teak	Segun	T	NM	10	2.33
65.	<i>Terminaliachebula</i> Retz.	Arjuna	Haritaki	T	NM	10	1
66.	<i>Trewiamacrophylla</i> Roxb.	-	-	T	NM	10	1.33
67.	<i>Ziziphusmauritiana</i> Lamk.	Chinee Apple	Ber	T	NM	13.33	1.25
68.	<i>Avicennia officinalis</i> L. var. <i>alba</i> Blume	-	-	A	M/A	16.67	2.2
69.	<i>Avicennia officinalis</i> L. var. <i>nigra</i> Cowan	-	-	A	M/A	30	6
70.	<i>Azadirachta indica</i> A. Juss.	Neem Tree	Nim	T	NM	23.33	1.43
71.	<i>Bambusatulda</i> Roxb.	Bengal Bamboo	Baas	T	NM	10	1.33
72.	<i>Barringtonia acutangula</i> (L.) Gaertn.	-	-	A	NM	6.67	1
73.	<i>Bombax ceiba</i> L.	Silk cotton Tree	Shimul-Tula	T	NM	10	1
74.	<i>Borassus flabellifer</i> L.	Palmyra palm	Taal	T	NM	6.67	1.5
75.	<i>Bridelia retusa</i> (L.) A. Juss.	Spinous Kino Tree	Geio	T	NM	10	1.33
76.	<i>Bridelia stipularis</i> (L.) Blume	-	Harinhara	T	NM	10	1
77.	<i>Cassia fistula</i> L.	Golden Shower	Sonalu	T	NM	6.67	1.5
78.	<i>Casuarina equisetifolia</i> Forst.	Beach casuarina	-	T	NM	10	2.33
79.	<i>Ceiba pentandra</i> (L.) Gaertn.	Java cotton	Sirmai Tula	T	NM	6.67	1.5
80.	<i>Citrus grandis</i> (L.) Osbeck.	Forbidden Fruit	Jambura	T	NM	13.33	0.75
81.	<i>Cocos nucifera</i> L.	Coconut tree	Narokel	T	NM	16.67	1.4
82.	<i>Dalbergia sissoo</i> Miq.	Indian rosewood	Shisham	T	NM	13.33	2
83.	<i>Diospyros montana</i> Roxb.	Mottled Ebony	Bangab	T	NM	3.33	2
84.	<i>Diospyros peregrina</i> Guerke	Indian Persimmon	Deshi gab	T	NM	3.33	1
85.	<i>Dysoxylum excelsum</i> Blume	-	-	T	NM	6.67	1.5
86.	<i>Erythrina ovalifolia</i> Roxb.	Coral Bean	o harikekra	A	NM	10	1
87.	<i>Eucalyptus camaldulensis</i> Dehnhardt	Murray red gum	-	T	NM	10	2.33
88.	<i>Feronia limonia</i> (L.) Swingle	Wood Apple	Kait, Kadbhel	T	NM	10	1.33
89.	<i>Ficus benghalensis</i> L.	Banayan Tree	Baut	T	NM	13.33	1.25
90.	<i>Ficus racemosa</i> L.	Cluster Fig Tree	Dumur	T	NM	10	1
91.	<i>Ficus religiosa</i> L.	Sacred Fig Tree	Asvattha	T	NM	10	1.33
92.	<i>Ficusrumphii</i> Blume	Banayan Tree	Baut	T	NM	6.67	1
93.	<i>Gmelinaarborea</i> Roxb.	Beechwood	Gamari	T	NM	10	1.33



S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
94.	<i>Grewia nervosa</i> (Lour.) Panigr.	-	Patka	T	NM	16.67	2.6
95.	<i>Holarrhenaantidysenterica</i> (L.) exDecne. Wall.	-	Kurchi	T	NM	16.67	2.4
96.	<i>Hopeaodorata</i> Roxb.	-	Telsur	T	NM	10	1.33
97.	<i>Lagerstroemia speciosa</i> (L.) Pers.	Queen's Crepe	-	T	NM	10	1.33
98.	<i>Lanneacoromandelica</i> (Houtt.) Merr.	Mehendi	Jiga	T	NM	13.33	1.5
99.	<i>Leucaenaleucocephala</i> (Lamk.) de Wit.	River Tamarind	-	T	NM	10	2.33
100.	<i>Litsea glutinosa</i> (Lour.) Robinson	Indian laurel	Kukurchita	T	NM	10	1.67
<b>Shrubs</b>							
101.	<i>Acanthus ilicifolius</i> L.	-	-	T	M/A	36.67	6.91
102.	<i>Arundobengalensis</i> Retz.	-	-	T	NM	13.33	4.75
103.	<i>Averrhoa bilimbi</i> L.	-	-	T	NM	13.33	1
104.	<i>Averrhoa carambola</i> L.	-	-	T	NM	13.33	1
105.	<i>Bauhinia acuminata</i> L.	-	-	T	NM	13.33	1.5
106.	<i>Caesalpinia bonduc</i> (L.) Roxb.	-	-	T	NM	3.33	2
107.	<i>Calotropis gigantea</i> (L.) R. Br.	-	-	T	NM	10	1
108.	<i>Calotropis procera</i> (Ait.) R. Br.	-	-	T	NM	16.67	2.4
109.	<i>Capparis zeylanica</i> L.	-	-	T	NM	10	1.67
110.	<i>Citrus limon</i> (L.) Burm. f.	-	-	T	NM	13.33	1.25
111.	<i>Clerodendrum indicum</i> (L.) O. Kuntze	-	-	T	NM	10	1.33
112.	<i>Clerodendrum viscosum</i> Vent.	-	-	T	NM	23.33	7.43
113.	<i>Clinogynedichotoma</i> (Roxb.) Salisb. ex Benth	-	-	A	NM	10	2.67
114.	<i>Combretum acuminatum</i> Roxb.	-	-	T	NM	16.67	1.8
115.	<i>Dalbergia stipulacea</i> Roxb.	-	-	T	NM	10	1.33
116.	<i>Dendrophthoe falcata</i> (L. f.) Etting.	-	-	T	NM	10	1.67
117.	<i>Flueggea virosa</i> (Roxb. ex Willd.) Baill.	-	-	T	NM	10	1.67
118.	<i>Glycosmis pentaphylla</i> (Retz.) A. DC.	-	-	T	NM	10	3.33
119.	<i>Hibiscus rosa-sinensis</i> L.	-	-	T	NM	10	1.67
120.	<i>Hibiscus tiliaceus</i> L.	-	-	A	M/A	16.67	2.2
121.	<i>Ipomoea fistulosa</i> Mart, ex Choisy	-	-	A	NM	13.33	3.75
122.	<i>Jatropha curcas</i> L.	-	-	T	NM	6.67	1.5
123.	<i>Jatropha gossypifolia</i> L.	-	-	T	NM	10	1.33
124.	<i>Justicia adhatoda</i> L.	-	-	T	NM	10	6.67

Description of the baseline environment of project area

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
125.	<i>Lantana camara</i> L.	-	-	T	NM	16.67	3.4
126.	<i>Lawsoniainermis</i> L.	-	-	T	NM	10	1.33
127.	<i>Melastomamalabathricum</i> L.	-	-	T	NM	13.33	2.5
128.	<i>Mussaendaroxburghii</i> Hook. f.	-	-	T	NM	10	1.67
129.	<i>Phyllanthusreticulatus</i> Poir.	-	-	T	NM	16.67	2.2
130.	<i>Sennasophora</i> (L.) Roxb.	-	-	T	NM	10	1.33
131.	<i>Tabernaemontanadivaticata</i> (L.) R. Br. Ex Roem. & Schult.	-	-	T	NM	13.33	2.5
132.	<i>Triumfettarhomboidea</i> Jacq.	-	-	T	NM	16.67	4.2
133.	<i>Vitex negundo</i> L.	-	-	T	NM	6.67	2.5
134.	<i>Vitex trifolia</i> L.	-	-	T	NM	3.33	2
135.	<i>Ziziphusoenoplia</i> (L.) Mill.	-	-	T	NM	10	1
<b>Herbs</b>							
139.	<i>Adiantumphilippense</i>	-	-	T	NM	13.33	49
140.	<i>Ageratum conyzoides</i> L.	-	-	T	NM	23.33	5
141.	<i>Alternantheraparonichyoides</i> St. Hil.	-	-	A	M/A	6.67	3.5
142.	<i>Alternantheraphiloxeroides</i> (Mart.) Griseb.	-	-	A	NM	16.67	3.6
143.	<i>Alternantherasessilis</i> (L.) R. Br. ex Roem. & Schult.	-	-	T	NM	13.33	10.75
144.	<i>Alysicarpusvaginalis</i> DC.	-	-	T	NM	13.33	2.25
145.	<i>Amaranthus spinosus</i> L.	-	-	T	NM	16.67	7
146.	<i>Amaranthusviridis</i> L.	-	-	T	NM	13.33	2.5
147.	<i>Anisomelesindica</i> (L.) O. Kuntze	-	-	T	NM	13.33	2
148.	<i>Axonopuscompressus</i> (Sw.) P. Beauv.	-	-	T	NM	23.33	14.86
149.	<i>Bacopamonneri</i> (L.) Pennell	-	-	T	NM	6.67	12
150.	<i>Blechnum orientale</i>	-	-	T	NM	3.33	2
151.	<i>Blumealacera</i> (Burm. f.) DC.	-	-	T	NM	26.67	3.38
152.	<i>Boerhaaviadiffusa</i> L.	-	-	T	NM	10	4
153.	<i>Capsicum frutescens</i> L.	Bird pepper	Kancha lanka	T	NM	10	1
154.	<i>Christelladentata</i>	Downy Wood fern	-	T	NM	10	1.67
155.	<i>Chromolaenaodorata</i> (L.) King & Robinson	Bitter Bush	Assam lata	T	NM	20	4
156.	<i>Chrysopogonaciculatus</i> (Retz.) Trin.	golden false	Chorant	T	NM	16.67	13.2
157.	<i>Cleome rutidosperma</i> DC.	-	-	T	NM	10	1.67

Description of the baseline environment of project area

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
158.	<i>Cleome viscosa</i> L.	Wild mustard	Hurhuria	T	NM	16.67	1.6
159.	<i>Colocasia esculenta</i> (L.) Schott	Dasheen	Kachu	A	NM	13.33	3.75
160.	<i>Commelinabenghalensis</i> L.	Day Flower	Kanchira	T	NM	26.67	3.25
161.	<i>Commelinalongifolia</i> Lamk.	-	-	T	NM	10	2.67
162.	<i>Crinum amoenum</i> Roxb. Ex Ker. Gawl.	-	-	A	M/A	6.67	2.5
163.	<i>Crinum latifolium</i> L.	-	-	T	NM	10	1.33
164.	<i>Croton bonplandianus</i> Baill.	-	-	T	NM	20	5.17
165.	<i>Cryptocorine</i> sp.	East Indian Fruit	-	A	M/A	16.67	3.4
166.	<i>Curcuma domestica</i> Valet.	-	-	T	NM	10	5
167.	<i>Curcuma zedoaria</i> (Christm.) Rose.	Indian Arrowroot	Sothi	T	NM	16.67	3.4
168.	<i>Cyathulaprostrata</i> (L.) Blume	-	-	T	NM	10	3
169.	<i>Cynodondactylon</i> (L.) Pers.	Dhub Grass	Durba	T	NM	16.67	17.2
170.	<i>Cyperus bulbostylis</i> (Rottb.) C.B. Clarke	-	-	T	NM	13.33	3
171.	<i>Cyperus compressus</i> L.	-	-	T	NM	10	1.67
172.	<i>Cyperus eragrostis</i> Vahl	-	-	T	NM	13.33	5.75
173.	<i>Cyperus exaltatus</i> Retz.	-	-	A	M/A	6.67	3.5
174.	<i>Cyperus rotundus</i> L.	Nut Grass	Mutha	T	NM	13.33	2.5
175.	<i>Cyperus</i> sp.	-	-	T	NM	10	2
176.	<i>Cyrtococcum oxyphyllum</i> (Steud.)	-	-	T	NM	16.67	11.6
177.	<i>Desmodium gangeticum</i> (L.) DC.	-	Salpani	T	NM	13.33	5.25
178.	<i>Desmodium triflorum</i> (L.) DC.	-	-	T	NM	16.67	18.4
179.	<i>Digitaria longiflora</i> (Retz.) Pers.	-	-	T	NM	10	4.67
180.	<i>Eclipta alba</i> (L.) Hassk.	-	-	T	NM	20	2.5
181.	<i>Eclipta erecta</i>	-	-	T	NM	3.33	2
182.	<i>Eichhornia crassipes</i> (Mart.) Solms	Water-hyacinth	Kachuripana	A	NM	10	8.33
183.	<i>Elaeocarpus angustifolius</i> Blume	-	-	T	NM	10	1
184.	<i>Elephantopus scaber</i> L. Elephant's Foot	Prickly Leaved	Gojialata	T	NM	13.33	3.75
185.	<i>Eleusine indica</i> (L.) Gaertn.	Crowfoot Grass	Malangakuri	T	NM	20	7.17
186.	<i>Eragrostis tenella</i> (L.) P. Beauv. Ex Roem. & Schult.	-	-	T	NM	16.67	6.2
187.	<i>Evolvulus nummularius</i> (L.) L.	-	-	T	NM	30	8.89
188.	<i>Fimbristylis miliacea</i> (L.) Vahl	-	-	T	NM	13.33	2.75
189.	<i>Heliotropium indicum</i> L.	Heliotrope	Hatishur	T	NM	13.33	1.5

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
190.	<i>Hodgsoniamacrocarpa</i> (Blume) Cogn.	-	-	T	NM	10	1.33
191.	<i>Hygrophilaphlomoides</i> Nees	-	-	A	NM	10	4.67
192.	<i>Hyptissuaveolens</i> (L.) Poit.	-	Tokma	T	NM	10	3
193.	<i>Imperatacylindrica</i> (L.) P. Beauv.	-	-	T	NM	13.33	29
194.	<i>Kyllinganemoralis</i> (J. R. Forst. & G Forst.) Dandy ex Hutch. & Dalziel	-	-	T	NM	20	5.17
195.	<i>Laporteainterrupta</i> (L.) Chew	-	-	T	NM	10	1.67
196.	<i>Leersiahexandra</i> Sw.	-	-	A	NM	10	4.33
197.	<i>Lemnaperpusilla</i> Torrey	-	-	A	NM	10	39.33
198.	<i>Leucasaspera</i> (Willd.) Link	-	Donkolos	T	NM	13.33	2.25
199.	<i>Leucasbiflora</i> (Vahl) Benth.	-	-	T	NM	10	1.67
200.	<i>Leucascephalotes</i> (Roth) Spreng.	-	-	T	NM	10	2
201.	<i>Linderniaanagallis</i> (Burm. f.) Pennell	-	-	T	NM	13.33	3
202.	<i>Linderniaantipoda</i> (L.) Alston	-	-	T	NM	10	2.67
203.	<i>Lippianodiflora</i> (L.) Rich.	-	-	T	NM	13.33	17.5
204.	<i>Ludwigiahyssopifolia</i> (G. Don) Exellapud A. & R. Fernandes	-	-	A	NM	13.33	2.5
205.	<i>Mariscusaristatus</i> (Rottb.) Cherm.	-	-	T	NM	10	3
206.	<i>Melocannabambusoides</i> Trin.	-	-	T	NM	6.67	3.5
207.	<i>Merremiaumbellata</i> (L.) Hallier f.	-	-	T	NM	10	1.67
208.	<i>Mimosa pudica</i> L.	-	-	T	NM	13.33	2.75
209.	<i>Monochoriahastata</i> (L.) Solms.	-	-	A	NM	10	5
210.	<i>Murdannianudiflora</i> (L.) Brenan	-	-	T	NM	10	2.67
211.	<i>Musa paradisiaca</i> L.	-	-	T	NM	10	1.33
212.	<i>Nelsoniacanescens</i> (Lamk.) Spreng.	-	-	T	NM	13.33	5.5
213.	<i>Nymphaeapubescens</i> Willd.	-	-	A	NM	10	2.33
214.	<i>Nymphaeastellata</i> Willd.	-	-	A	NM	6.67	2.5
215.	<i>Nymphoidesindicum</i> (L.) O. Kuntze	-	-	A	NM	10	3.67
216.	<i>Ocimumamericanum</i>	-	-	T	NM	10	2.33
217.	<i>Ocimumbasilicum</i> L.	-	-	T	NM	13.33	4.75
218.	<i>Oldenlandiacorymbosa</i> L.	-	-	T	NM	16.67	4.8
219.	<i>Oldenlandiadiffusa</i> (Willd.) Roxb.	-	-	T	NM	10	3.33

Description of the baseline environment of project area

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
220.	<i>Ophiorrhiza</i> L.	-	-	T	NM	6.67	2
221.	<i>Oplismenus burmanii</i> (Retz.) P. Beauv.	-	-	T	NM	13.33	5.25
222.	<i>Oxalis corniculata</i> L.	-	-	T	NM	10	4.67
223.	<i>Paederia foetida</i> L.	-	-	T	NM	10	3
224.	<i>Pandanus foetidus</i> Roxb.	-	-	T	M/A	6.67	2.5
225.	<i>Panicum brevifolium</i> L.	-	-	T	NM	20	6.33
226.	<i>Paspalum distichum</i> L.	-	-	T	NM	16.67	11.2
227.	<i>Peperomia pellucida</i> (L.) H. B. & K.	-	-	T	NM	13.33	4.25
228.	<i>Persicaria lapathifolia</i> (L.) S. F. Gray	-	-	A	NM	10	2.67
229.	<i>Phaulopsis imbricata</i> (Forssk.) Sweet	-	-	T	NM	6.67	3
230.	<i>Phyllanthus urinaria</i> L.	-	-	T	NM	16.67	2.8
231.	<i>Physalis minima</i> L.	-	-	T	NM	10	2.67
232.	<i>Pityrogramma calomelanos</i> (L.) Link.	-	-	T	NM	10	1.67
233.	<i>Pothos scandens</i> L.	-	-	T	NM	10	3
234.	<i>Pouzolzia indica</i> (L.) Gaudich.	-	-	T	NM	13.33	3.75
235.	<i>Pouzolzia zeylanica</i> (L.) Benn.	-	-	T	NM	16.67	4.6
236.	<i>Pteris vittata</i>	-	-	T	NM	10	1.33
237.	<i>Pteris longifolia</i> var. <i>vittata</i>	-	-	T	NM	13.33	3
238.	<i>Ruellia tuberosa</i> L.	-	-	T	NM	10	2
239.	<i>Rungia pectinata</i> (L.) Nees	-	-	T	NM	13.33	4.75
240.	<i>Scirpus articulatus</i> (L.) Palla.	-	-	A	NM	10	16
241.	<i>Scoparia dulcis</i> L.	-	-	T	NM	13.33	2.5
242.	<i>Selaginella acicularis</i>	-	-	T	NM	6.67	2.5
243.	<i>Sida acuta</i> Burm. f.	-	-	T	NM	16.67	4
244.	<i>Sida cordifolia</i> L.	-	-	T	NM	16.67	1.8
245.	<i>Sida rhombifolia</i> L.	-	-	T	NM	13.33	4
246.	<i>Solanum nigrum</i> L.	-	-	T	NM	10	2.67
247.	<i>Solanum</i> sp.	-	-	T	NM	6.67	2.5
248.	<i>Solanum surattense</i> Burm. f.	-	-	T	NM	6.67	2
249.	<i>Spermacoce latifolia</i> Aublet	-	-	T	NM	13.33	3
250.	<i>Synedrella nodiflora</i> (L.) Gaertn.	-	-	T	NM	20	3.83
251.	<i>Typhonium trilobatum</i> (L.) Schott	-	-	T	NM	10	2.67

Description of the baseline environment of project area

S.N	Scientific Name	English Name	Local Name	Habitat	Mangrove	Frequency (%)	Abundance
252.	<i>Vernoniacinerea (L.) Less.</i>	-	-	T	NM	16.67	3.4
253.	<i>Vitistrifolia L.</i>	-	-	T	NM	13.33	3
254.	<i>Zingiberpurpureum Rose.</i>	-	-	T	NM	10	2.67
<b>Climber</b>							
255.	<i>Calamusviminalis Willd.</i>	-	-	T	NM	6.67	1.5
256.	<i>Clerodendrumnerme (L.) Gaertn.</i>	Garden Quinine	Ban Jui	A	M/A	10	3.67
257.	<i>Cocciniacordifolia Cogn.</i>	Ivy Gourd	-	T	NM	13.33	1.5
258.	<i>Derris trifoliata Lour.</i>	Sea Derris	Panlata	A	M/A	13.33	4
259.	<i>Dioscoreabelophylla (Prain) Voigt ex Haines</i>	-	-	T	NM	10	2
260.	<i>Dioscoreahamiltonii Hook. f.</i>	-	Murmujja amiala	T	NM	6.67	1.5
261.	<i>Ichnocarpusfrutescens (L.) R. Br.</i>	Black Creeper	Dudhi	T	NM	10	1.67
262.	<i>Lygodiumflexuosa</i>	Maidenhair creeper	Miau-maka-la	T	NM	13.33	1.5
263.	<i>Mikaniacordata (Burm. f.) Robinson</i>	Climbing hemp-	-	T	NM	10	8
264.	<i>Momordicasubangulatasubsp. Renigera</i>	Spine gourd	-	T	NM	3.33	1
265.	<i>Mukiamaderaspatana (L.) M. Roem.</i>	-	-	T	NM	6.67	2.5
266.	<i>Smilax ovalifoila Roxb.</i>	-	-	T	NM	6.67	1.5
267.	<i>Tinosporacrispa (L.) Hook. f. &amp;</i>	-	Gulanha	T	NM	3.33	2
268.	<i>Wedeliabiflora C.B. Clarke Thorns.</i>	-	-	T	NM	6.67	1.5

Source: ESIA Study of Karnafuly Dry Dock by AECOM





*Acacia auriculiformis*



*Acalypha indica*



*Acalypha*



*Acanthus ilicifolius*



*Adiantum philippense*



*Alternanthera paaronichyoides*



*Melastoma malabathricum*



*Momordica sp.*





*Amaranthus viridis*



*Ampelocissus burbata*



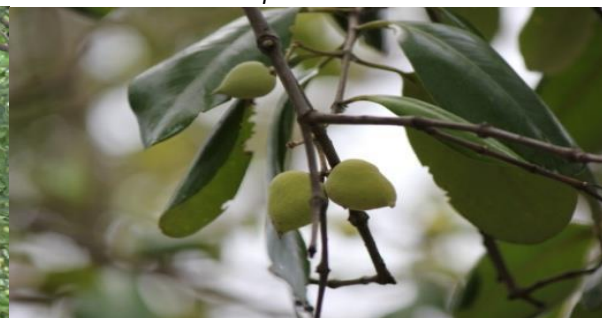
*Annona reticulata*



*Asclepiadaceae*



*Azadirachta indica*



*Avicennia officinalis var. nigra*



*Bacopa monnieri*



*Chrysopogon aciculatus*

**Figure 62: Flora Observed during Primary Survey**

Source: Field Survey

## Implication

The site is devoid of any vegetation cover, as significant part of it is inundated by water during high tides. KDDSEZL has reclaimed the southern portion of the site by sand filling. The project will not require clearance of vegetation as part of pre-construction activities. The dredging activities for construction of Jetties and dry dock (about 7 m and 13 m below existing ground level respectively) can lead to potential siltation. During operation phase of the project the impact on ecology of the area will be mainly because of the generation of pollutants mentioned under water and soil quality sections above.

### 4.2.2. Aquatic survey

Aquatic survey of River Karnafuly was carried out to appraise and enlist the present status of Phytoplankton, Zooplanktons, Insect fauna, Mollusks and Fish species found in and around the proposed project site. Three sampling locations were selected at different points of River Karnafuly during both high and low tides of the river. The approach to the Aquatic survey involved collecting, processing, and analyzing Aquatic organisms to determine the health of the biological community.

### Methodology for On-Site Data Collection

A comprehensive survey of the Aquatic diversity around the project site included collection of samples from three different locations of River Karnafuly. Water samples were collected from approximately 40 m radius of each of the sampling locations. The collected samples were identified and verified through secondary data and after consultation with local fishermen. Physical parameters of the water samples were checked and recorded at site. Fishing nets were used to collect different types of fishes, macro and micro invertebrates from each of the sampling locations.

From each of the sampling locations, about 10 L of water (one L each time) was collected and sieved using special plankton nets were to collect the different types of Phytoplankton and Zooplankton available in the water sample. Around five samples were collected from each sampling locations and the different Phytoplankton and Zooplankton species were studied in a “rafter cell counter” under microscope. The Table below represents the details of the ecological survey sites.

**Table 64: Aquatic Survey Site Locations**

Location Code	Name of the Location	Geographical Coordinates	Description of the site
AS1	Marine Academy Jetty Ghat	22°14'43.40"N 91°50'0.32"E	River shore was found to be sandy and sloppy with strong currents in the river. Western shore of the river is covered by stones and concrete built blocks to protect the banks of the river from erosion. A small patch of Mangrove plantation was observed in the eastern part of the River. Sampling period recorded very strong flow of current flowing towards the Bay of Bengal.
AS2	About 1 Km upstream of	22°15'14.02"N 91°50'8.04"E	Both the sides of the river are covered by stones and concrete built blocks to protect the river bank by erosion Some

Location Code	Name of the Location	Geographical Coordinates	Description of the site
	the Marine Academy Ghat		fishermen were found to catch fish by using hooks. Sampling period recorded very strong flow of current flowing towards the Bay of Bengal.
AS3	Confluence of the river Karnafuly and the Bay of Bengal	22°13'4.18"N 91°48'12.85"E	Both the sides of the river are covered by stones and concrete built blocks to protect the river bank by erosion. Sampling period recorded very strong flow of current flowing towards the Bay of Bengal.

Source: ESIA Study of Karnafuly Dry Dock by AECOM

## Observations

Water quality includes various physical and biological parameters which has direct influence on the Aquatic organisms and vegetation. Abundance of fishes and their growth are dependent on the quality of water and availability of food. Table below presents the physical parameters of water samples examined at each of the sampling locations.

**Table 65: Water quality parameters from the different sampling locations of Karnafuly**

Parameters	AS1	AS2	AS3
Temperature (0C±SE)	30.8±1.07	32.0± 0.5	31.4±0.3
Secchi-depth (cm±SE)	6.20±1.2	6.40±0.3	7.00±0.0

Source: ESIA Study of Karnafuly Dry Dock by AECOM

**Note: Each data represents average of five samples**

The insect fauna was recorded only from the eastern part of the River Karnafuly around the Bangladesh Marine Academy is presented in the following Table. Insect nets were used to collect flying insects. Larval forms of different insects were collected from different water bodies by using dippers. Immature stages of dragonfly and damselfly were collected. These are being reared in the laboratory until they reach their adult stage.

**Table 66: Insect fauna recorded from the different sampling locations Karnafuly River**

Common name	Order name	Abundance
Dragon fly nymph	<i>Odonata</i>	+
Damselfly nymph	<i>Odonata</i>	+
Mosquito	<i>Diptera</i>	+
Flies	<i>Diptera</i>	+
Ant	<i>Hymenoptera</i>	+

Source: Field Survey

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

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

Mollusk fauna of the different sampling locations are presented in the following Table. Higher numbers of mollusk (live or dead) were recorded from Location 1 which may be due to the soil and ecological condition of the area. Dense population of the mollusk attached with the stones and concrete blocks were also recorded from each sampling location.



**Table 67: List of Mollusks recorded from the different sampling locations the River Karnafuly**

Common Name	Scientific Name	Sampling Locations		
		AS1	AS2	AS3
Choto Samuk	<i>Littoraria melanostoma</i>	++	+	+
Choto Samuk	<i>L. scabra</i>	++	+	+
Choto Samuk	<i>L. undulate</i>	++	-	-
Choto Samuk	<i>Neritima smithi</i>	++	+	+
Kata Samuk	<i>Cerithium tenellum</i>	++	-	-
Lomba Leza	<i>Cerithidea cingulata</i>	++	+	+

Source: Field Survey

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

Several types of small fishes were captured and have been presented in the following Table. Fishermen were found to catch the fish fries by using special type of nets. Huge numbers of minute crabs were also captured in their nets.

**Table 68: List of small fishes captured during survey period by different types of fishing nets from the River Karnafuly**

English Name	Local Name	Scientific Name	Abundance	IUCN Status, 2000
Catfish	Golsha Tengra	<i>Mystus cavasius</i>	+	V
Bar eyed goby	Bele	<i>Glossogobius giuris</i>	+	NT
Long whiskers catfish	Nuna-Tengra	<i>Mystus gulio</i>	++	DD
Big-eyed Jewfish	Koitor Poa	<i>Johnius coitor</i>	+	NT
Corsula Mullet	Bata	<i>Rhinomugil corsula</i>	+	NT
Flathead sillago	Tular Dandi	<i>Sillaginopsis panijus</i>	++	NT
Eel goby	Lal Chewa	<i>Odontamblyous rubicundus</i>	++	NT
Paradise threadfish	Tapasi, Rishi	<i>Polynemus paradiseus</i>	+	NT
Olive Barb	Sarputi	<i>Puntius sarana</i>	++	NT
Mudskipper	Chiring	<i>Apocryptes bata</i>	+	NT
Prawn	Chingri	<i>Macrobrachium sp.</i>	+	DD

Source: Field Survey

**Note: Status: ++Common, +Few, NT- Not Threatened, DD- Data Deficit**

Few avifaunal species were also observed during the study at the eastern side of River Karnafuly which includes Threatened species (as per IUCN status) such as *Dendrocopos macei*, *Halcyon smyrnensi* and *Columba livia*. List of avifaunal species recorded is presented in the Table below.

**Table 69: Observed Avifaunal species recorded in the study area near River Karnafuly**

English Name	Local Name	Scientific Name	Abundance	IUCN status (2000)
Pond Heron	Konch Bak	<i>Ardeola grayii</i>	++	Least Concern
Little Cormorant	Pankouri	<i>Phalacrocorax niger</i>	++	Least Concern
Black Kite	Cheel	<i>Milvus migrans</i>	++	Least Concern
Brahminy Kite	Shankho Cheel	<i>Haliastur Indus</i>	+	Least Concern
Red Vented Bulbul	Bulbul	<i>Picnonotus cafer</i>	+	Least Concern
House Crow	Kaak	<i>Corvus splendens</i>	++	Least Concern
Tailor Bird	Tuntuni	<i>Orthotomus sutorius</i>	+	Least Concern
Fulvous Breasted Woodpecker	Kath thokra	<i>Dendrocopos macei</i>	++	Least Concern
White-throated Kingfisher	Machhraanga	<i>Halcyon smyrnensi</i>	++	Least Concern
Green Bee-eater	Shobuj Shuichora	<i>Merops orientalis</i>	++	Least Concern

English Name	Local Name	Scientific Name	Abundance	IUCN status (2000)
Common Pigeon	Kabutar	<i>Columba livia</i>	++	Least Concern
Spotted Dove	Pairst	<i>Streptopelia chinensis</i>	++	Least Concern
Oriental Magpie-Robin	Doyel	<i>Copsychus saularis</i>	+	Least Concern
Little Egret	Bok	<i>Egretta garze</i>	+	Least Concern

Source: Field Survey

Phytoplankton are the producer of the river ecosystem and thus their statuses are of prime importance. Phytoplankton and Zooplankton found in the water samples of different sampling locations includes *Calothrix sp.*, *Surirella sp.*, *Monostyla sp.* and *Nebalia sp.* etc. Detailed list is presented in the following Table.

**Table 70: Phytoplankton recorded from the water samples of the River Karnafuly**

Name of species	Number of species at different sampling locations		
	Location 1	Location 2	Location 3
<b>Phytoplanktons</b>			
<i>Calothrix sp</i>	5	7	7
<i>Navicula sp</i>	4	5	4
<i>Oscillatoria sp</i>	6	2	3
<i>Chaetoceros sp</i>	8	5	6
<i>Ceratium sp</i>	7	2	3
<i>Rhizosolenia sp</i>	2	2	5
<i>Podolampas sp</i>	6	5	6
<i>Cynebella sp.</i>	3	6	5
<i>Nodularia sp</i>	3	2	6
<i>Arabaena</i>	4	4	3
<i>Navicula sp.</i>	3	4	2
<i>Surirella sp.</i>	5	3	4
<i>Microcystis sp.</i>	3	6	4
<i>Cosciodiscus</i>	3	5	3
<i>Dinophysis sp</i>	3	1	1
<i>Nitzschia sp.</i>	2	6	4
<b>Zooplanktons</b>			
<i>Nauplius sp</i>	2	4	1
<i>Amphipod sp.</i>	5	7	2
<i>Streptocephalus</i>	2	4	1
<i>Calonid sp.</i>	4	4	2
<i>Acrocalanus sp.</i>	5	2	1
<i>Apus</i>	2	2	-
<i>Eucalanus sp.</i>	2	4	1
<i>Daphnia sp.</i>	2	2	2
<i>Brachionus sp.</i>	3	2	2
<i>Paracalanus sp</i>	4	1	3
<i>Cypris</i>	2	3	2
<i>Diffugia sp.</i>	2	2	2
<i>Glaucoma sp.</i>	3	2	1
<i>Horella brehmi</i>	3	3	2
<i>Brachionus sp.</i>	4	3	2
<i>Monostyla sp.</i>	1	4	2
<i>Argulus sp.</i>	3	2	3
<i>Phacus sp.</i>	3	4	4
<i>Nebalia sp.</i>	2	4	2



Name of species	Number of species at different sampling locations		
	Location 1	Location 2	Location 3
<i>Cyclops sp.</i>	1	3	1

Source: Field Survey

**Note:** Data from each sampling location represents total of 5 samples, 1 ml each time.

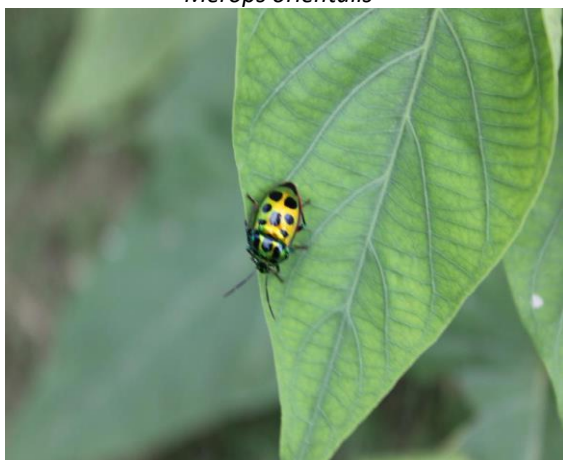
Record of very few Zooplanktons may be due to the heavy flow of rain water from the upstream.



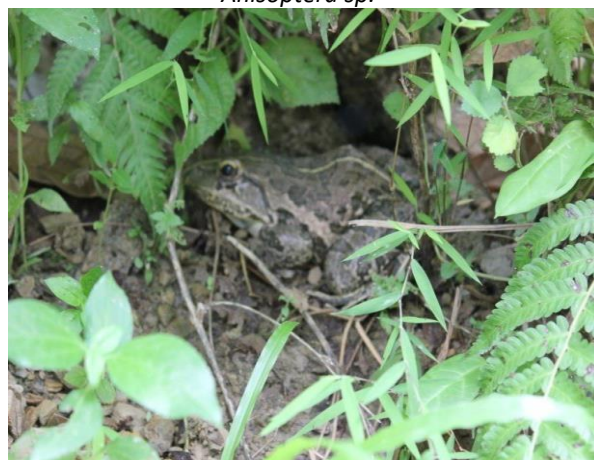
*Merops orientalis*



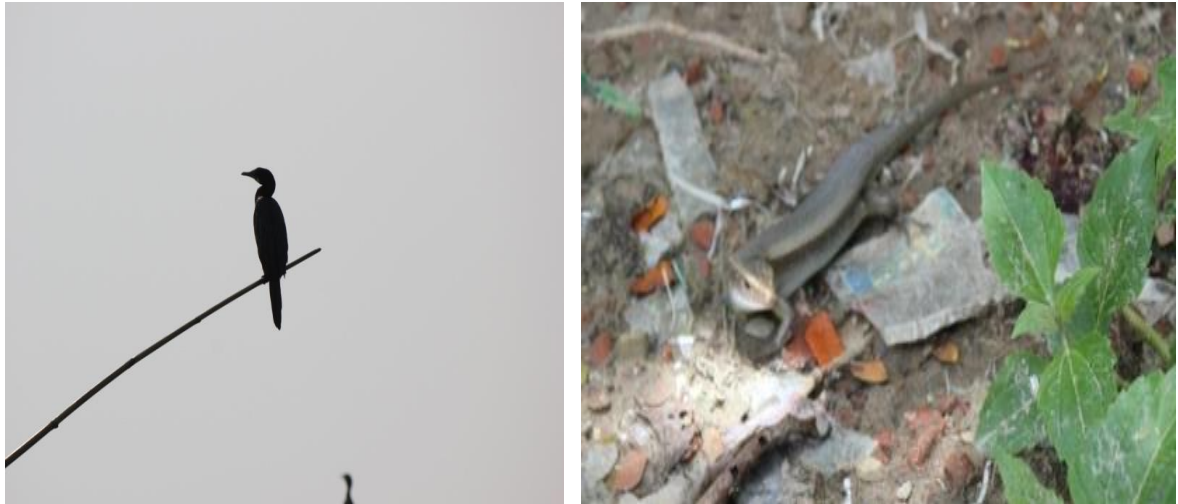
*Anisoptera sp.*



*Hemiptera*



*Rana tigris*

*Phalacrocorax niger**Eutropis macularia***Figure 63: Faunal Observed during Primary Survey***Source: Field Survey*

### Faunal Species of Ecological Importance

During the survey three groups of Gangetic Dolphins were observed near the Marine Academy Jetty Ghat and about 20 Dolphins near Kalurghat Bridge area. The Gangetic dolphins are classified as an endangered species in Bangladesh and is placed in the Third Schedule of Bangladesh Wildlife (Preservation) (Amendment) Act 1974 (IUCN Bangladesh 2000). This species is on Appendix 1 of the CITS and is also listed in Appendix 11 of CMS.

According to discussion with Dr. Banojir Ahmed, Professor of Zoology, Chittagong University; an expert on Gangetic Dolphins, or susu in Bangladesh Dolphins of this area uses the River Sangu as their breeding ground. Presently its population is divided by dams into isolated groups and has a much reduced range. The lowest estimate for the total population is 1,200–1,800 individuals. However, none of the Gangetic Dolphin species were observed to inhabit near the proposed project site

### Implication

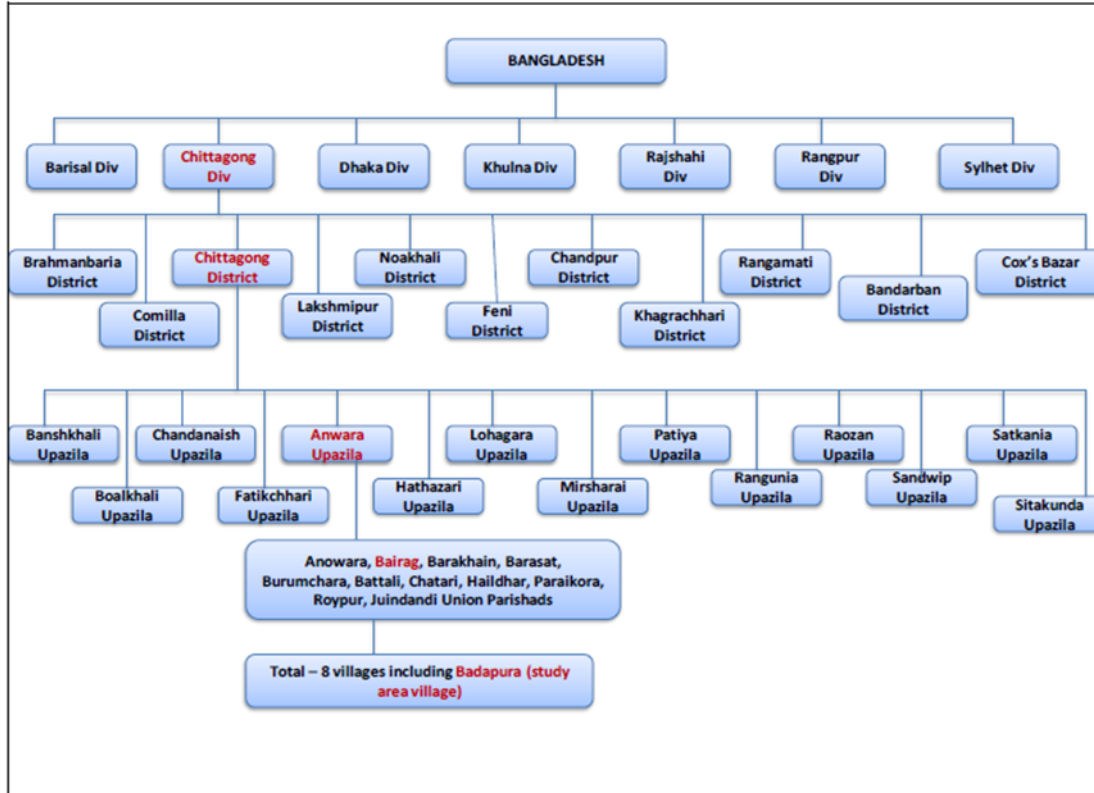
The site is devoid of any vegetation cover, as significant part of it is inundated by water during high tides. KDDSEZL has reclaimed the southern portion of the site by sand filling. The project will not require clearance of vegetation as part of pre-construction activities. The dredging activities for construction of Jetties and dry dock (about 7 m and 13 m below existing ground level respectively) can lead to potential siltation. During operation phase of the project the impact on ecology of the area will be mainly because of the generation of pollutants mentioned under water and soil quality sections above.

## 4.3. Socio-economic environment

### 4.3.1. Administrative set up

Chittagong district is divided into 14 Upazila of which Anwara Upazila is one of them. Anwara Upazila has been further divided into 11 Unions, 85 Mauzas, and 78 villages. Bairag Union

Parishad is one of the 11 Unions under Anwara Upazila. Badalpura village ‘the study area’ falls within Bairag Union Parishad. The thematic administrative set up in Chittagong District has been provided in the following Figure.



**Figure 64: Thematic administrative set up of Chittagong District**

Source: <http://www.lged.gov.bd/DistrictArea2.aspx?Area=UnionParishad&DistrictID=11>

#### 4.3.2. Project influenced villages

KDDSEZL, as per the Land Valuation Report conducted by IDLC in June 2014, has acquired the required land for the proposed project. The total land purchased from private individual sellers (Badalpura village) amounts to 8.31 acres, while area leased (99 years) from Government of Bangladesh is 7.80 acres and area leased (10 years) from Chittagong Port Authority is 2.12 acres. A total of 36 Deed Document Representative has sold their land for the proposed project activities. The area delineated for the current study has been identified giving significance to the population which will be directly and indirectly affected by the project activities.

**Project Affected Village:** The land has been primarily obtained from the village of ‘Badalpura’ under Bairag Union Parishad, Anwara Upazila, Chittagong District. Hence, the area within 2 km radius of the project site (belonging to Badalpura village) has been referred to as the ‘study area’.

The socio-economic baseline is based on the secondary information (Population and Housing Census Data, 2011 published by Bangladesh Bureau of Statistics) available on the

study area as well as the social survey undertaken during the site visit (details of which have been provided in Section 5 of the report). A total of 18 affected titleholders (legal representatives) from a list of 36 titleholders provided by KDDSEZL were contacted for the survey to throw light on their socio-economic status. In addition, 6 households of random sampling within 2 km of the project site were also included to represent families that were not part of the sale of land to the project proponent.

#### 4.3.3. Demographic profile

The total population of the study area as per the 2011 Population and Housing Census Data was at 4235 wherein the total male population was 2388 (56.38%) and total female population was 1852 (43.73%) respectively. The sex ratio in Badalpura was 129 (per every 100 female) while the total number of households was 736 wherein general households comprised of 691, institutional households 40 and others households 5 in total. The area of Bairag Union Parishad of which the study area is a part of is 4013 acres and density of population in the Bairag Union is 1881.

The average size of the Households in Badalpura village was 5.5. The percentage distribution of general households by size of family members has been provided below in the Table.

**Table 71: Percentage Distribution of General Households by size of Family Members**

Study Area	Percentage of General Households per family size							
	1 person	2 person	3 person	4 person	5 person	6 person	7 person	8+ person
Badalpura village	0.9	4.1	10.4	19.5	22.0	16.6	11.1	15.3

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C03.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C03.pdf)

From the table above, it can be observed that an average family size residing in Badalpura village consists of five members. There are 15.3% of households which comprise of eight and more members while families having one person are less than 10%.

As per the recent data (2015) collected from Bairag Union Parishad on the population of Badalpura, the total population reported is 3176, with males comprising 51.16% (1625) of the population and females making up the remaining 48.83% (1551). The percentage distribution of population as recorded in 2011 under various age groups ranging from 1 to 65+ years has been provided below to showcase the demographic set up of the resident population. The Table below highlights the percentage distribution of population.

**Table 72: Percentage Distribution of Population under various age groups**

Study Area	Percentage Distribution of Population under various age groups									
	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-49 years	50-59 years	60-65 years	65+ years
Badalpura Village	8.6	11.8	12.5	14.5	15.3	7.9	21.0	4.3	1.8	2.3

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C04.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C04.pdf)

In Badalpura village, 21% of the population falls within the 30-49 age group while 15.3% comprises the 20-24 age bracket. There is only 1.8% of the population falling within the age group between 60-64 years. As per consultations carried out with the representative of Local

Government and population in Badalpura Village, there are no indigenous communities residing within the village.

### Findings from the Social Survey:

**Male Female Sex Ratio:** As per the survey conducted, in reference to all members of the 24 households as per their sex, there were a total of 89 males and 85 females. Age Group of Members in the Household: In reference to the age group of members of households surveyed, Table below provides the details,

**Table 73: Age Group of members of Household Surveyed**

Place	Age Range of Members (years)									
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	0-10
Badalpura	24	45	33	30	17	8	8	5	4	24

Source: ESIA Study of Karnafuly Dry Dock by AECOM

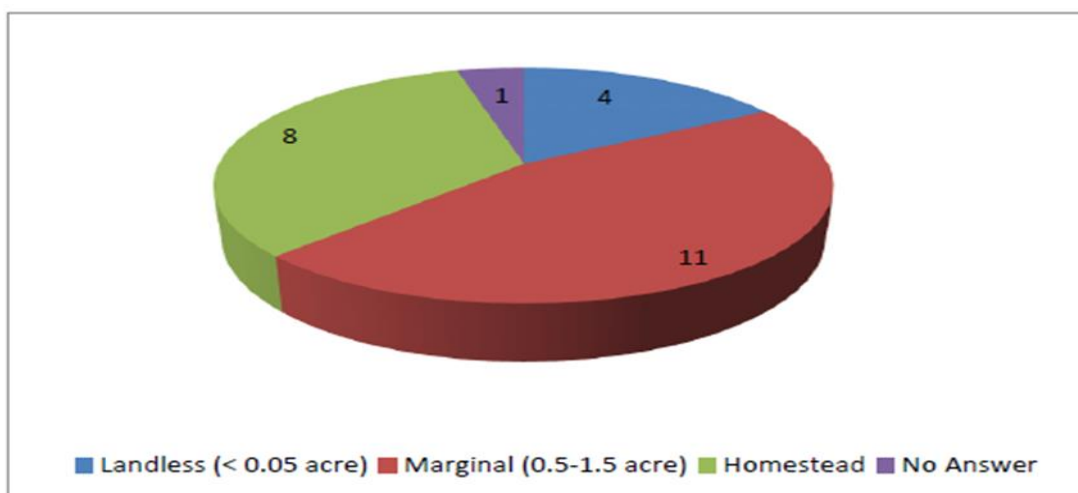
It is observed from the above table that majority of the population of the household surveyed fall within the age group 10-20 years projecting a younger population in the village. The highest older population falls within the age group between 40-50 years.

**Family Size:** The demographic characteristics of households including family size reflect the dependency ratio of family members on the earning member. As per the respondents, the average size of the family consists of 8 to 12 members. Out of the 24 respondents, 10 respondents belong to nuclear family households comprising of immediate parents and wards. The remaining 14 respondents belong to joint family households (12-20 members) wherein the grandparents, parents, brothers and their family and children are part of the household which accounts for a higher dependency ratio.

**Land Ownership Details:** Land is a key asset for rural and urban poor. It provides a foundation for economic activity and the functioning of market (credit) and non-market institutions (local government and social network) in many developing countries. On the basis of this, to correlate the trends of poverty by land ownership in the study area, land ownership details were incorporated in the questionnaire. The details of land ownership amongst the 24 respondents have been provided in the Figure below.

As observed in the above figure, 11 respondents have marginal land ranging from 0.5-1.5 acres in their possession while 8 respondents had no land except for their homestead. This exhibits the fact that land holdings in the study area are meagre. As depicted earlier, agriculture not being a main occupation in the study area, the households do not have a pattern of large land holdings under their ownership. In addition, the constant erosion of Karnafuly River and flooding of the low lying areas have also resulted in land holdings becoming smaller. This fact can be related to the area that has been purchased and filled by KDDSEZL for the proposed project activity.

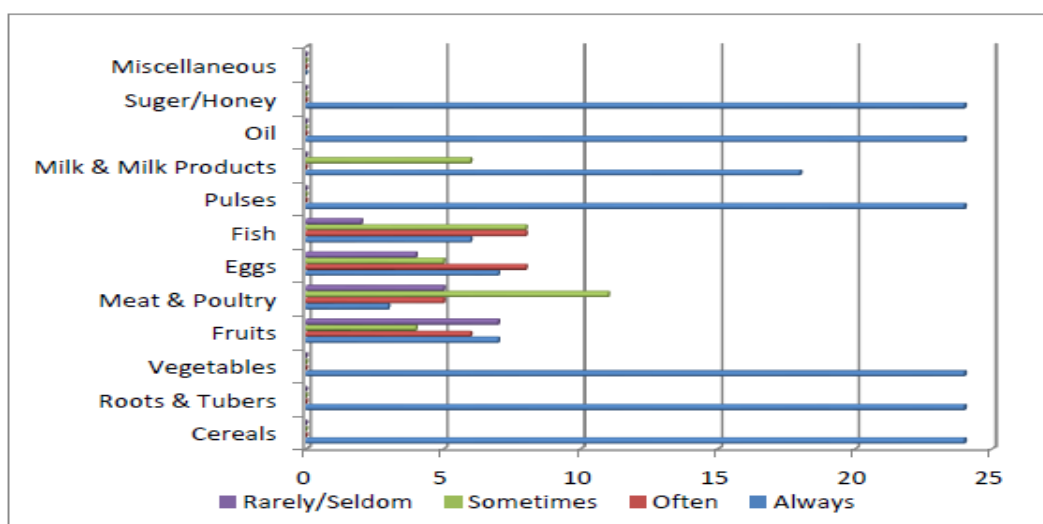




**Figure 65: Land Ownership Details of Respondents**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

**Nutritional Intake Detail:** The Food Energy Intake (FEI) method focuses on the nutritional status as measured by food-energy intake relative to caloric norms. The method finds the consumption expenditure or income level at which food-energy intake is just sufficient to meet predetermined food-energy requirements for good health and normal activity levels. To deal with the fact that food-energy intakes naturally vary at a given income level, the FEI method typically calculates an expected value of intake at given income (or the regression of food energy intake on income). To highlight the correlation between poverty level and nutritional intake, a list of foods and their frequency were incorporated as part of the questionnaire. The nutritional intake details of the respondents have been provided in the Figure.



**Figure 66: Nutritional Intake details of the Respondents**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

As observed in the above figure, food like cereals, roots and tubers, vegetables, pulses, oil and sugar/honey are consumed by all respondents on a daily basis which show the



purchasing capacity of all respondents to purchase these goods. In reference to the intake of eggs, only 7 respondents consume it always while 8 respondents consume it twice a week, 5 respondents consume it sometimes which accounts to thrice a week and 2 respondents rarely/seldom consumes it. A total of 6 respondents consume fish always, 8 respondents often consume it which accounts to twice a week, 8 respondents consume it sometimes which accounts to thrice a week and 2 respondents consume it seldom/rarely. Milk and milk products are consumed by 18 respondents always while 6 respondents consume it sometimes. Fruits are consumed by 7 respondents always, often by 6 respondents, sometimes by 4 respondents and rarely/seldom by 7 respondents. Meat and poultry are consumed by 3 respondents always, often by 5 respondents, sometimes by 11 respondents and rarely/seldom by 5 respondents respectively.

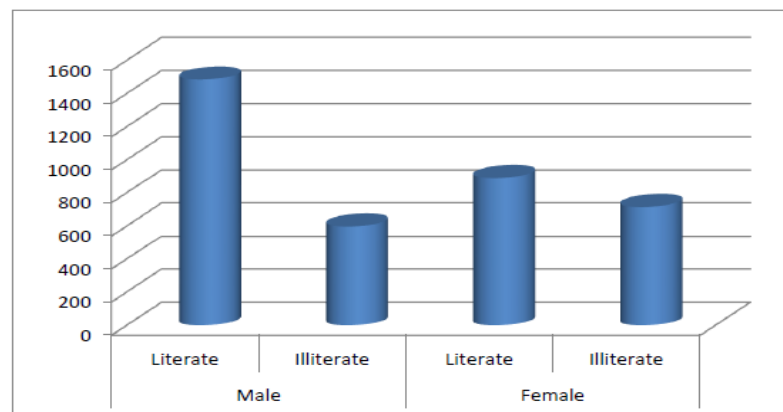
#### 4.3.4. Religious demography

The constitution of Bangladesh established Islam as the state religion, however, in 2010 a Supreme Court decision reversed a 1975 amendment and reaffirmed secularism as a Constitutional principle wherein provision for the right to profess, practice, or propagate all religions, subject to law, public order, and morality had been provided. It elaborates that every religious community or denomination has the right to establish, maintain, and manage its own religious institutions.

According to the 2011 Population and Housing Census Data, in the study area there are 4130 (97.52%) people following Islam, 100 (2.36%) people following Hinduism, 1 (0.02%) person following Buddhism and 4 (0.09%) persons following other religions.

#### 4.3.5. Literacy level

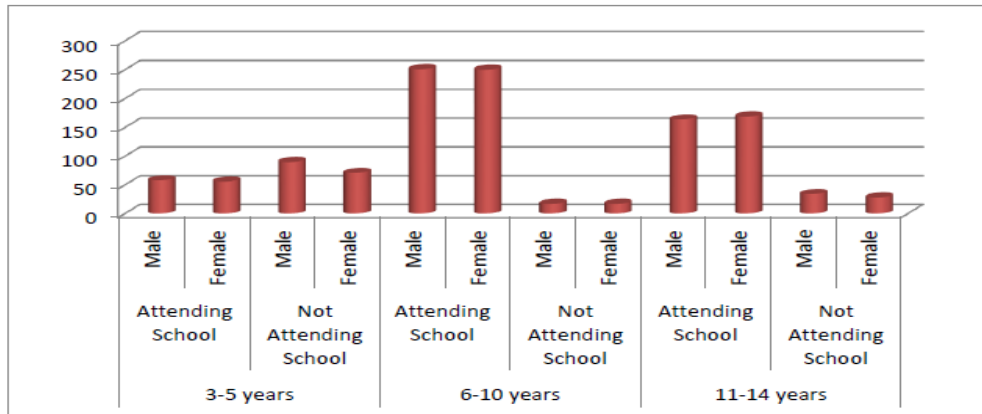
As per the 2011 Census Data, 64.4% of the population are literates with male literates comprising 71.3% and female literates, 55.5% of the literate population respectively. A total of 56.10% of the population aged 7 years and above can write a letter while 31% between the same aged groups cannot write. In the following Figure, the distribution of population aged 7 years and above in terms of literacy and gender has been presented.



**Figure 67: Distribution of Literate Population aged 7 years and above**

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C06.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C06.pdf)

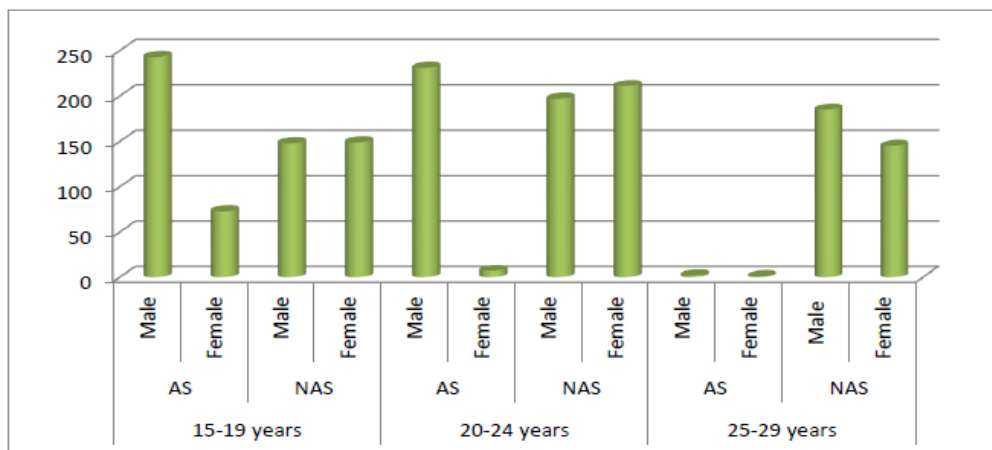
In the above figure, it is observed that there are 62.18% of the male population aged 7 years and above that can write a letter while there are 48.11% of the female population within the same age group which can write a letter. The female population in the same age group which cannot write a letter is substantially high at 38.60% as compared to the male population at 25.04%. In following Figure, the distribution of population in the study area aged 3-14 years along lines of gender and attendance of school has been provided.



**Figure 68: Distribution of population attending schools aged 3-14 years**

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C07.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C07.pdf)

In the above figure, it is observed that the aged group between 6-10 years has the highest number of school attendance with male population accounting for 251 and females 250 of the total population attending schools. In the age groups between 11-14 years, the school going male population accounts for 164 while females comprise 169 of the population. Between the age group of 3-5 years, the population not attending schools is higher wherein the male population accounts for 90 and females, 71 respectively. In the following Figure, the distribution of population in the study area aged between 15-29 years attending school have been provided.



**Figure 69: Distribution of Population attending schools aged 15-29 years**

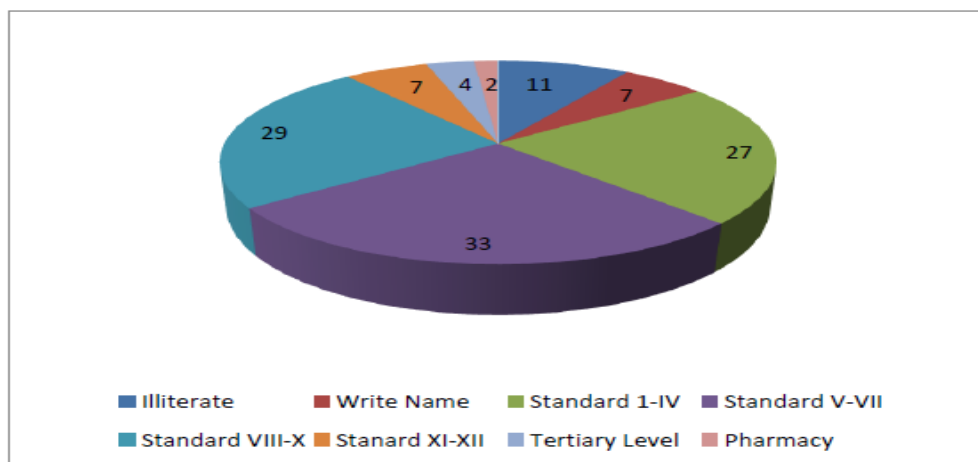
Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C08.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C08.pdf)

AS – Attending School; NAS – Not Attending School

In the above figure, it is observed that in the age groups between 15-19 years and 20-24 years, the highest attendance of school goers comprises the male population with 243 while the female population accounts for 231 respectively. The female school going population showcases a decreasing trend as the age group goes higher. The female school going population is 73 between the age group 15-19 years while between the age group 20-24 years and 25-29 years, it is 7 and 1 respectively. Between the age group 20-24 years and 25-29 years, both the males and females not attending school is higher as shown in the figure.

### Findings from the Social Survey

Education being a powerful driver of development, it is one of the strongest instruments for reducing poverty and improving health, gender equality, peace, and stability. To assess the enrolment pattern of the study area, questions relating to literacy level among the family members of the respondents were included within the questionnaire. The literacy level amongst the respondents and their family members has been represented in the following Figure.



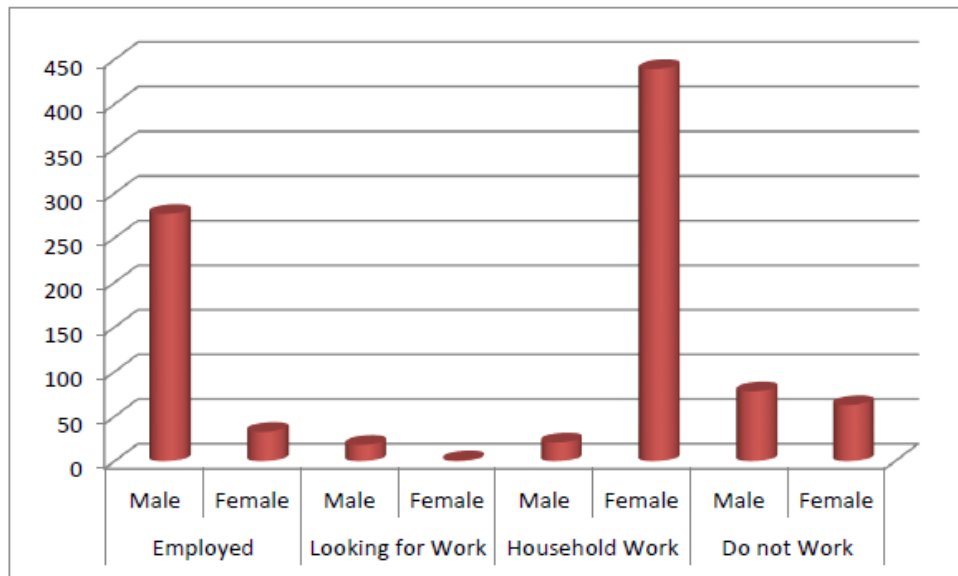
**Figure 70: Literacy Level of Respondents and Family Members**

*Source: ESIA Study of Karnafuly Dry Dock by AECOM*

In the figure above, 33 of the respondent's family members fall within the category of Standard V-VII wherein 24 respondent's family members studied till Standard V. The reason of so many respondents studying till Standard V and dropping out is because in the study area there is only one primary school catering to students till Standard V. Before the establishment of Marine Academy High School in the area, this primary school was the only school providing education in the area. A total of 11 respondent's family members responded that they did not receive any sort of formal education. This group mainly consisted of the older generation especially elderly women. At the tertiary level, 4 respondent's family members, 1 completed and 3 are pursuing their higher education at degree level and an engineering college. In addition, 2 respondent's family members, one still pursuing pharmacy course has been observed.

#### 4.3.6. Employment status

The employment status here refers to the population aged 7 years and above who are not attending schools but are engaged or looking for some sort of employment. In Badalpura village, the total population falling in this category accounts for 930 (21.95%) people wherein males comprise 394 (42.36%) and females, 536 (57.63%) respectively. In the Figure below, the employment status of population falling within this category has been provided.



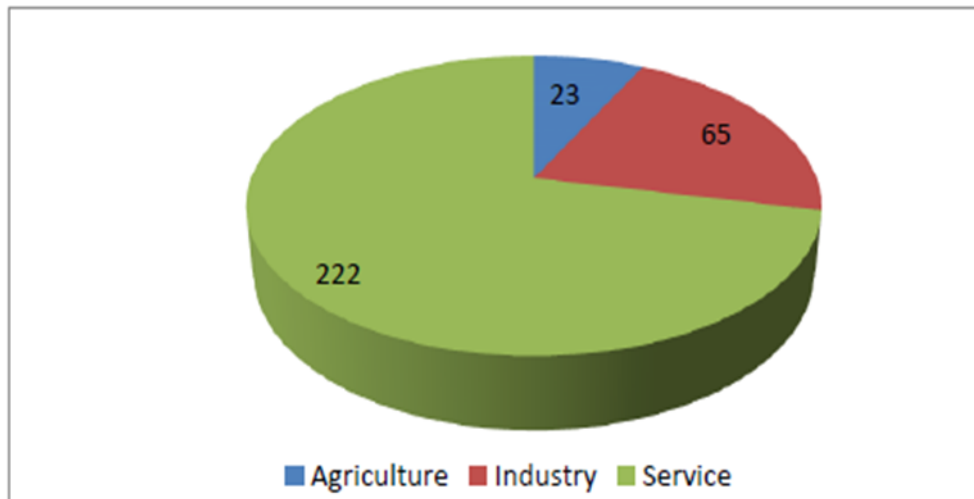
**Figure 71: Distribution of Population aged 7 years & above not attending school by employment status**

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C10.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C10.pdf)

It is observed in the figure above that males occupy the highest percentage of employed workers at 277 (29.78%). While females occupy the highest percentage of workers engaged in household activities at 439 (47.20%) respectively. It can also be ascertained here that the total female population employed is relatively low at 33 (3.54%).

#### 4.3.7. Occupation pattern

Occupation pattern here defines the area of work that the population of a place is generally engaged in. It can vary from primary to secondary and tertiary sectors. In the study area, the total working population employed are 310 (33.33%) wherein 277 (89.35%) males and 33(10.64%) females are occupied in some sort of employment. In the following Figure, the occupation pattern of the population aged 7 years and above not attending school but employed have been provided.



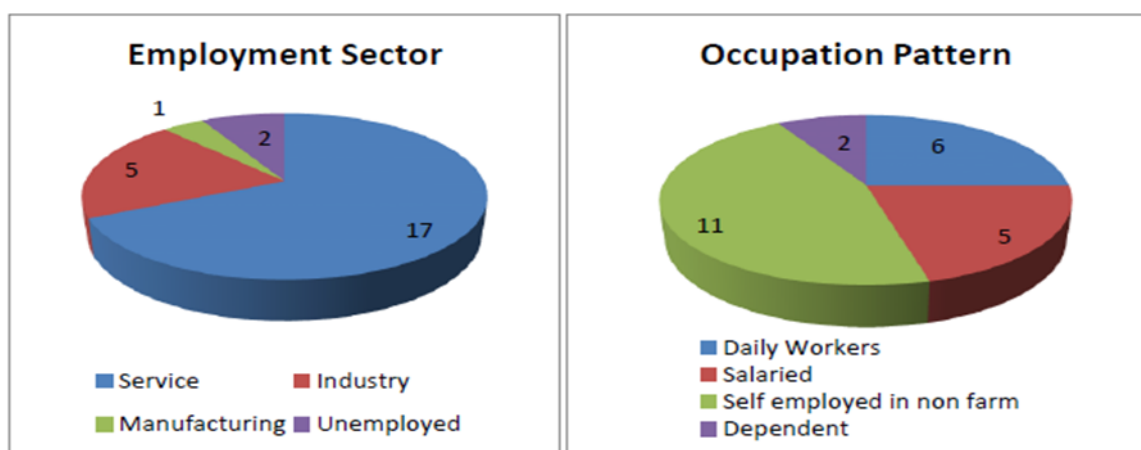
**Figure 72:** Distribution of population aged 7 years & above not attending school but employed

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C11.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C11.pdf)

It is observed from the above figure that 222 (71.61%) persons of the working population are employed in the activities relating to boat operation, contractors, shop owners etc. while people occupied in the agricultural sector are relatively less at 23 (7.41%).

#### Findings from the Social Survey

Income details define a person's ability to meet the necessary basic needs and capacity of expenditure level. This can be attributed towards the employment status and occupational pattern of the individual and his/her contribution to the welfare of the family. The details of the occupation and income of the 24 respondents have been provided in the following Figures.



**Figure 73:** Details of Employment sector and Occupation pattern among the respondents

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The figures above define the sectors in which the respondents are engaged in and the occupation pattern so that the income generated from the source and purchasing power of

the individual can be assessed. In the Employment Sector Figure, 17 respondents had responded that they were engaged in some sort of service ranging from boat operators, running and owning shops, contractors etc. Five respondents surveyed worked in the industrial sector as security guards and manager. One respondent worked in a garment factory while two respondents were unemployed, one of them being an elderly woman dependent on her son in laws income as a security guard. In total, there were 18 income earners among the 24 respondent families.

The Occupation Pattern figure exhibits the types of occupation the respondents have been engaged in. Out of the 24 respondents, 11 of them earn their income as self-employed in non-farm activities, five respondents received salary and six respondents were daily workers. Two respondents were dependent on other source of income indirectly as they were not engaged in any trade directly. In the following Figure, the details of the monthly income bracket have been provided.

It is observed from the figure above that 10 respondents out of the 24 earned incomes between 5000 to 10000 Bangladesh Taka (BDT) in a month while 9 respondents earned between 10000 to 20000 BDT. Three respondents earned more than 20000 BDT in a month which shows a higher purchasing power amongst these individuals. Two respondents received money below 5000 BDT in a month as they were unemployed and dependent on family members for their sustenance.

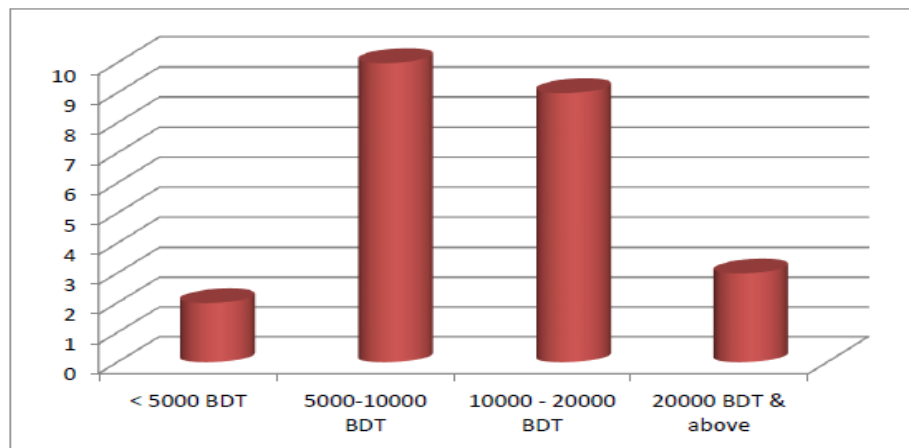


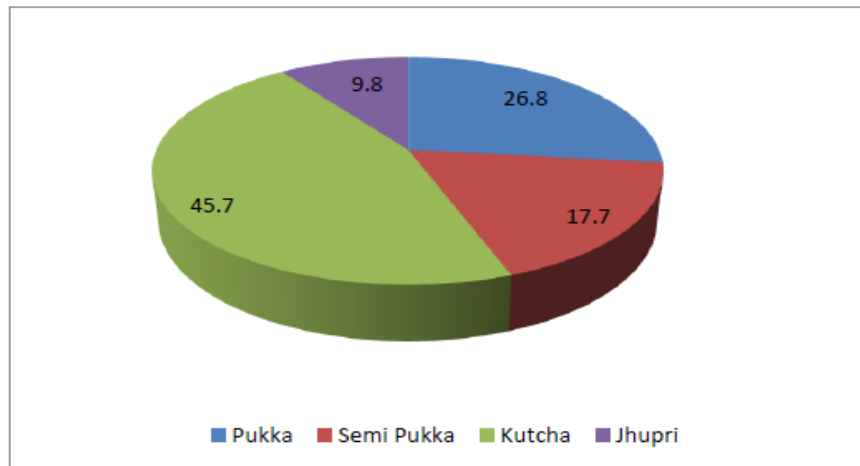
Figure 74: Details of monthly income bracket amongst the respondents

Source: ESIA Study of Karnafuly Dry Dock by AECOM

#### 4.3.8. Existing public amenities

The social infrastructure indicates the development pattern of the area by analyzing the existing infrastructure available in the study area. According to 2011 Census Data, out of the 691 general households in the study area, 28.4 % have sanitary (water sealed) facilities, 31.5% have sanitary (non-water sealed) facilities, 31.7% have non-sanitary facilities and 8.4% have no sanitary facilities. In the following Figure, the percentage of types of house structure in general households have been provided.





**Figure 75: Percentage of types of house structures in General Households**

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C14.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C14.pdf)

It is observed in the figure above that 45.7% of general households in Badalpura village have kutcha house structures highlighting the purchasing power of the study population. A total of 26.8% of households have concrete houses showcasing the population with better economic status. In reference to the source of drinking water and electricity connection, the following Table highlights the details as present in the study area.

**Table 74: Amenities present in General Households in Study Area**

Study Area	Source of Drinking Water (%)			Electricity Connection (%)
	Tap	Tube well	Others	
Badalpura village	22.7	65.4	11.9	83.8

Source: [http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong\\_C15.pdf](http://www.bbs.gov.bd/Census2011/Chittagong/Chittagong/Chittagong_C15.pdf)

As observed in the table above, in the study area 83.8% of general households are connected with electricity. In terms of source of drinking water, the main source as depicted is tube well. Due to the proximity of the area to Karnafuly River, water is not an issue as the depth of tube wells is around 20-30 feet.





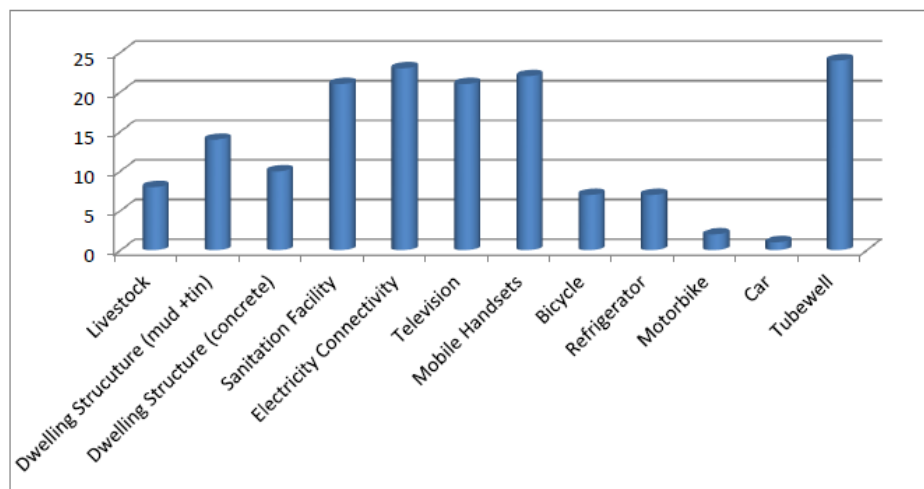
**Figure 76: Existing Amenities within the Study Area**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The housing tenancy of the general households in the study area as per the Census Data showcases that 71.8 % are owned while 24.3% are rented and 3.9% are free. As rented houses have grown due to developments in the area, this has supplemented family's source of income in the study area.

### Findings from the Social Survey

Basic Assets & Amenities: Asset poverty can be defined as a household's inability to access wealth resources that are sufficient enough to provide for basic needs for a period of three months. Basic needs refer to the minimum standards for consumption and acceptable needs. Here the focus on basic assets and amenities refer to the ability of the population to afford physical assets and derive benefits from these assets. All the respondents mentioned that they owned the houses they are currently residing in. In the following Figure, the details of the basic assets and amenities under the ownership of the respondents have been highlighted.



**Figure 77: Details of Basic Assets and Amenities under ownership of respondents**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

The figure above indicates that out of the 24 respondents, 8 owned livestock ranging from cows and goats to poultry. A total of 14 respondents resided in structures comprising of mud walls and tin roofs while 10 respondents resided in structures made of concrete. In reference to sanitation facilities available in individual households, a total of 21 respondents responded that they possessed the facilities within their household while 3 respondents mentioned that they shared the sanitary facilities with their neighbors as it was a common one. A total of 23 respondents responded that they had electricity connection in their house however, the power supply was erratic and load shedding takes place 4 to 6 hours in a day. All 24 respondents have mentioned that they have a tube well which is the source of drinking water. In terms of televisions, 21 respondents mentioned that they owned one each; 22 respondents owned mobile handsets; 7 respondents owned a bicycle and refrigerator each; 2 respondents owned a motorbike and 1 respondent owned a car.

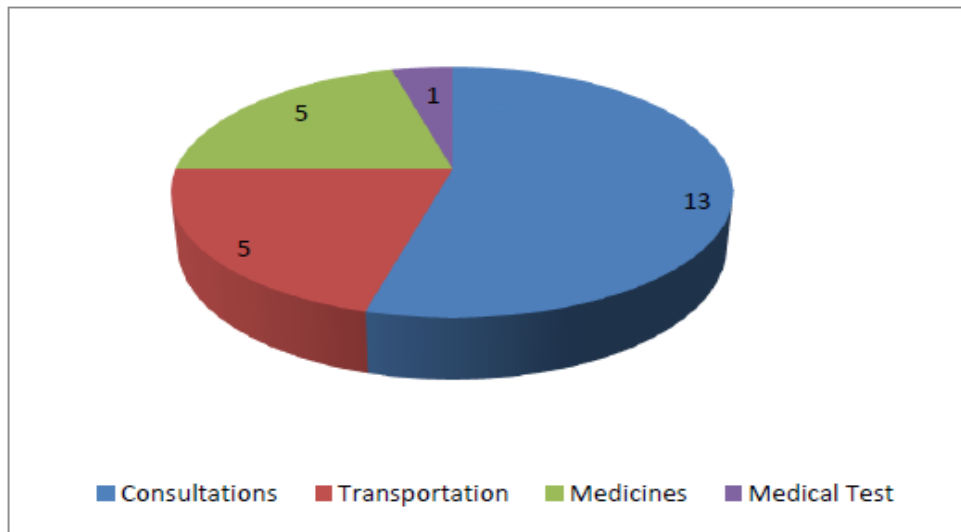
**Health Details:** Poverty is a major cause of ill health and a barrier to accessing health care when needed. This is partly due to the costs of seeking health care, which include not only out-of-pocket spending on care (such as consultations, tests and medicine), but also transportation costs and any informal payments to providers. It is also due to the considerable loss of income associated with illness in developing countries, both of the bread winner, but also of family members who may be obliged to stop working or attending school to take care of an ill relative. In addition, poor families coping with illness might be forced to sell assets to cover medical expenses, borrow at high interest rates or become indebted to the community.

To assess the aspect of health in terms of common illness, feasibility of seeking health care, distance of nearest health center from place of residence, immunization of children in the family and medical expenditure have been taken into consideration to highlight the correlation between the individual and his/her ability in spending money for medical care.

As per the respondents, the common illness among the residents of the study area is malaria, typhoid, diarrhoea, fever, common cold and diabetes among the older generation. A pharmacy with a registered pharmacist serves the village in terms of regular illness. In case of major illness, he recommends them to see a doctor. An MBBS doctor is available at Marine Academy and he consults the village people.

The nearest health centers are the Anwara Upazila Health Centre (0.5 to 1 km) and Chittagong Medical College (approx. 18 km) which are frequented by the residents of the village in case of major ailments and emergencies.

The Government of Bangladesh through their free immunization program for children from 12-23 months hold camps in village schools to provide the services. In the study area too, medical camps catering for free immunization programs are provided to children free of cost. In the following Figure, the range of medical expenses which the respondents find most expensive has been provided to highlight the capacity of individual expenditure.



**Figure 78: Details of medical expenditure among respondents**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

In the figure above on medical expenditure, 13 respondents mentioned that consultations with doctors were the most expensive. The consultation charges range from 600-1500 BDT each time. A total of 5 respondents were of the view that transportation to the hospital was the most expensive while 5 respondents mentioned that medicines were the most expensive. In regard to medical test, one respondent claimed that it was the most expensive amongst medical care.

**Existing Public Amenities:** In reference to the existence of public amenities in the study area with regards to the transport connectivity, the most common transport used by the local population is boat followed by public bus and autos (CNG).

There is one government bank (Sonali Bank) situated in Marine Academy which serves the entire population. In addition, there is a post office based within the premises of Marine Academy as well. The road condition within the entire village is unpaved.

There are three primary schools in the area (one run by the Government, second run by Marine Academy and third run by BRAC). In addition, there is one high school as well run by Marine Academy.

#### **4.3.9. Existing cultural resources**

As per the consultations carried out with the population in the study area, there are two mosques situated within the study area, Hazi Anor Ali Jam-E-Masjid established in 1930 and Badalpura Kadria Jam-E-Masjid established in 1875 which are about 300m and 500m respectively from the project site. Besides these two structures, there are no sites of archaeological or cultural significance around the project site area.





**Figure 79: Household Survey**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

#### **4.3.10. Gender Profile (Social Status of Women)**

To comprehend the existing living pattern of the local population residing across the study area, a look at the social status of women and the role that women have been playing both at the domestic and economic level needs to be taken into consideration. As the patriarchal values are entrenched in Bangladesh's society, women often play a more subordinated and dependent role. Even though they constitute almost half the population, various indicators pertaining to literacy level, labor force participation, mortality rate etc. reveal the dismal status of women to that of men.

According to the UN Gender Development Index 2012, Bangladesh ranked 111<sup>th</sup> out of a total of 180 countries worldwide. As per the World Bank data 2012, 49.35% of the total population constitutes females. In reference to the literacy level, a total of 53.4% women are literate as compared to 62% of literate males.

As per the demographic profile of females in Bangladesh, the infant mortality rate of females is 44.71 deaths for every 1000 live births as compared to 49.79 male deaths for every 1000 births. The life expectancy of females at birth is 72.31 years which is higher to that of males at 68.48 years. The maternal mortality rate is 240 deaths for every 100,000 live births.

In terms of education and enrollment of females in various levels, the rate of participation is low as compared to the total female population. The female enrollment rate at the primary level is 50.2%, at the college level it is 45.48%, while 37.23% are enrolled in professional courses, 52.13% are enrolled in madrasah education, 35.66% are enrolled in teacher training courses, 27.21% are enrolled in technical – vocational educational courses and 30.03% in university courses, respectively. This rate of enrollment highlights a bleak picture when it comes to female education level in the country.

As per the Labor Force Survey conducted in 2010, Bangladesh had a total of 16.2 million females working in various types of employment sectors wherein rural (female) workforce participation accounted for 77.4%. Apart from the employed workers, the unemployed female population in Bangladesh was 1.0 million females and those not included in the labor force were 30.5 million. Out of these, the female unemployed rate at the rural area accounted for 65.7% whereas 22.9 million were not included in the labor workforce.

In the formal sector, 1.3 million females were engaged while in the informal sector, a total of 14.9 were employed. This apparent disparity shows the lack of employment opportunities available for women as a whole. Women's household work continues to remain unrecognized, uncounted and invisible. In the agricultural sector 68.84% females were engaged followed by the service sector at 21.89% and industry sector at 13.32%, respectively. Details of employed persons engaged in major occupations has highlighted females engaged in agriculture, forestry, fisheries occupation at 64.8%, followed by production & transport laborers at 14.0% and service workers at 8.1%.



In the process of the social survey, women's response was gathered to highlight the viewpoint of issues pertaining specifically to women and their status in the study area which have been elaborated in details in the following sections,

**Literacy Level:** Most of the women consulted, studied till Standard V and have dropped out of school highlighting absence of school in the area. Women of older generation were illiterate and depended on their sons.

**Government Schemes for Women:** All respondents were vocal in their response that the most popular government scheme implemented for women related to family planning and vaccination programs for child health.

**Pattern of Employment:** In terms of pattern of employment amongst the women folk, most of the women are engaged in doing household related activities. Few women of the village are involved as garment workers working in garment factories. Some women who have completed their high school level education have joined Non-Governmental Organizations and are working as teachers.

**Employment purpose of Men travelling out of the Study Area Villages:** Most respondents were of the view that the men of the household are mostly engaged in service, daily workers and contractors related activities. There are a few of them who travel out of the area to Dubai for employment purposes.

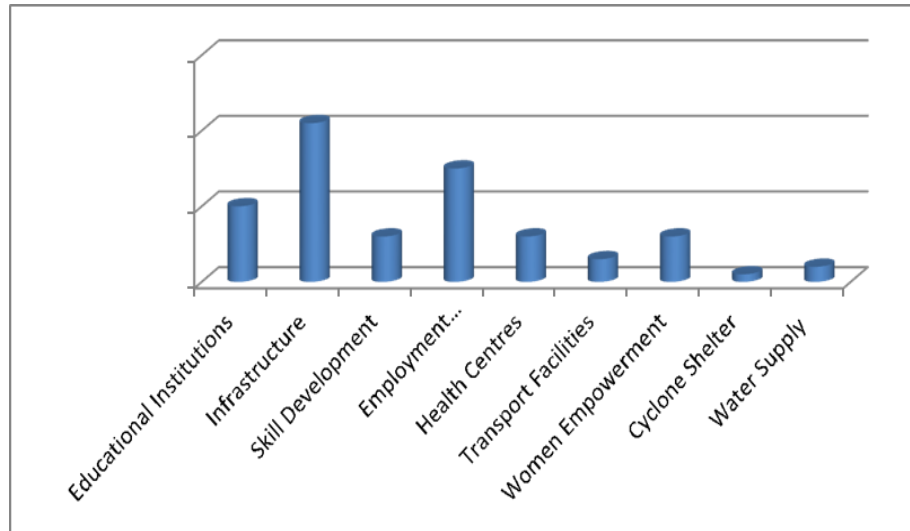
**Medical Issues:** The most common medical issues amongst women that were highlighted were childbirth and anemia. During childbirth, during the consultations it was mentioned that a village 'dai' (midwife) is usually called in.

**Presence of Vocational Centers:** There are no vocational centers catering to women in the area.

**Expectations:** Most women respondents were of the view that the need of the hour should be development of health centers and employment opportunities among women. Medical health camps catering to women health issues should be held regularly to impart information and steps for necessary actions at times of emergencies. In addition, vocational centers catering to skills like stitching, knitting, handicraft making, pickle making etc. should be opened up so that women while sitting at their homes can take up steps to supplement their economic condition and raise their status in the society.

#### **4.3.11. Need assessment**

A need assessment was conducted amongst the respondents to highlight the expectations of the local population in the area from the proposed project proponent. These views were collected in order to comprehend the need of the locals so that prioritizing of welfare activities by the project proponents can be better chalked out in the future. The detail of the areas wherein utmost priority needs to be given is shown in the Figure given below.



**Figure 80: Areas as defined by the respondents which need utmost priority**

Source: ESIA Study of Karnafuly Dry Dock by AECOM

From the figure above, the following areas had been identified amongst the respondents which require utmost priority in terms of deliverance of activities,

Road accessibility has been named as the area which needs the highest attention. Issues pertained to the monsoons when commuting by boat which is the most common mode of transport becomes difficult thus, creating problem among the local communities. Proper road access which is lacking in the area was suggested as a means which can ameliorate this problem. In addition, construction of drains in the village was also mentioned as a necessary requirement.

Lack of employment opportunities have also been mentioned as a major problem amongst the local communities in the area. The communities being involved mainly as daily workers, self-employed, boat operators etc. have highlighted that absence of industries in the area have restricted the growth of people to seek employment and diversifying to other sectors.

Healthcare has been rated as an area where in a large amount of work needs to be undertaken. Most of the respondents were of the opinion that due to lack of proper roads connecting areas with hospital facilities, dependence on the water transport is essential which becomes difficult in the monsoon season.

Educational facilities in the area with trained teachers, toilets, classroom and playground have been mentioned as a necessity in the area.

Skill development in terms of skills like masonry, welding, small electrical and mechanical work, driving, mobile repairing, computer education etc. should be imparted as part of polytechnic curriculum so that the local population can be eligible for jobs opportunities which might arise in the future.

Vocational centers offering skills like stitching, handicraft making etc. should be set up to inculcate the women folk in the mainstream economy so that they could be earn an income besides being engaged with household activities.

Availability of transport facilities has also been mentioned as an area which needs to be given priority.

Supply of pure drinking water was also highlighted as a major concern among two respondents.

## **Chapter 5**

# **STAKEHOLDER ANALYSIS, CONSULTATION, PUBLIC AWARENESS, DISCLOSURE AND GRIEVANCE REDRESS**

## **5. Stakeholder analysis, consultation, public awareness, disclosure and grievance redress**

### **5.1. Introduction**

Stakeholder consultations are important processes through which a two ways dialogue is created between the project proponents and the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. They can comprise individuals, communities, social groups, organizations etc. It is often observed that the poor and the marginalized are often ignored either due to the fact that they are unaware or do not have a forum to voice their opinion. As per World Bank's Policy on Disclosure of Information, 2002 participation of public is necessary as it is a two ways process wherein people learn about and have input into design of projects that affect their lives, well-being and environment.

By identifying and consulting all stakeholders, especially the poor and the vulnerable, it is essential to ensure that the project meets the need of all sections of the people. Stakeholder engagement is a continuous and inclusive process between a project proponent and those potentially impacted encompassing various activities and interactions over the entire life of the project.

### **5.2. Scope and objectives of the study**

As part of the ESIA study, stakeholder identification, stakeholder analysis, consultation, public awareness, disclosure and grievance redressal are important components which are required to be undertaken in a project to maintain transparency and sense of ownership among the local communities in the area. The following aspects were encompassed within the process of stakeholder engagement:

- To identify the key stakeholders of the proposed project and assess the power relationships as well as the level of influence and interests of the stakeholders involved in the development of the project.
- Undertake a stakeholder analysis to categorise the most important actors for the preparation, design, implementation and monitoring of the proposed project.
- Undertake consultations including inform and consult with the local communities likely to be affected by the proposed project as well as stakeholders that are influenced like NGOs.
- Examine opportunities and conditions for the participation of the stakeholders including vulnerable groups in the project cycle.

- The project being categorised as Category A as per the World Bank Environment Assessment Policy (OP 4.01), the stakeholders are required to be consulted twice: a) in meetings held during the screening and scoping stage and b) when a draft EIA is made available, it is a requisite that a summary of the report is to be translated in the local language and displayed to the public in a locally accessible location prior to the meeting. Various forms of consultations like public meetings, focus group discussions, one-to-one interviews etc. should be adapted to the stakeholders with the goal of ensuring a broad and meaningful engagement process.
- To disseminate relevant materials to the affected groups in a timely group manner prior to the consultation and in a form and language that is understandable and accessible to the groups being consulted. Records of all consultations are to be maintained and updated regularly.
- To develop a Grievance Redressal Procedure to respond to queries and address any complaints, disputes and grievances regarding any aspect of the project. This procedure should include the mechanism and composition of the Grievance Redress Committee (GRC) involving NGOs, local elites and representatives of local government to ensure accountability and transparency of the grievances addressed.
- To describe the disclosure requirements of environmental and social documents at different stages of the project and guide the project proponent to disclose the same so that the stakeholder consultation, full information on the designs and environmental and social impacts and mitigation measures are properly disclosed and made accessible to the local population.

### **5.3. Study area**

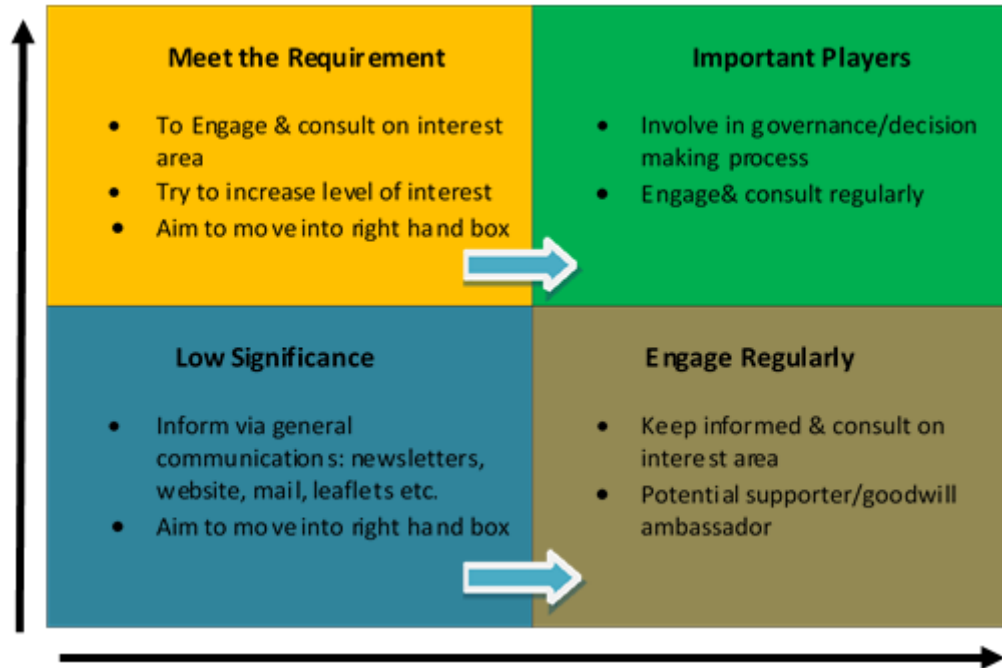
The stakeholders for the project were prioritized based on the level of impact and influence they wield over the different phases of the project cycle. The proposed project site being located in Badalpura village, consultations were primarily undertaken with the local communities residing within 2 km (in Badalpura village) from the project site considering the impacts (if any) and proximity that might affect the local population around the area. In addition, consultations were also undertaken with indirect stakeholders which were identified during the time of the site visit.

### **5.4. Study methodology**

The process of stakeholder consultation was initiated with the identification of stakeholder by assessing the level of interest and influence of the stakeholders and their power relationship towards the project. Once the tentative stakeholders were shortlisted, they were grouped into identifiable groups of people with similar interest. The stakeholder was then mapped to a matrix to showcase the stakeholder groups and their interest areas which also helped to develop a communication plan assigned to each stakeholder's focus and concerns.

Once the interest of the stakeholders was mapped they were categorized in terms of importance. To initiate this step, a common approach of mapping the interest and power or

influence of each stakeholder group on a quadrant (power/interest grid) was drawn out. This step was to assess the interest/influence into high, medium and low as well as to assess the power relationship, impact, support and attitude of the various identified stakeholders. In the grid as mentioned, it shows that the stakeholders which fall within the left grid have scope of diverting to the sections on the right grid over some given amount of time. The following Figure highlights the power/interest grid that would be used to categorize the stakeholders.



**Figure 81: Power/Interest Grid of Stakeholders**

*Source:* Adapted from Eden and Ackermann (1998: 121-5, 344-6)

To initiate the stakeholder engagement process, two levels of engagements were focused upon. The first comprised of a social survey to understand the socio-economic status of the study population including the concerns/issues and expectations of the local community and second, conduct of focus group discussions, one-to-one interviews and public hearing to gather the viewpoints of the various identified stakeholders as well as disclose information on the proposed project and its potential impacts on the lives of the local communities and respond to queries of the concerns and aspirations raised in a neutral manner.

A simple random sampling method was adopted to undertake the social survey comprising of a list of open-ended and close ended (using likert scaling) questions. The target of the social survey was to understand the views of project affected households (land owners who have sold their land for the proposed project) and other households (households that have not sold their land) so that a representative sample could be gathered in reference to Badalpur village.

The criteria of identifying these households were based on the proximity to the site area, households from whom land were procured and socio-economic characteristics.



Households within 2 km of the project site were focused upon to undertake the survey. The details of the social survey findings have been furnished in Section 4 on Socio-Economic Baseline. Besides the local population, members of local governing institutions, opinion leaders and NGO's working in the area were identified and interviewed to incorporate the views of other indirect stakeholders.

#### **5.4.1. Desk based review**

A desk based research of documents available in the public domain and provided by the project proponent was reviewed. On the basis of the desk based research, information on the socio-economic baseline of the study area, the land required for the project and details of the land owners that sold their land was gathered. The websites and reports that were reviewed for the study have been provided in the following:

- Population and Housing Census Data, 2011 (of Badalpura village under Bairag Union Parishad);
- Agricultural Census Data, 2008 by Bangladesh Bureau of Statistics;
- Economic Census Data, 2003 by Bangladesh Bureau of Statistics;
- Bangladesh Literacy Survey Report, 2010 by Bangladesh Bureau of Statistics;
- World Bank' Bangladesh Poverty Assessment Report 2000-2010;
- Poverty Assessment for Bangladesh: Creating Opportunities and Bridging the East-West Divide; World Bank Bangladesh Development Series Paper No. 26;
- Report on Monitoring of Employment (Labour Force) Survey, 2009;
- Report on Household based Livestock and Poultry Survey, 2009 by Bangladesh Bureau of Statistics;
- Report on Welfare Monitoring Survey, 2009 by Bangladesh Bureau of Statistics;
- Report on Valuation of Property (Land and Building) provided;
- Copy of No Objection Certificate (NOC) from Bairag Union Parishad;
- Copy of Sale Deed of one Titleholder;
- Copy of Lease Document with Chittagong Port Authority;
- Copy of Lease Document with Revenue Deputy Collector, Chittagong;
- Copy of Land Deed details with titleholder and land purchased;
- List of Employees engaged with KDDSEZL

#### **5.4.2. Questionnaires & interview schedule**

A structured questionnaire with both open ended and closed ended questions was developed to undertake the social survey. The questionnaire was divided into 11 sections comprising of aspects related to location related information, respondent and family details, literacy level, land ownership details, basic assets and amenities, occupation and income details, nutritional intake details, health details, amenities present in the area of residence, gender profile, perception about the project and need assessment of the study population. A sample copy of the Social Survey Questionnaire has been attached as **Annexure IV**.

A reconnaissance survey and site visit was undertaken to the study area. A schedule to undertake the survey and interviews were drawn up so that all the required tasks could be

completed within the timeframe. The following Table highlights the schedule of social survey and consultation.

**Table 75: Schedule for the Social Survey and Stakeholder Consultation**

S. No.	Tasks
1.	Social Survey & interviews with local stakeholders
2.	Public Hearing
3.	Interviews with Stakeholders
4.	Interviews with (indirect) Stakeholders
5.	Second Public Hearing

#### 5.4.3. Stakeholder identification

The stakeholders in the project were identified based on their level of interest and influence over the project activities. The stakeholders were primarily divided into direct and indirect and further regrouped as internal and external. In the following Table, the types of stakeholders as per their level of interest and influence have been provided.

**Table 76: Types of Stakeholders as per their interest and influence.**

Sl. No.	Types of stakeholders	Groups+ Individuals
1.	Direct Internal Stakeholders	<ul style="list-style-type: none"> <li>KDDSEZL</li> <li>Direct Employees of KDDSEZL (present and future)</li> </ul>
2.	Direct External Stakeholders	<ul style="list-style-type: none"> <li>Project Affected Households</li> <li>Local Community in Badalpura Village</li> <li>Opinion Leaders within Badalpura Village</li> <li>Government of Bangladesh (Revenue Department, Chittagong District)</li> <li>Chittagong Port Authority</li> <li>Future Contractors</li> <li>Financial Intermediary</li> </ul>
3.	Indirect Internal Stakeholders	<ul style="list-style-type: none"> <li>Families of Direct Employees</li> </ul>
4.	Indirect External Stakeholders	<ul style="list-style-type: none"> <li>Local Government (Member of Badalpura Village, Chairman and members of Bairag Union Parishad)</li> <li>Department of Environment, Ministry of Environment and Forest</li> <li>Chittagong Dry Dock Limited</li> <li>BRAC (NGO)</li> <li>Chittagong Development Authority</li> <li>Bangladesh Inland Water Transport Corporation</li> <li>Bangladesh Inland Water Transport Authority</li> <li>Bangladesh Forest Research Institute</li> <li>Bangladesh Water Development Board Bangladesh Marine Fisheries Academy Bangladesh Marine Academy</li> <li>Local Media</li> <li>Vendors</li> </ul>

The description of each stakeholders and their grouping into the various types have been provided below:

**Direct Internal Stakeholders:** Direct internal stakeholders comprise the parent company or the project proponent and the employees of the company that are directly controlled by the

parent company. Direct internal stakeholders comprise of the following group/individual and entities:

- **Karnafuly Dry Dock Special Economic Zone Limited:** KDDSEZL being the owner of the proposed project is the primary stakeholder. KDDSEL by its virtue of adhering to international standards like World Bank and IFC Performance Standards is bound to undertake the project in a manner which upholds its commitments to identify and mitigate all associated environmental and social risks for all its project activities.
- **Direct Employees:** At present, a total of 28 employees with 9 workers from Badalpura village are engaged in KDDSEZL. Once the project becomes operational, there will be approximately 1500 workers that will be engaged. The employees being direct stakeholders, their feedback is essential to foster and maintain the worker management relationship.

**Direct External Stakeholders:** Direct external stakeholders comprise the project affected people, local communities, third party contractors, supply chain and financial intermediary who are directly affected by the project activities but are not directly controlled by the project proponent.

- **Project Affected Households (PAHs):** As per details provided by KDDSEZL Management, there have been 36 deed document representatives (legal representatives of 36 land title holders) that sold their land for the proposed project. On review of the sale deed, it was observed that other family members of the title holders have also put their consent and attestation on the sale deed by attesting the document. Consultations with 18 households (families of 18 deed document representatives) of the 36 deed document representatives were carried out wherein their socio-economic status was recorded. Invitation to the public hearing held on KDDSEZL premises was also provided to them during the consultation process. The PAHs are key stakeholders as the adherence to commitment by KDDSEZL can be detrimental in deciding the extent of cooperation and support they receive from the affected community.
- **Local Community in Badalpura Village:** The development of the proposed project will lead to an increase of vehicle movement and influx of workers from other areas which will in turn, affect the local community to a considerable extent. Constant consultation and disclosure of information about the proposed project activities need to be communicated to the local community so that transparency and support about the activities can be maintained from the local population.
- **Opinion Leaders within Badalpura Village:** Opinion leaders like ex-member of Badalpura village, primary school teacher, and religious leaders of the local Mosque fall within the category of opinion leaders. Being residents of Badalpura village, their opinions are valuable regarding the impacts and mitigation measures that would be applied to the different phases of the project.
- **Government of Bangladesh (Revenue Department, Chittagong District):** As the proposed project has leased (99 years) land amounting to 7.80 acres from the

Revenue Department, Chittagong District for the proposed project, this department is a key stakeholder to the proposed project.

- **Chittagong Port Authority:** A total of 2.12 acres has been leased from the Chittagong Port Authority for a 10 years period by KDDSEZL. Hence, the Chittagong Port Authority also is a key stakeholder of the proposed project. In addition, the Chittagong Port Authority has already given the necessary permission to KSBL to construct the KDDSEZ project.
- **Future Contractors:** Third party contractors usually consist of those workers who are not directly contracted by the parent company but instead are sub contracted by the Contractors. As both the Contractors and third party contractors would be engaged in the different phases of the project activities, they would be considered as stakeholders as well.
- **Financial Intermediary:** The financial intermediaries comprise of financial institutions, in this case World Bank who is undertaking the project financing. This stakeholder tends to be influential and have a set of guidelines which KDDSEZL would need to comply. KDDSEZL will also have to comply with various undertakings made to the financial institution besides the set guidelines. In addition, IDLC Finance Limited here also falls within this category as through them KDDSEZL will receive the requisite funding from World Bank.

**Indirect Internal Stakeholder:** Indirect internal stakeholders consist of the secondary stakeholders who would have a more indirect interest but within the direct influence of the project.

- **Families of Direct Employees:** Families of direct employees (present and future) comprise the indirect internal stakeholder. This group would be indirectly affected by the decision of the project proponents if promotion or retrenchment of their family members directly employed in the operational facilities is undertaken.

**Indirect External Stakeholder:** Indirect external stakeholders comprise those stakeholders whose interest even though are indirect they fall within the external group such as those involved in institutions or agencies concerned with managing the resource or those who depend at least partially on the business generated by the resource.

- **Local Government (Member of Badalpura Village, Chairman of Bairag Union Parishad):** The government at the local level comprising the present member of Badalpura Village, Chairman and members of Bairag Union Parishad will be responsible to play an active role pertaining to the collection of grievances regarding issues that might arise from the project activities. They will be responsible to act as the communication channel between the local area and the project proponent. They are considered as indirect stakeholders as they do not have a day to day role in the project development but will play a significant role in monitoring that the resolution of project level issues by KDDSEZL is carried out in a transparent manner.

- **Department of Environment (DOE), Ministry of Environment and Forest:** The requirement of authorization from the Ministry of Environment and Forest is necessary for the proposed project to commence. KDDSEZL is bound to follow the instruction from the Department of Environment to perform environmental protection of the area under them. The external reporting made to DoE and its observations will guide the implementation of the proposed project activities.
- **Chittagong Dry Dock Limited (CDDL):** KDDSEZL being the second dry dock to be constructed in Chittagong District after the oldest functioning Government run Chittagong Dry Dock Limited can develop communications with the management of CDDL. This will help the management of KDDSEZL to be apprised and updated of details pertaining to the establishment of a dry dock special economic zone facility. By regularly being updated of inputs relating to dry dock facilities within the country and other areas in South Asia will help KDDSEZL in knowledge development of this project.
- **BRAC (NGO):** BRAC being the sole NGO currently working in the welfare of the community in Badalpura Village can play an important role in collaborating with KDDSEZL for future welfare activities of the community.
- **Chittagong Development Authority:** Anwara Upazila falling under Development Planning Zone – 12 of Detail Area Plan of Chittagong Development Authority has been considered as an external stakeholder as Badapura village falls under Anwara Upazila.
- **Bangladesh Inland Water Transport Corporation:** The views of the Corporation were sought as the agency is involved in monitoring the traffic flow on the river and assessment of traffic movement could be best provided by the agency.
- **Bangladesh Inland Water Transport Authority:** As the project might affect the flow of the water transport along Karnafuly river, Bangladesh Inland Water Transport Authority that monitors the flow of traffic on the river, the agency has been considered as an external stakeholder.
- **Bangladesh Forest Research Institute:** Near the project area, a small patch of mangroves was observed, to assess whether this patch would be affected due to the project, the Forest Department was considered as an external stakeholder. Here, Bangladesh Forest Research Institute had been contacted to understand their views about the mangrove plantation.
- **Bangladesh Water Development Board:** The proposed project being a necessary development for the river system of Bangladesh, views of Bangladesh Water Development Board regarding this project was considered crucial.
- **Bangladesh Marine Fisheries Academy:** The Marine Fisheries Academy was considered as an indirect stakeholder as knowledge about the fish population in the Karnafuly River and an assessment on the impact of the fish population due to the development of the project could be understood from professionals based at the Academy.

- **Bangladesh Marine Academy:** The location of Bangladesh Marine Academy being within 10 km radius from the proposed project, views of Bangladesh Marine Academy are necessary to assess the viewpoint of external stakeholder's relating to the development in the area.
- **Local Media:** Media groups that have covered the public hearing of the facilities are active and can be brought within the gamut of external stakeholder. In future, these media groups can be updated on the development of the project activities and publicise any subsidiary developments that the project proponent will undertake for the local community.
- **Vendors:** The vendors that will be engaged in the operational phase of the project will form a significant part of the project activities. The vendors will fall within the category of indirect external stakeholder as the crux of their function is to source raw material to the project.

#### 5.4.4. Stakeholder analyses

Stakeholder analysis takes a more comprehensive view of the stakeholder's group interests, how they would be affected and to what extent and the influence that they could have on the project. These aspects cumulatively provide the basis for constructing the stakeholder engagement strategy. Once different types of stakeholders have been identified and listed, matrices and other illustrative devices can be developed that map the nature of the stakeholder's interest in the project, the extent to which stakeholder interests converge or overlap, their importance in the different phases of the project activities and their influence over the project (as depicted in the power/interest grid). The key stakeholders identified in the above section have been categorised into four major groups: Government Agencies, Positively Affected Stakeholders, Critical to Engage and Donors. The categorisation list of key stakeholders has been provided in the following Table.

**Table 77: Categorisation List of Key Stakeholders.**

Categorisation	Key Stakeholders
Government Agencies	<ul style="list-style-type: none"> <li>• Government of Bangladesh (Revenue Department, Chittagong District)</li> <li>• Chittagong Port Authority</li> <li>• Department of Environment, Ministry of Environment and Forest</li> <li>• Chittagong Dry Dock Limited</li> </ul>
Positively Affected Stakeholders	<ul style="list-style-type: none"> <li>• Project Affected Households</li> <li>• Direct Employees of KDDSEZL (present and future)</li> <li>• Families of Direct Employees</li> <li>• Future Contractors</li> <li>• Local Community in Badalpura Village</li> <li>• Vendors</li> </ul>
Critical to Engage	<ul style="list-style-type: none"> <li>• Local Government (Member of Badalpura Village, Chairman and members of Bairag Union Parishad)</li> <li>• Opinion Leaders within Badalpura Village</li> <li>• Local Media</li> <li>• BRAC (NGO)</li> <li>• Chittagong Development Authority</li> <li>• Bangladesh Inland Water Transport Corporation</li> </ul>



Categorisation	Key Stakeholders
	<ul style="list-style-type: none"> <li>• Bangladesh Inland Water Transport Authority</li> <li>• Bangladesh Forest Research Institute</li> <li>• Bangladesh Water Development Board</li> <li>• Bangladesh Marine Fisheries Academy</li> <li>• Bangladesh Marine Academy</li> </ul>
Donors	<ul style="list-style-type: none"> <li>• Financial Intermediary (World Bank &amp; IDLC Finance Limited)</li> </ul>

In order to map the interest of the stakeholders on the project activities, a matrix showcasing the stakeholders and their interest has been developed. This step is to assess the interest/influence into high, medium and low as well as to assess the power relationship, impact, support and attitude of the various identified stakeholders. The interest matrix of the stakeholders has been provided in the following Table.

**Table 78: Interest Matrix of Stakeholders.**

Categorisation	Key Stakeholders	Influence Power to facilitate or impede project	Importance Degree of priority needs and interests	Interest Level
Government Agencies	Government of Bangladesh (Revenue Department, Chittagong District.	Low	Low	High
	Chittagong Port Authority	Low	Medium	High
	Department of Environment, Ministry of Environment and Forest	High	High	High
Positively Affected Stakeholders	Chittagong Dry Dock Limited	Low	Low	Low
	Project Affected Households	Low	Medium	High
	Direct Employees of KDDSEZL (present and future)	Low	Medium	High
	Families of Direct Employees	Low	Medium	High
	Future Contractors	Low	High	High
	Local Community in Badalpura Village	Low	Medium	High
	Vendors	Low	High	High
Critical to Engage	Local Government (Member of Badalpura Village, Chairman and members of Bairag Union Parishad)	Low	Medium	Medium
	Opinion Leaders within Badalpura Village	Low	Medium	Medium
	Local Media	Low	Medium	Medium
	BRAC (NGO)	Low	Medium	Medium
	Chittagong Development Authority	Low	Low	Medium
	Bangladesh Inland Water Transport Corporation	Low	Medium	Medium
	Bangladesh Inland Water Transport Authority	Low	Medium	Medium
	Bangladesh Forest Research Institute	Low		Medium
	Bangladesh Water Development Board	Low	Low	Medium
	Bangladesh Marine Fisheries Academy	Low	Medium	Medium
	Bangladesh Marine Academy	Low	High	High
Donors	Financial Intermediary (World Bank & IDLC Finance Limited)	High	High	High

*Source:* Adapted from World Bank (2003b)

Having contemplated the stakeholders in terms of their interest matrix, the next step is to map the stakeholders by mapping them as per their interest and power as mentioned as determined by the matrix. By using a power/interest grid, each stakeholder has been categorized in either of the four sections of meet the requirement, important player, low significance and engage regularly. The Figure given below highlights the power/interest grid of the stakeholders identified.



**Figure 82: Power/Interest Grid of Stakeholders Identified**

As per the interest matrix, the stakeholders which have a high interest in the project due to opportunities, benefits and risks involved have been categorised in the section of important players. The stakeholders which have a medium to high interest in the project has been categorised in the section of meet the requirement while the stakeholder which has low interest has been categorised in the low significance section. Those stakeholders wherein

communication has to be regular has been categorised in the engage regularly section. Given ample amount of time during the different phases of the project cycle, the stakeholders who are in the meet the requirement section can be important players. Similarly, the stakeholder in the low significance can be shifted to the engage regularly by the project proponent if a proper plan of stakeholder engagement and consultation is duly developed and implemented.

### **5.5. Project influenced area: public consultations**

Consultations were held with various stakeholders during the site visit. The stakeholders comprised of representative of NGO, opinion leaders, local government officials, representative from government agencies. The details of the consultations held with various stakeholders have been provided in the following:

#### **5.5.1. Consultations by Shahidul Consultant**

##### **Views of Ms. Tanjena Akhter, Teacher, BRAC School (Non-Governmental Organization)**

Within the study area, only one NGO, BRAC (formerly Bangladesh Rural Advancement Committee) has been working for the upliftment of the people. BRAC's focus area has been organising the poor using communities' own human and material resources. The organization catalyses lasting change, creating an ecosystem in which the poor have the chance to seize control of their own lives. Their holistic development approach has been geared toward inclusion, using tools like microfinance, education, healthcare, legal services, community empowerment, social enterprises and BRAC University.

The teacher of the BRAC School, Ms. Tanjena Akhter, a resident of Badalpura village was contacted to give her views about the NGO's work in the area and the concerns and issues faced by the village. In Badalpura village, BRAC has been functioning since 2010 in the form of a BRAC school for underprivileged children. The school has 30 students enrolled wherein education and medical expenses are given to poor and handicapped children. There are 12 classes in total which are run daily from 8 a. m to 1 p.m. The school provides education till Standard V. Children from underprivileged background of Badalpura, Chalekha and Shahempur (adjacent to Badalpura village) villages come to this school. Most of the parents of these children work as daily wage labourers. The poor economic status of the children is accounted for before enrolling any students to the school. Education materials in the form of books and stationeries are provided free to these children.

On enquiring about the issues and concerns faced by Badalpura village, it was reported that upliftment of women is required for the society to progress. Most women being engaged in household activities do not have the economic independence to make decisions. It was mentioned that women from poor families want their daughters to be educated but because of their financial conditions, they are unable to send their wards to schools. In addition, there are no vocational centres providing skill development in the village to cater to illiterate and semi-literate girls and hence, most of them do not engage in any activity except their

household activities. The other areas which need attention in the village are the roads and medical centres which require to be developed.

**Views of Ms. Aki Barua, Civil Society Alliance (CSA) Officer, BRAC (NGO), Anwara Upazila**

Ms. Barua, the CSA Officer of BRAC based at Anwara Upazila was contacted to understand her views on the socio-economic status of Badalpura village and how development of such a project in the vicinity of the village will bring out change in the existing status. Ms. Barua responded that Badalpura village and Anwara Upazila as a whole is developing from what it was 10 years ago. A lot of changes can be observed in the form of both men and women both being engaged in employment, children are now all going to school and many industries and factories have set up base in Anwara which have supplemented people's income so the development of KDDSEZ in the area will benefit the society at large. BRAC has been working in Anwara since 2001 in the area of small loan distribution for entrepreneurial work, health care, family planning, educational programmes, sanitation program and providing legal aid for destitute. On asking whether the organisation was aware of development of KDDSEZL in Badalpura village, Ms. Barua replied in the negative. Information relating to the KDDSEZL both negative and positive impacts was disclosed to the CSA Official. Ms. Barua went on to mention that development of KDDSEZL in the area is a good step as this might benefit the village in terms of creating employment opportunities which would in turn reduce the poverty level present in the village. This would also lead to development of the village. However, environmental concerns should be addressed adequately and laws of the country should be abided in the strictest possible manner. The CSA Official could not comment about the risks that might emerge due to this development. Relating to the development of the village, the BRAC representative mentioned that home wise tube wells and toilets for the village were the most important requirement followed by health care facilities which is absent in Badalpura village. The Official went on to mention that as work opportunities might grow in the area, steps to develop skill development was also important so that education and work together could complement each other.

**Views of Md. Rafiq, Present UP Member, Badalpura Village**

Md. Rafiq the present Union Parishad (UP) member of Badalpura village has held his position for the last 19 years. As per his views, the main occupation of the population of the area comprise of 20% boat workers, 5% government officials, 65% private service in factories and businesses and 10% have gone out of the country for employment purposes. The factories around the area including the KEPZ have developed the surrounding areas and have exposed the population to a diverse range of employment opportunities. The average monthly income of the people in the village is between 7000-10000 BDT. Two NGO's were working in the area, one, World Vision in 2008 and BRAC in 2010. At present, BRAC is the only NGO working on education related aspects.

The only Government Scheme that has been implemented in the area is the Food for Work Program designed to generate employment among the local population. The program aims to create food-wage employment during the slack season, mostly in construction and maintenance of rural roads, river embankments, and irrigation channels. A major objective of the program is to provide income to the rural poor during the slack period when the unemployment rate in rural areas increases. Wage payments are made in kind (i.e., in wheat, pulses) rather than in cash.

The main issues and concerns in the village are related to lack of educational facilities, health centres, unemployment and poor infrastructure facilities like roads and drainage. A sluice gate should be constructed by KDDSEZL to bar the water (passage) entering the village where the facility ends so that the nearby households will not be flooded. This will benefit the entire community.

**Views of Md. Abul Hashem, Ex- UP Member, Badalpura Village**

Md. Abul Hashem, being a land seller to the proposed project and an ex- UP member of Badalpura village was satisfied with the amount received for the land sold. He asserted that with the proposed project coming to the area, employment opportunities for the local population will increase. In addition, skill development would also increase with the increase of job opportunities. In addition, the proposed project will benefit the village as it is a strong protection from the rise of water during the ebb and flow of tide cycle. Moreover, the proposed project will create economic opportunities among the people with rent accommodation and creation of small business and contract work. There are no concerns or issues about the proposed project that were mentioned by the ex-member as he mentioned that the project would only benefit the area.

**Views of Md. Kibria, Primary School Teacher, Badalpura Village**

Md. Kibria has been working in the Government Primary School, Badalpura Village for 20 years. He was contacted as being a resident of the area and observing the changes taking place in the village, his observations would give us an understanding of the concerns and issues prevalent in the area. As per his views, people now are more willing to send their children to school as compared to seven eight years back. However, more schools need to be set up to cater to the demand for higher education which is currently lacking in the area. There are approx. 500 students currently enrolled in the primary school and 8 teachers teaching in the school, one teacher from Badalpura village. The ratio of teacher student is skewed and more teachers need to be employed in the school. The Government has taken the decision to upgrade the school and increase the level to Standard VIII which is still to be implemented on the ground.

The dropout rate among boys is higher than girls due to the fact that they usually leave in order to get employed in factories and in turn, support their family. As the Government is taking more initiative in promoting girl education wherein girl students receive scholarships,



this has resulted in more girls being interested in studies and continuing their education beyond Standard V. A remarkable change has come with women's attitude changing wherein they have become more confident in coming out of their house and trying to search for a job which was not visible in earlier years. Most of the girl dropouts from the village are currently engaged in garment factories. The population of Badalpura is mainly engaged in daily wage, NGOs, shops and business. The main issues and concerns affecting the village is unemployment. Even though few employment opportunities have grown with the coming of Korean Economic Processing Zone (KEPZ) and private factories in the area, this has not been enough to meet the demand of labour supply. Secondly, with the consciousness of education, the demand for educational facilities catering for higher education has also risen which is currently not available in the village. Lastly, health centres in the village need to be developed so that the people can be benefitted better.



**Figure 83:** Consultation with CSA, BRAC Office, Anwara Upazila (Left); Primary School Headmistress, Badalpura (Right)

**Views of Mrs. Farida Parbeen, Headmistress, Badalpura Primary School**

Mrs. Parbeen was consulted to gather her viewpoint on the development of KDDSEZL in the village which she works in. Badalpura Primary School has a total of 475 students enrolled with eight (08) teachers managing the classes. Students come from Badalpura and adjoining areas to attend the classes. On the awareness of the project, Mrs. Parbeen confirmed that she was aware of the project. The land usage of the area prior to KDDSEZL owning the land parcels was enquired, to which she reported that the area was reclaimed land and it had no use as it was constantly eroded by the river. The reclamation activity has helped the village land area from being eroded as the project has acted as a barrier between the river and the village. The development of the KDDSEZL would be beneficial for the community as it would create employment opportunities and a certain technical skill set which would help the local population immensely. The Badalpura village at large has a sizable population living at poverty level through which the employment opportunities can help alleviate. Healthcare services can also be developed in the area. In regards to pollution, Mrs. Parbeen was of the

opinion that there is not much concern if KDDSEZL strictly adheres to measures that could curb the spread of pollution in the area. She mentioned that infrastructure in the area needs to be improved especially that of the primary school as an additional building is required including furniture for the classrooms. Flood water entering the village and the lack of drainage facility in the village is also a constant problem which requires adequate attention.

**Views of Sheikh Md. Naseruddin, Principal, Marine Academy High School and College**

Due to the vicinity of this school in the project area, viewpoint of the Principal was gathered. The Principal mentioned that the development of the KDDSEZL in the area was an important step for the village as a whole as this would help create employment opportunities for the local population. Relating to environment concerns, he was of the opinion that he was not entirely 100% sure that no pollution might occur due to the project activities and KDDSEZL in fact, should ensure and commit to prevent polluting the environment by strictly abiding to the laws of the country. He went on to report that due to the coming up of the project, bank of the river which used to be constantly eroded is now protected which includes the houses of the village as well. He was of the opinion that due to the KDDSEZL, development of the road beside project location which was earlier a muddy stretch has now improved. The project is a positive step in raising the socio-economic status of the local population residing in the area.

**Commandant Sajid Hussain, Bangladesh Marine Academy, Badalpara**

Commandant Hussain in his views when consulted mentioned that the proposed KDDSEZL project was not a friendly project in terms of environment and as per the norms of the Academy. In 2012-13, when the proposed project required a no objection certificate from 12 institutions relating to the setting up of the project in the area, Marine Academy was the only institution that did not provide their assent. He was of the opinion that the beneficial aspects would be very minimal as the solitude of the area was being disturbed as more and more people are coming to the area. Shops in the area have increased which have resulted in the local population congregating with no purpose which has resulted in increase of noise levels.



**Figure 84:** Consultation with Principle, Marine academy high school and college (Left);  
Director, DoE, Chittagong division (Right)

#### **Views of Nawab Ali, Chairman, Bairag Union Parishad**

The Chairman when contacted reflected how the proposed KDDSEZL project would be beneficial to the area and also the national economy. The education and infrastructure in the area needs to be developed and with this proposed project the social status of people residing in the Badalpura will improve with jobs, health centres and education facilities being developed.

The proposed plans are also beneficial as it projects a barrier between the river and the village. Whenever, the river swells with the ebb and flow of tides and expands during the monsoon, the village because of its proximity to the river has continuously being flooded every year. This will eventually be controlled because of the development of the KDDSEZL.

Employment opportunities in the area would also increase with skill development of the population. Administrative jobs catering to women who have passed their higher secondary education will be created as well. Economic condition of the village will improve with rented accommodations in the area for the dry dock officials and subsidiary businesses like shops; barber shops etc. would also be developed. In addition, contract work for the locals will also see a rise. A No Objection Certificate (NOC) was provided by Bairag Union Parishad to the project proponent for the proposed project which has been attached as **Annexure I(E)**

The KDDSEZL officials have committed towards the development of the area by developing schools, colleges, health centres and skill development of the population which will be beneficial for all.

#### **Views of Mr. Maqbool Hussain, Director, Department of Environment, Chittagong Division**

Mr. Hussain in his views mentioned that KDDSEZL is required to follow the normal procedure for Environment Clearance and renewable of certificate. In addition, it is mandatory for KDDSEZL to follow the terms and conditions as mentioned in the Environment Clearance. The noise pollution during the construction and operation phase should be within

permissible limits. Pollution generation during both these phases should be mitigated adequately and precautionary measures should always be followed. Monitoring of management activities should be undertaken periodically to minimise the risks and impacts of activities on the environment.

**Views of Capt. M.Z. Islam, Dock Master, Chittagong Port Authority**

Capt. M.Z. Islam as per his views on the project stated that the location of the proposed project is feasible as it comes before the river bend. The studies conducted for the project is sufficient as it shows that criteria for docking and feasibility of ship turning due to its size have already been considered. Navigation on the river might be affected to a slight extent as docking/undocking period of ships might take some time but this can be avoided if shorter period for this activity can be adjusted and envisaged.

**Mr. Nazrul Alam, Deputy Conservator, Chittagong Port Authority**

Mr. Alam in his views stated that development of KDDSEZL for the country is an important step. However, on asking whether the docking would be undertaken during slack water which does not have much current, he mentioned that KDDSEZL should consider properly whether they will have the capability of docking ships using slack water. Movement of ships might get affected during this period and hence, a plan should be developed relating to movement of vessels across the channel. He was of the opinion that due to major construction activities, a lot of siltation might occur and adequate measures will need to be taken to ensure that siltation is controlled. In addition, erosion of the river banks will need to be prevented and a good training wall should be considered as an adequate measure. A mooring dolphin at the entry of the dry dock will be required to navigate ships into the dry dock. In reference to dredging materials, he reported that no material can be deposited at deep sea and instead suggested that this material could be used for land filling purposes. In conclusion, he mentioned that the area where the KDDSEZL was to be set up is sensitive because of the navigation route, however, as dearth of dry docks was a major problem in the country, permission for construction of dry dock was given as it was an important step for the economy of the country.

**Views of Md. Nashiruddin, Hydrographer, Chittagong Port Authority**

Md. Nashiruddin in his views claimed that KDDSEZL in the area is necessary as at present the Government has only one dry dock functioning which is not sufficient for the traffic flow of ships. He stated that as a lot of merchant ships come to Bangladesh including Bangladesh Shipping Corporation which has 10 ships and the facilities provided by the existing dry dock is limited as it does not have the capacity to maintain all ships. In addition, he mentioned that a major drawback with the present existing dry dock is that it can only maintain small ships and is inadequate in repairing and maintaining bigger merchant ships. Thus, the proposed KDDSEZL will plug this drawback by catering to bigger merchant vessels and thus, this requirement will prove to be essential.



**Figure 85:** Consultation with Dock Master, Chittagong port authority (Left); Deputy Conservator, Chittagong port authority (Right)

**Views of Engr. A. M. Nuruddin Ahmad, Managing Director, Chittagong Dry Dock Limited**

Engr. A. M. Nuruddin Ahmed observed that the current existing dry dock was developed and began operating only in the early eighties. The dry dock has been catering to all kinds of repair needs of national and international vessels upto 16500 DWT and has engaged close to 611 workers. However, the new proposed KDDSEZL will facilitate ship repairing, ship building, and dry docking of ocean going vessels up to 100,000 tons DWT. In addition, the location of the KDDSEZL is also beneficial for the new project as it is on the bend of the river thus, making it easier for bigger vessels to be repaired and maintained near the mouth of the river rather than going in waters. He asserted that a KDDSEZL project is necessary for the economy and hope that this proposed project becomes successful both for the national economy and the local population in the area.

**Views of Siddiquir Rehman, Superintendent Engineer, Chittagong Water Development Board**

The Superintendent Engineer mentioned his awareness of development of dry dock and said that the Water Development Board has been engaged in the work of bank protection. He was of the opinion that due to erosion activities, bank protection in the form of sea dykes has been developed across the bank. As per his view, he reported that the location where the KDDSEZL would be set up is not prone to much erosion as the Board has not set up any sea protection measures in the area.

**Views of Engr. Bidyut Kumar Saha, Executive Engineer, Bangladesh Water Development Board**

Engr. Bidyut was of the opinion that Karnaphuli river has no trend of erosion as no embankment measures have been developed alongside the river till date. He was of the view that the river was not vulnerable and had a lesser bracket of risk as compared to other



rivers of Bangladesh. In the last one year, no erosion concern has been raised by the local population.



**Figure 86:** Consultation with Superintendent Engineer, Chittagong Water Development Board (Left); Executive Engineer, Chittagong Water Development Board (Right)

**Views of Md. Faisal Alam Chowdhury, Manager (Commerce), Bangladesh Inland Water Transport Corporation**

Md. Faisal in his opinion stated that as Bangladesh has only one dry dock in the country which is government run, the development of this new project is essential for the country as a whole. As more than 500 ferries and vessels navigate this route, services of one existing dry dock has been overburdened. Due to this, there has been no other alternative for ships to dry dock but with this development, things would change eventually. As the dry dock will be located on the opposite side of the river, no much obstruction to traffic movement is envisaged. The country will benefit from this project as the capacity is much larger than the existing dry dock.

**Mr. A.S.M. Ashrafuzzaman, Executive Engineer, Bangladesh Inland Water Transport Authority**

Mr. Ashrafuzzaman in his opinion stated that the proposed KDDSEZL would be beneficial for the national economy as ships belonging to the Inland Water Transport Authority could also be docked here. At present, to dock one ship, a six month waiting period is common as only one dry dock exist in Chittagong, so this project would help to a large extent reduce the waiting period. In addition, the proposed project would also create employment opportunities for both men and women which will in turn decrease poverty level and improve women empowerment. In reference to environmental pollution, he was of the view that disposal points for waste generated should be identified and disposed adequately. The dredging material should be disposed off at banks of the river and on islands to raise the land level, however, prior to the material disposal, the land area should be fenced with bamboo and accordingly filling should be carried out.





**Figure 87:** Consultation with Manager (Commerce), Bangladesh Inland Water Transport Corporation (Left); Executive Engineer, Bangladesh Inland Water Transport Authority (Right)

**Mr. Kazi Hasan Bin Shams, Superintending Engineer, Chittagong Development Authority**

Mr. Shams when contacted provided his opinion stating that the proposed KDDSEZL project is important for Chittagong and Bangladesh as a whole. He was of the view that the people of the area would be most benefitted by the project as it would create employment opportunities. The project in the area would also lead to infrastructure development of the area thus, in turn benefitting the local population of the area.

**Mr. Rafiqul Islam, Division Officer, Administrative Division, Bangladesh Forest Research Institute**

Mr. Islam who is also a scientist (entomologist) was consulted on his views regarding development of KDDSEZL in Badalpura area. He stated that the Forest Department plants mangrove plantation known as Kewra (*Sonneratia apetala*) along the bank of the river so as to prevent erosion and cyclones affecting the land habitation area. This is the only species which can survive in the area. As he was made aware of the small patch of mangrove plantation near the project area, he mentioned that KDDSEZL should steps so that pollution generated out of the project activities do not affect this plantation area and adequate measures are to be adopted for this purpose.

**Mr. Adhir Chandra Das, Assistant Director, Marine Fisheries Office, Chittagong**

When contacted, Mr. Das commented that he had no observations regarding the proposed project in Badalpura area as the area comes directly under Chittagong Port Authority. He stated that at present the traffic in the river has increased and lesser number of fishes has been observed.

**Views of Md. Mahbub Alam, Head of Department of Marine Fisheries and Deputy Project Director, BMFAID&S Project, Marine Fisheries Academy under Ministry of Fisheries and Livestock, Chittagong**

Md. Mahbub Alam in his views stated that the main problem of fisheries in the area was that the number of breeding of carp which is approximately 10-11 km from the proposed KDDSEZL project has reduced considerably over the years. This case was also observed in the case of giant prawn spawning. The salinity of the river is an idle place which is good for breeding purposes, however, over the years this has decreased and the cause of it is yet unknown. Some population believe that Karnafuly Paper Mills might be the cause but no evidence regarding this has been published. The Environment Department did some sampling a couple of years back however, results of this has been inconclusive. The industries along the bank such as tannery, petro chemical, sugar refinery and oil spills from Padma and Meghna River might be the cause of pollution of Karnafuly river.

The river has not been treated as an active commercial fishing area, only local population undertake fishing related activities in the river. The tidal fluctuation of the river which goes upto 4-5m at times is one of the reason how the polluted water gets discharged into the river, even then due to this tidal fluctuation, the area does not remain polluted. Gangetic dolphins have been spotted in the river however, the exact number in the river has not been recorded. One species of Hilsa known as Hilsa Toli (*Tenuualosa toli*) was one fish that had existed in the river but it is not found in the area anymore. After the 1991 cyclone, this fish species population has shown a decrease. Municipal dumping has been the main discharge into the river as no treatment plans have been developed to treat the sewage coming out of the City. This could also be a factor of the pollution levels rising gradually in the river.



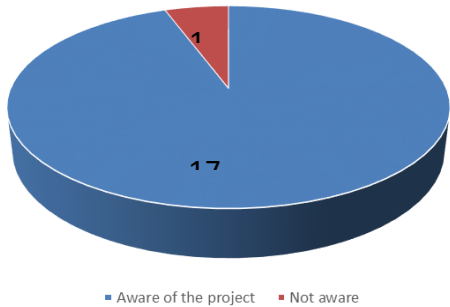
**Figure 88:** Consultation with Divisional Officer, Bangladesh Forest Research Institute (Left); Head of Department, Marine Fisheries Academy (Right)

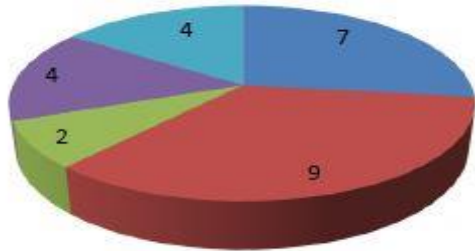
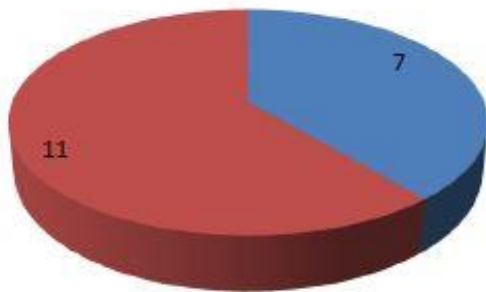
***Perception about the Project***

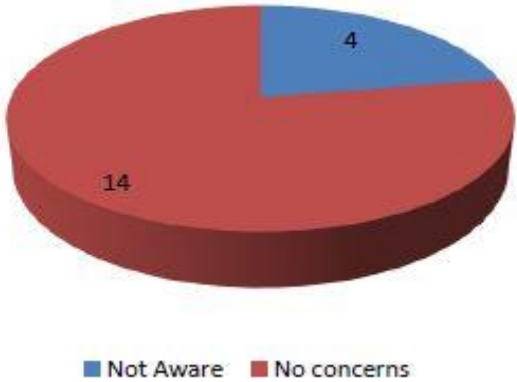
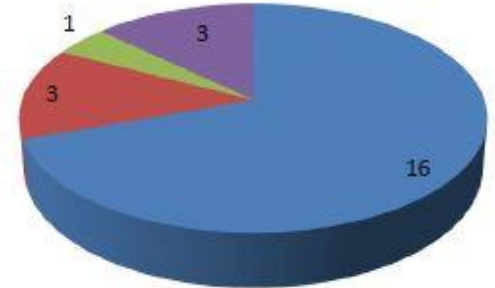
In addition to the above consultations conducted with various stakeholders, during the social survey, a section of questions regarding the perception about the project was asked

to direct project affected households who sold their land for the proposed project. It is to be noted that the survey targeted all the available project affected households of Badapura village which could be contacted during a two site visit undertaken by Shahidul Consultant. Here, a household is considered as a unit which includes the affected landowner along with his/her dependents. In total, thirty six (36) landowners (project affected households) have been affected by the project out of which eighteen (18) landowners were covered for the survey to demonstrate a sample representation of the total affected households. Details concerning the viewpoints of members belong to the project affected households have been provided in the following Table.

**Table 79: Responses from Project Affected Households on Perception about the Project.**

Sl. No.	Questions	Response	Description
1.	Awareness about the project?		<p><i>Aware of the Project:</i> 17 respondents replied that they were aware that a dry dock project was going to come up in the area.</p> <p><i>Not aware:</i> Only 1 respondent was not aware about the dry dock project. This person was briefed about the project during the consultation person.</p>
2.	Status of land prior to the its sale?	18 respondents – no sites of cultural/ archaeological significance.	<i>Vacant and barren land:</i> All 18 respondents responded that the land prior to the purchase was vacant and barren that was submerged during the constant flooding of the banks due to the river's ebb and flow tide.
3.	Any cultural heritage/ archaeological site near the project site?	18 respondents – no sites of cultural/ archaeological significance.	<i>No sites:</i> All 18 respondents replied that there are no sites of cultural/archaeological significance in the village and near the vicinity of the project site. There are only two mosques in the area which are approx. 300 and 500 m away from the project site.
4.	Have the land prices increased with the coming of the project in the area?	18 respondents – Yes	<i>Yes:</i> All 18 respondents felt that the land prices have gone up in the area because of the project and other factories like KAFKO and KEPZ coming up in the vicinity as well.
5.	Was negotiation of land prices done?	18 respondents - Yes	<i>Yes:</i> All 18 respondents were in the affirmative about negotiation of land prices being.
6.	Was the payment on the sale of land received adequate?	18 respondents – Yes	<i>Yes:</i> All 18 respondents replied that they were satisfied with the payment received on sale of the land. They were of the opinion that the land had no

Sl. No.	Questions	Response	Description
			value and it used to be submerged most of the time because of the area getting inundated so they were willing to sell their parcel of land to the project.
7.	How the amount was received utilised?	 <p>■ Marriage of Kin ■ Construction/Renovation of House ■ Investment in Business ■ Savings in Bank ■ Treatment of Illness</p>	<p><i>Marriage of Kin:</i> 7 respondents used the money they received in the marriage of their children.</p> <p><i>Construction/Renovation of House:</i> 9 respondents replied that they used part of the money in the construction and renovation of their houses.</p> <p><i>Investment in Business:</i> 2 respondents have invested the money in small business as contractor and running a shop.</p> <p><i>Savings in Bank:</i> 4 respondents besides using part of their money have deposited the remaining amount in saving accounts in a bank.</p> <p><i>Treatment of Illness:</i> 4 respondents have used part of their money in the treatment of illness and purchasing medicines.</p>
8.	Besides payment of money, did you receive any other benefit?	 <p>■ Received Benefit ■ No Benefit</p>	<p><i>Received Benefit:</i> 7 respondents responded that they received benefit besides payment of money in the form of employment opportunities like security guards, small contractors and site management positions for KDDSEZL.</p> <p><i>No Benefit:</i> 11 respondents replied that they did not receive any benefits besides receiving their share of the payment. They responded that they were expecting some benefit such as employment opportunities, infrastructural development in the area etc.</p>

Sl. No.	Questions	Response	Description
9.	Concerns about the project?	 <p>■ Not Aware ■ No concerns</p>	<p><b>Not Aware:</b> 4 respondents replied that they are not aware of the problems and issues that might come up with the setting up of the project in the area.</p> <p><b>No Concerns:</b> 14 respondents responded that they had no concerns with the setting up of the project in the area.</p>
10.	Expectations about the project?	 <p>■ Employment Opportunity ■ Road Condition ■ Transport Facilities ■ Barrier</p>	<p><b>Employment Opportunity:</b> 16 respondents felt that besides other benefits mentioned below, employment opportunities would increase with the coming up of the project in the area.</p> <p><b>Road Condition:</b> 3 respondents responded that they believed that with the setting up of the project, the road conditions in the area would improve.</p> <p><b>Transport Facilities:</b> 1 respondent was of the view that more traffic would be seen once the project gets operational and hence, this would help develop the transport facilities in the area.</p> <p><b>Barrier:</b> 3 respondents replied that with the project being set up and land being reclaimed, a major benefit has been that the site has acted as a barrier between the river and the village thus preventing the flood water to enter the villages which was a common site earlier,</p>





**Figure 89: Consultation with various Stakeholders**

### **5.5.2. Public hearing by KDDSEZL**

As per World Bank's Environmental Assessment Policy (OP 4.01), if the Project is categorised as Category 'A', the stakeholders will have to be consulted twice, one, in a meeting held during the screening and scoping stage, and second, when the draft EIA has been developed. As per ADB's Safeguard Policy requirement, the project proponent is required to undertake meaningful consultations with affected persons and communities at the project preparation stage as well as throughout the project cycle on an ongoing basis. Timely dissemination of information to the affected people in an atmosphere free of intimidation and coercion has been called upon.

In order to fulfil this requirement, two public hearings have been conducted within Badalpura village. The first public hearing was conducted on at premises of KDDSEZL. Information relating to the public hearing was published in The Daily Star, a national daily and in The Daily Azadi, a local daily. In addition, information was also disseminated through the focus group discussions, household surveys and announcements were made after the evening prayers in the two mosques situated within the villages.

A second public hearing was conducted on at the premises of Badalpura Primary School. Notice of this public hearing was published in an English Daily, 'New Nation' and a Bengali Daily 'Dainik Azadi'.

#### **First Public Hearing**

The public hearing was held in the premises of KDDSEZL and was attended by a total of 53 attendees primarily from Badalpura Village. A list detailing the attendees has been added as **Annexure VII**. The public hearing was attended by an array of speakers namely,

- Mr. A. Mazumdar, Executive Director, KDDSEZL
- Mr. Nawab Ali, Chairman, Bairag Union Parishad
- Mr. Md. Rafiq, Member, Badalpura Village
- Mr. Muhammad Abul Foysal, Shahidul Consultant, Bangladesh.
- Dr. Nasir Uddin Khan, Managing Director, Adroit

The consultation commenced with an opening speech from Mr. A. Mazumdar, Executive Director, KDDSEZL, addressing the gathering. A description of the project and its benefit was detailed out for the public. An introduction was given on everyone who would be speaking during the public hearing. Mention of major projects like KAFCO and Marine Academy and development to the area was highlighted. However, he mentioned that will the KDDSEZL proposed to come out in the area, development in various aspects like education, infrastructure, employment opportunities would increase thus benefitting the local community. He mentioned that environmental and social assessment studies were being conducted to assess the feasibility of the project in the area and once an analysis of the findings come out will they be ascertained whether to put up the project in the area after required permissions. He further went on to thank the people for the land that was procured for the proposed project and acknowledged their sacrifice in taking such a step and restated that the problem of unemployment will decrease with the coming of the project in the area. He also asked the people for their support to make this project a success.

The second speaker Mr. Md. Rafiq, Member, Badalpura Village thanked everyone for taking time out and making an effort to attend the hearing. He stressed that the project will help in the development of the area and it is a positive step in the right direction. He opined that the status of the local population will improve and employment opportunities for the local people would increase.

This speech was followed by Mr. Nawab Ali, Chairman, Bairag Union Parishad, who also thanked the attendees for coming to the public hearing. He also stated that the proposed KDDSEZL will help the area develop tremendously. He mentioned that a major benefit that can already be witnessed with the coming up of the KDDSEZL is the barrier that has been created between the river and the village. This has helped reduce the flooding of the village significantly which was a common sight before the reclaim of land that was undertaken by KDDSEZL. He mentioned that the project would bring employment opportunities in the area and help in the infrastructural development of the village.

Mr. Muhammad Abul Foyzal, Socio-environmental Expert of Shahidul Consultant thanked the attendees for coming to the public hearing. He went on to mention that the studies undertaken in the past few days assessing the socio-economic and environment aspects have been undertaken to know the status in the area. The proposed project will help the area by creating stable employment opportunities, contract jobs as suppliers and opening of small businesses. The project has already benefitted the area by controlling the inflow/flooding of the village and it will continue to safeguard the village. KDDSEZL being the project proponent will try and improve the existing infrastructure like roads, schools and medical facilities which will benefit the local population. The project will have minimum environmental impacts however mitigation measures will be suggested if any environmental impacts come about. He concluded by asking the attendees for their support and

cooperation for the project which will not only help the local community but will benefit the country as well.

This was followed with Mr. Nasir Uddin Khan, Managing Director, Adroit, who talk about the project and the benefits that it would bring to the area and to Bangladesh at large. He stated that as part of Department of Environment's requirement of having a public meeting, this public consultation was called so that the population residing in the area could get an opportunity to voice their opinions and concerns regarding the proposed project. However, it was also mentioned that besides DOE's requirement, the project is also following international standards as World Bank is funding the project. By undertaking socio-economic, environment and ecological studies, the impact assessment of the proposed project can be ascertained. This will help in assessing the aspects closely and provide mitigation measures for impacts identified. Through this process the proper utilisation of funds is guaranteed. He mentioned that the people in the area should not look out for individual growth but instead should look at the benefit of the entire community. By this step, the future of the children will be secured and it will help in the development of the area in the long run.

### Question and Answer Round

Once all the public speakers contributed with their insights, the floor was opened to the attendees. The questions raised by the local population and the corresponding responses from the speakers have been provided in the following Table.

**Table 80: Questions and Answers of the Public Hearing**

S. No.	Questions	Replies
1.	Maolana Sultan Ashrifi of Badalpura Village mentioned that he was happy about the development of the project in the area and felt that development to the area would now increase and everyone would be benefitted by it.	
2.	Md. Suleiman one of the seven families to a title deed was of the opinion that he did not receive the amount for his share of land. He mentioned that his siblings have taken the entire amount without giving him his share and was requesting the management to compensate him for the land that belonged to him.	Mr. Mazumdar replied that he would talk to him personally and sort out the issue in an amiable manner. Mr. Mazumdar spoke to the individual after the public hearing and was apprised by the KDDSEZL's representative involved in the purchase of land that the said individual had signed the sale deed and the money was accordingly dispersed to the families. There is no pending payment at KDDSEZL's end and the matter was between the siblings as he felt he was given lesser payment while his siblings were given higher payments. Mr. Mazumdar spoke to the said person to discuss the issue with his siblings and find a solution to this.

S. No.	Questions	Replies
3.	Khafez Ahmed, who is currently engaged as a Security Guard with KDDSEZL mentioned that he personally sold his land for the proposed project and has got employment as one of the benefits. He mentioned that he was satisfied with the amount received and his being recruited as it has brought a stability in his life.	-
4.	Nayeebuddin, mentioned about flood control which has helped the community at large and has thanked KDDSEZL for their commendable effort. However, he mentioned that unemployment is still a major concern in the area and he would like to avail the employment opportunity that will arise.	Mr. Mazumdar replied that KDDSEZL will look into the problem of unemployment in the area and will try and provide employment opportunities to the local population wherever possible. He mentioned that with the development of this project, almost 1000 people are expected to receive employment and restated that this project will benefit the area significantly. In addition, he informed all those who were present that all concerns and issues that were highlighted were good and they were there to help clarify them. He encouraged the people that if they faced any issues/concerns to come up and meet the management stationed at the site so that their concerns/ issues could be addressed.

Once the question and answer round concluded, the meeting was declared closed by the organisers and a note of appreciation was sent out to the public for attending the same.





**Figure 90: First Public Hearing in KDDSEZL's premises**

**Second Public Hearing:**

The second public hearing was held in the premises of Badalpura Primary School and was attended by a total of 99 attendees from Badalpura village. A list detailing the attendees has been added as **Annexure VII**. The public hearing was attended by the following speakers namely,

- Lt. Commander T.I. Joarder, Executive Director, KDDSEZL
- Mr. Muhammad Abul Foysal, Socio-environmental Expert, Shahidul Consultant, Bangladesh.
- Mrs. Sultana Afrose, Social Consultant, Shahidul Consultant, Bangladesh.

The consultation opened with the distribution of the project brief in Bengali which provided a concise version of description of the proposed project along with the activities to be undertaken under different phases of the project cycle and the potential impacts that might emerge along with a gist of mitigation measures proposed to be implemented to minimise the risks and impacts. A presentation on the same was provided to the public at the start of the meeting. Following which Mr. Muhammad Abul Foysal provided an introduction of the

purpose of holding a public hearing and the importance of conducting an environment and social impact assessment study for the proposed project.

It was mentioned that adherence to international standards and regulatory requirements by the Project Proponent is a major criterion by which KDDSEZL has committed to comply with for the proposed project. Once discussion on the presentation was completed, the floor was thrown open for questions to be raised by the public.

### Question and Answer Round

The question raised by the local population and the corresponding responses from the speakers have been provided in the following table.

**Table 81: Questions and Answers of the Second Public Hearing**

Sl. No.	Questions	Replies
1.	Monzur Alam, a resident of Badalpura Village introduced himself and stated that at present, the main concern was the sound pollution that has been created by the ship building activity that is being carried out at the premises of the proposed KDDSEZL project. The activities run late into the night hours which have disturbed the surrounding areas. Complaints on this were forwarded to KSBL for which no action has been undertaken till date. In addition, the scrap generator that is currently in use has also been emitting a lot of noise by which the residents living within the vicinity of the project boundary have been disturbed. He was of the opinion that the proposed KDDSEZL location was not suitable for the local population considering the fact that employment opportunities that would be open in construction period would not convert to permanent employment and instead would be of a temporary nature.	Mr. Muhammad Abul Foysal replied that the technicality of the project has been assessed for the project to be feasible. He mentioned that the current activities underway at the premises of the KDDSEZL area was temporary and was not related to the project that was going to come up. He asked the KDDSEZL representative to take note of the person's grievance and to consider the redressal accordingly with discussions with KDDSEZL officials. He went on to state that the proposed project will be set up as per the conditions put forward by the lenders especially relating to adherence of regulatory and international standard requirements. As the project will be funded by external sources, regular audits will be conducted on a stringent basis to monitor that the project proponent is following the conditions that would be agreed on. It was also mentioned that the project will not harm any project affected people economically and the project will not restrict the access of the villagers to any facilities or natural resource areas such as fishing areas in the river.
2.	Siaulddin, a resident of Badapura started his query by stating that investment in the area is a good step, however, thinking about the welfare of the common people is of paramount importance. The point raised were: <ul style="list-style-type: none"> <li>Noise pollution has been created by the current work being undertaken at the dry dock premises during night hours as well;</li> <li>No outlet of drainage water to the river from the village. Lack of drainage facility for the outlet of water has been creating a problem for the local population;</li> </ul>	Lt. Commander T.I. Joarder replied that the cause of the noise pollution would be looked in and discussed with KDDSEZL officials and accordingly will be sorted out. In addition, the issue of the electric poles will be taken up with the Electricity Board and movement of the poles would be envisaged. <ul style="list-style-type: none"> <li>Development of drainage system and outlet of sewage connecting the worker accommodation area would be looked into and rectification of the issue would be looked into.</li> <li>Mr. Muhammad Abul Foysal mentioned that the siltation issue was also discussed with representatives of Chittagong Port Authority as well and as per the norms silt generated cannot</li> </ul>



Sl. No.	Questions	Replies
	<ul style="list-style-type: none"> <li>Electricity poles which have been erected in the middle of the drain near the vicinity of the project boundary which is causing an obstruction to the flow of water, thus causing stagnation of water leading to mosquito problem in the area;</li> <li>Siltation that would increase in the area once construction work on the KDDSEZL's commences;</li> <li>Sewage facilities connecting the toilets of current workers engaged in shipbuilding is creating an issue as the refuse flows directly into the village drain leading to foul odours and blockage of drains;</li> <li>They were unaware of the last public hearing that took place as no information was disseminated, however, this time through notices in the newspaper they learnt about the event and decided to attend it.</li> </ul>	<p>be disposed off at deep water instead it would be used for filling activities of low lying area.</p> <ul style="list-style-type: none"> <li>In reference to the last public hearing that was held within the premises of KDDSEZL, it was stated that information was disseminated to the local population during the survey that was undertaken and announcements were made at the mosque as well for the local population to attend the meeting. It was unfortunate that the locals felt that they were not informed adequately.</li> </ul>
3.	Hamedul Hoque, resident of Badalpura village Mentioned about the employment opportunities is a major concern in the area and was of the view that the local population would not be benefitted entirely by the project	Lt. Commander T.I. Joarder replied that KDDSEZL would look into the issue of employment generation amongst the local population and assured that opportunities would be provided for the locals wherever possible.



**Figure 91: Second Public Hearing in Badalpura Village**

## **5.6. Disclosure requirements**

Stakeholders have an understanding of the project environmental and social risks, impacts and opportunities when relevant project information is disclosed in an accurate and timely manner. In order to involve the stakeholders and to maintain an open communication process during the entire life of the project, the aim of disclosing information should be:

- To provide the local communities a schedule for the meetings and information on activities related to the project activities along with the mechanism for their feedback.
- To enhance the knowledge of the communities about the project activities and the expected performance.
- To publicise the project proponent's commitment in ensuring the best practices in terms of environment protection and health and safety for workers and contractors.

- To make the public aware about the grievance redressal mechanism so that the feedback of the public can be accounted for and accordingly addressed.

According to World Bank Environment Assessment Policy (OP 4.01) in all Category “A” projects the stakeholders are required to consult formally twice with the stakeholders, one, in a meeting held during the screening and scoping stage and second, when a draft EIA has been developed. According to ADB’s Safeguard Policy Statement, the stakeholders are required to undertake meaningful consultations with affected persons and communities at the project preparation stage as well as throughout the project cycle on an ongoing basis. Timely dissemination of information to the affected people in an atmosphere free of intimidation and coercion is essential.

As per these guidelines, KDDSEZL has undertaken the first requirement by holding two public hearings, one, on its premises in Badalpura village wherein notices of the public hearing were advertised in The Daily Star, a national daily and in The Daily Azadi, a local daily and second, at the premises of Badapura Primary School. Notice of this public hearing was published in an English Daily, ‘New Nation’ and a Bengali Daily ‘Dainik Azadi’. Besides these notices, announcements and information were related to the population of the village via discussions, through mosques after the evening prayers and dissemination of project brief prior to the commencement of the second public hearing.

In addition, KDDSEZL is required to display all project related information on the company’s website. Information is to be made available in Bangla and English.

The following documentation should be made available to the public at Bairag Union Parishad and displayed on the website and in hard copies:

- A. Summary of the Project
- B. Summary of the Stakeholder Engagement Plan (SEP)
- C. Summary of the Environmental and Social Action Plan (ESAP)
- D. Once the Grievance Redressal Mechanism has been developed, a gist of it in local language should be given to the Chairman of Bairag Union Parishad and a board reflecting the name, designation and contact numbers of the contact point in receiving grievances from the public should be publicised at the gate of KDDSEZL site office as well as on the Company’s website.

Additionally, a gist of the following plans in local language should be disclosed to the various stakeholders who are directly and indirectly impacted by the project activities whenever a need arises.

- a) Construction Labour Management Plan
- b) Waste Management Plan
- c) Occupational Health and Safety Plan
- d) Emergency Response Plan
- e) Stakeholder Engagement Plan
- f) Grievance Redressal Mechanism
- g) Environmental and Social Management Plan

## Chapter 6

### ANALYSIS OF ALTERNATIVE

#### 6. Analysis of alternatives

The World Bank's OP 4.01 necessitate examination of feasible alternatives to the proposed project site, technology, design and operation including the "without project" scenario. The subsequent section intends to assess all viable project designs to avoid or minimize involuntary resettlement, impact on natural habitat and justification of recommended emission levels and methodologies for pollution prevention and abatement. This section compares no project scenario, alternative site selection and alternative project designs for the proposed project.

##### 6.1. No project scenario

Bangladesh comprises of 24,000 km of inland waterways; wherein navigable route varies from 5968 km during the monsoon to 3865 km during the dry season. The inland waterways form an important mode of transport not only in the inland movement of freight and passengers but also in navigation of ocean vessels en-routing through the ports of Chittagong and Mongla. As per a study conducted on performance evaluation of the Ship Building Industries in Bangladesh<sup>41</sup>, it was revealed that at present more than 5,000 inland/coastal ships have been plying, which carry more than 90% of total oil product, 70% of cargo and 35% of passengers. All inland ships are constructed and repaired in local shipyards, however lack capacity for repairing of ocean vessels coming from Bay of Bengal. Figure given below illustrates Inland River ports present in Bangladesh with its navigation routes.

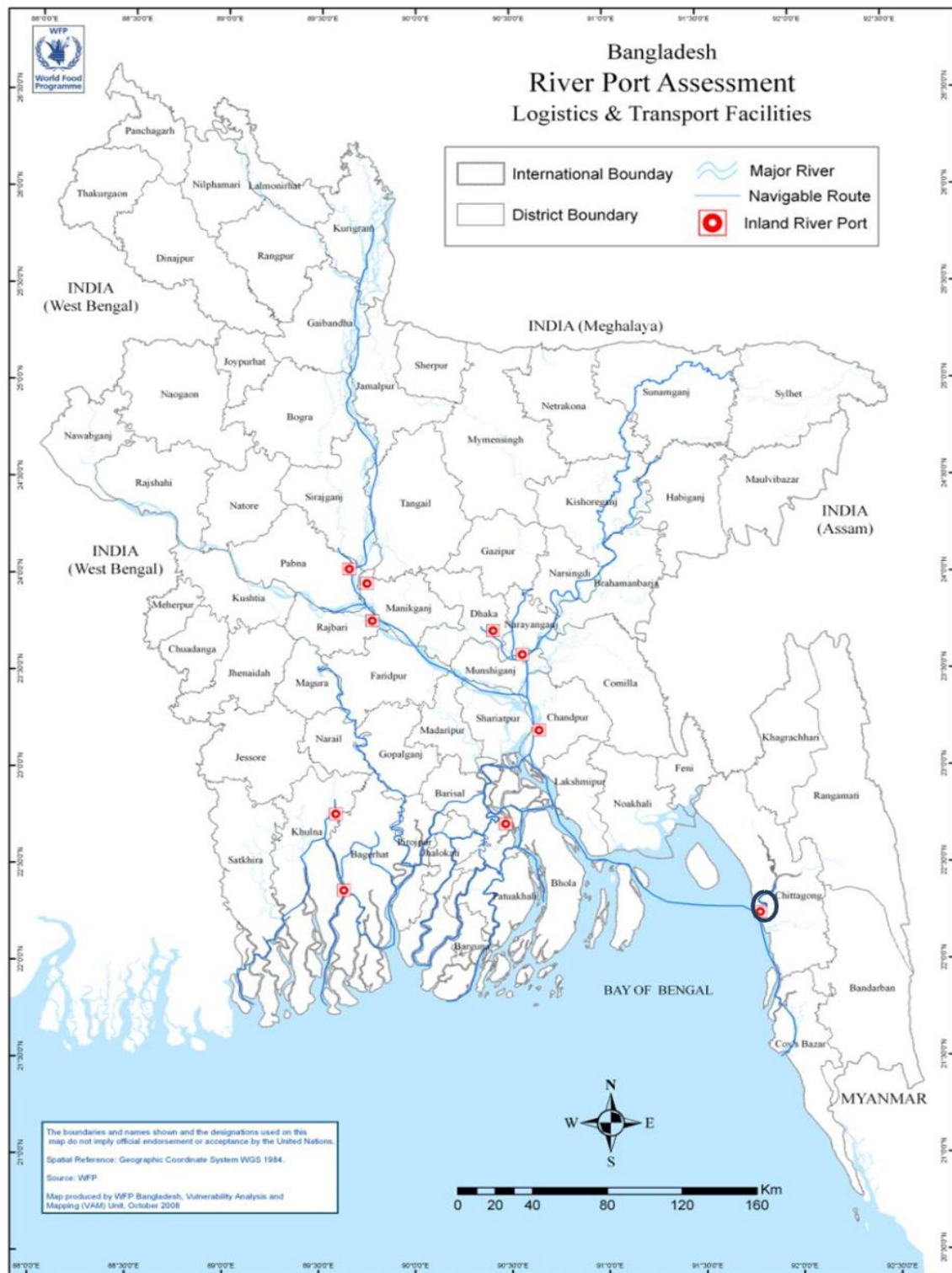
Chittagong Port being in close proximity to Bay of Bengal is the principal seaport catering to 92% of import-export handled in Bangladesh. Most industries like steel production, food processing, textile, petroleum products, chemical manufacturing have been built near the Bay of Bengal and the Karnafuly River. The port is estimated to handle 70% of the country's total imports and exports. The port is situated in lower estuarial section of the Karnafuly River, approximately at a distance of about 17 km from the mouth of the River. The total number of (incoming) ships calling at Chittagong Port in the last five years are summarised in the following Table. It was observed that the number of vessels coming at the port has remained steady, with increase or reduction in number of vessels ranging between 3-8%.

**Table 82: Details of incoming vessels to CPA**

Year	Incoming Vessel
2008	1,983
2009	1,916
2010	1,976
2011	2,082
2012	1,895

Source: Feasibility Report, prepared by BMT Asia Pacific

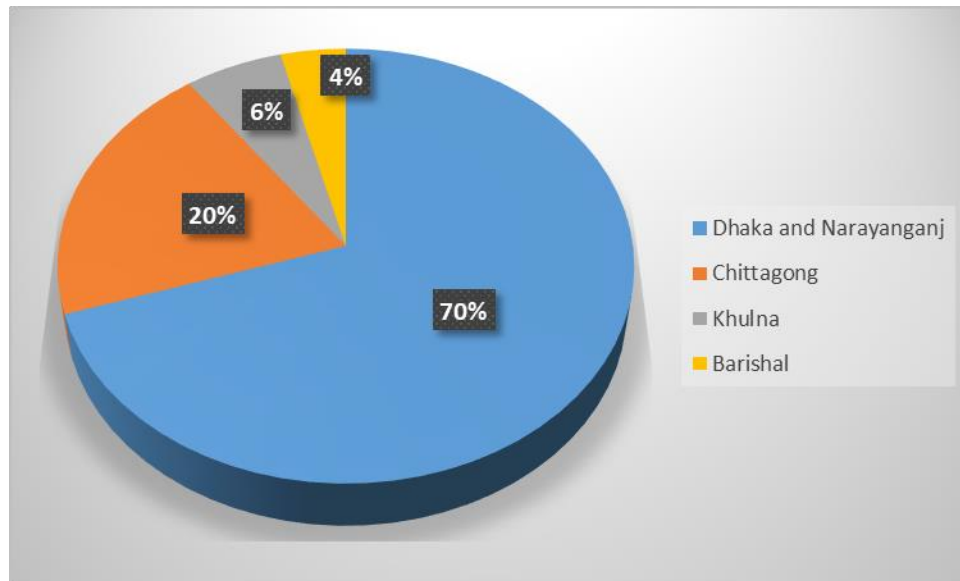




**Figure 92: Bangladesh River Port and Navigation Route**

Often, incoming ships require some maintenance and repairing works which includes removing old damaged steel works, repair of pipe works etc. According to a published paper, approximately 124 shipyards and workshops have been reported to be registered with

Department of Shipping. The percentage of shipyards located at major River Ports in Bangladesh has been depicted in the following Figure.



**Figure 93: Percentages of Shipyards at Major River**

*Source:* Journal of Mechanical Engineering “Identifying and Analysing Underlying Problems of Shipbuilding Industries in Bangladesh”, 2010

To cater ship repairing works, only 20% of total shipyards are located at Chittagong, as compared to the incoming number of vessels/ ships at Chittagong port on yearly basis. A dry dock has also been established by the Chittagong Dry Dock Limited to facilitate repairing works of ocean going ship with a capacity of 20,000 tones. However, a ship requires frequent dockings at 30 months, 60 months, or 90 months intervals; which is unable to meet the repairing needs of a large number of vessels at a given point of time due to the limited capacity of dry dock.

In this present scenario, there is an immediate need for another dry docking facility for large number of vessels arriving at Chittagong port. The country is therefore also being deprived of earning a large amount of foreign currency every year. The proposed project is seeking to build facilities adequate to repair vessels up to 100,000 tonnes DWT capacities. Moreover, KDDSEZL has a long standing relationship with GB Marine (Singapore) for providing engineering design support, and this relationship can be drawn upon to effectively transfer the needed engineering knowledge and capabilities to the new facility staff. A no project scenario can affect the shipping trade of the country, which otherwise can provide dry docking services to the internationally flagged vessels that call at Chittagong port; the major trading port of Bangladesh.

## 6.2. Alternative site selection

The Chittagong Port is located in the estuary of the Karnafuly River, nine nautical miles (16.67 km) inland from the shore of the Bay of Bengal. There is a draft restriction imposed upon entering vessels by virtue of the bar at the mouth of Karnafuly River and a sharp



reverse bend in the river known as the 'Gupta Bend'. The maximum vessel draft in the port ranges from 8.5 to 9.2 m (approximate tidal range 1.5 - 4.8 m). The maximum vessel length during the day is 186 meters, and restricted to 153 meters at night. The restriction on vessel length has also been imposed due to presence of Gupta Bend in the navigation route of Karnafuly River. The only dry docking facility available for ocean going vessels arriving at port is located at a distance of 7.7 km from the mouth of River, upstream of Gupta Bend.

The site for the proposed KDDSEZL is situated at a distance of 4.6 km inwards from the point of confluence of Karnafuly River and Bay of Bengal. Being located on downstream of Gupta Bend, ships can avoid the crossing of the bend for repairing services. Navigation is also limited in River to some extent due to periods of high tide which can cause deeper anchorage areas at the Karnafuly River entrance. Some unloading of import cargo from bulk carriers into inland vessels is allowed at these outer anchorages. These activities necessitate ship repairing activities to be undertaken and the site selected is the most appropriate site, owing to the proximity to the Bay of Bengal. The proposed dock shall be designed for vessels up to 253 meters length.

Siting of an economic zone facility is also characterized by a number of technical and economic criteria like easy access, physical and topographical features, and hydrographic, meteorological and hydrogeological factors. The following environmental and ecological criteria have been taken into account before siting of the proposed project was undertaken.

- The location shall be away from sensitive and critical habitats on land and coastal waters (coral reefs, breeding and nesting grounds, fishing zones, migratory routes of birds and mammals).
- There shall be minimal displacement of local population, diversion of forest and agricultural land.
- There shall be minimal disturbance and losses to existing socio-economic activities and minimum depletion of available resources due to direct and induced development.

The site selection criteria employed for assessing the site has been detailed below in the following Table.

**Table 83: Justification of Criteria opted.**

Sl. No.	Criteria	Justification for site selected
1.	Location	Located on eastern bank of Karnafuly River and about 4.6 km north east of confluence point of Bay of Bengal and Karnafuly River. The location of the proposed dry dock has been selected approx. 3km downstream from current dry dock facility of Chittagong Dry Dock Limited. It will cater to ocean going vessels, which find it difficult to reach the existing dry dock due to vessel size restriction during day and night time.
2.	Topography and Land Use	The topography of the area is flat and at present the project site has been reclaimed upto 6m above ISLWL with sand dredged from the river. The land will be raised by another 1m to achieve the required minimum elevation of 7m.
3.	Proximity to Eco-sensitive areas	There is no ecological sensitive area within 5km of the study area. However, a patch of marshy wetland is observed to be present at a distance of 300m in south

Sl. No.	Criteria	Justification for site selected
		west of the proposed site. This patch tends to fill during high tide in Karnafuly River, and get emptied during low tide.
4.	Involuntary Resettlement	The land selected for the proposed project is vacant land and there are no houses on the site. Also, the land was not being used by villagers for any economic activities hence there is no loss of livelihood of the project affected villagers.
5.	Connectivity/ access	The site is connected by water navigation through Karnafuly River. The project site is also accessible via Chittagong – Anwara - Banskhali road, located at a distance of 3.5km in east direction. Transportation of construction material and machinery can be undertaken by road also apart from river.

## Conclusion

The site selected is most suitable in terms of location, as sea front vacant land has been secured for the proposed KDDSEZL facility, devoid of any need of resettlement. Also, the proposed shipyard is closer to the mouth of the Karnafuly River and before the Gupta Bend the maximum size of the vessels expected to call at the proposed shipyard dry-dock is 253 metres.

## 6.3. Alternative dry dock designs

### Selection of Jetty/Wharf

The structures shall be designed in such a way that it will sustain all loads and conditions likely to occur throughout the design life and remain fit for the use for which it is required, with appropriate degrees of reliability. With reference to functional requirements of the proposed KDDSEZL, two options have been considered for the purpose of floating repairs i.e., **Dolphin Jetties** and **single Contiguous Wharf** in terms of performance, loading and unloading facility, dredging requirements and profitability. The following Table provides a comparative analysis for criteria selected for both the options.

**Table 84: Comparative Analysis of Design Options.**

Criteria	Option 1- Dolphin Jetties	Option 2- Contiguous Wharf	Comparative Analysis
<b>Design</b>	Two dolphin jetties comprising of a loading / unloading platform, breasting dolphins, and mooring dolphins has been proposed under this option. An approach trestle will connect the jetty to the shore and will accommodate a roadway, pedestrian walkway and utilities corridor. The platform will accommodate jib crane, bollards and fenders for carrying out repair works.	A contiguous wharf consisting of long continuous platform and a mooring dolphin has been proposed under this option. The platform will be connected with shore by a pair of approach trestles. The platform will accommodate jib crane with crane rails, bollards, fenders and gangway access tower for carrying out repair works.	More number of mooring dolphins will be required for securing the ships/vessels with Option 1.  Option 2 will be an elongated structure with a long continuous platform requiring more space.
<b>Economic Value</b>	As per the preliminary budgetary cost estimated for the proposed project, the cost of construction of jetty is approx. 14% of the total cost of the project.	As per the preliminary budgetary cost estimated for the proposed project, the cost of construction of contiguous	Option 1 is more viable in terms of economic value

Criteria	Option 1- Dolphin Jetties	Option 2- Contiguous Wharf	Comparative Analysis
		wharf is approx. 21% of the total cost of the project.	
<b>Extent of Dredging required</b>	The amount of dredging required for construction of two dolphin jetties will be minimal.	Due to contiguous nature of wharf, dredging requirement is more on both the sides of the wharf.	Requirement of dredging is less with option 1.
<b>Construction</b>	The construction required is less, as two independent dolphin jetties will be constructed.	The construction required will be more for contiguous wharf which consists of long continuous platform and a mooring dolphin.	The amount of construction materials and cost is less in case of Option 1.
<b>Flexibility</b>	Shifting of vessels to various places will be difficult as, two dolphin jetties will be constructed separately from other.	Establishing of wharf will facilitate required shifting of vessels to reach various locations of the ship for repairing purpose.	Option 2 has more flexibility in terms of number and type of vessels berthed for repair works due to presence more space on wharf.

Considering the economic value associated with the construction of dolphin jetties over contiguous wharf, **Option 1** is considered for the proposed project and jetties shall be designed to accommodate ships of different sizes.

### **Dock Orientation**

Three options were considered pertaining to the orientation of dry dock to minimize the cost of dredging by maximizing the use of the existing channel. Social variables like physical displacement, involuntary resettlement etc. have also been considered and analysed for fixing the orientation of dry dock on the land procured.

#### **Option 1**

The option considered for the orientation of KDDSEZL is parallel to the Badalpura village road. However, the distance between berthing line, where one of the dolphin jetties is proposed to be located and the placement of KDDSEZL is maximum which can increase the extent of dredging required, hence the cost associated with it. The parallel alignment of KDDSEZL with the existing village road can cause disturbance to the prevailing activities on the other side of the road. Also, there can be loss of access to common property of village and services. The first option is shown in the following Figure.

#### **Option 2**

The orientation of KDDSEZL considered in second option is skewed at an angle of 15 degrees and is crossing the existing Badalpura Village Road. In this option also, the amount of dredging required will be high due to distance with the berthing line and placement of dry dock. In this option considered, the alignment of dry dock is overlapping with the existing village road, which forms an important means of access to the common property resources of Badalpura Village. The major social risk associated with this option is disruption caused

to the existing village road which will eventually induce a negative development effect of the proposed project. This option is presented in the following Figure.

### **Option 3**

In this option, the dock entrance is in line with the existing berthing line which minimizes the distance between dolphin jetty and dry dock and extent of dredging required. Also, the orientation of Dry dock is not crossing the existing Badalpura Village Road. The social impacts in terms of loss of access to road, disruption to life of locals will be negligible and hence no displacement is required. This option is presented in the following Figure.

### **Conclusion**

After comparing all three options considered for the orientation of dry dock, option 3 comes out as the best option due to minimal requirement of dredging and negligible disturbance to the existing Badalpura village Road. Also, there will be no need of physical or economic displacement or any negative consequences will be triggered that will diminish the developmental impact of project.



Figure 94: Dock Orientation Option-1

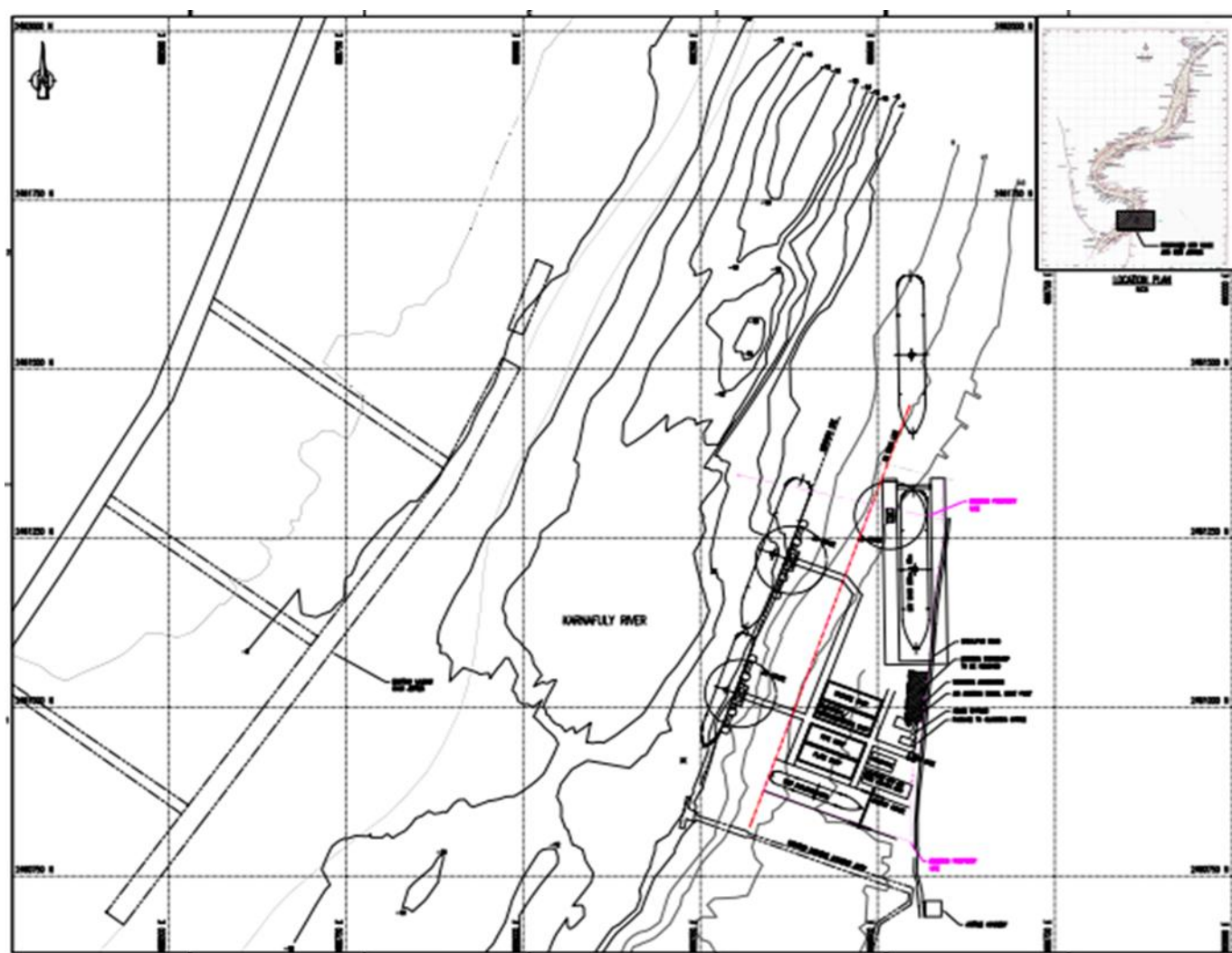


Figure 95: Dock Orientation Option-2





Figure 96: Dock Orientation Option-3

## Chapter 7

### IMPACT ASSESSMENT AND MITIGATION MEASURES

#### 7. Impact assessment and mitigation measures

This chapter describes various environmental and social impacts identified and assessed for the construction and operation phases of the proposed development of the KDDSEZL and associated facilities. The specific objective of this section is to:

- Identify and assess the range of potential impacts and the extent of their severity;
- Explain the ways in which the project might affect air, water and land environment, ecology, water, socio-economic resources, livelihoods, cultural patterns, as well as access and infrastructure issues;
- Suggest viable mitigation measures for the identified impacts;
- Provide inputs to develop a management plan based on the proposed mitigation measures.

The impacts have been identified through available project documents; discussions with the local community; the project proponents and Shahidul Consultant's previous project experience in handling assignments of similar nature. An impact evaluation and significance matrix has been developed for the qualitative assessment of impacts. Mitigation measures are identified for residual or minimised impacts which cannot be avoided as part of the project development and operations. The section also identifies cumulative impacts which act along with other impacts to affect the same environmental resource or receptor. The significance and magnitude of such impacts will be much greater in that case.

#### 7.1. Summary of project activities

##### Construction

The construction of the KDDSEZL will involve dredging, reclamation, batching plants for concrete preparation, piling, construction office spaces, internal roads, drainages etc. The construction activities will also require significant number of workers at site, as well as movement of vessels and construction vehicles. The construction activities will generate construction debris, dredge material, run off water/silt, sewage, domestic waste, waste oil from machinery which can lead to potential environmental degradation.

##### Operations

The operation of KDDSEZL will involve movement of large vessels for docking; there will be some impact on the Karnafuly river navigation when vessels align for docking. Noise will be generated during sand blasting and fabrication-forging of metal sheets. There will be significant volume of waste, hazardous and non-hazardous, generated from the maintenance and repair work of vessels, including bilge, bottom sludge, paint flakes, septic tank waste, etc. The operations will also have significant health and safety risk for workers

working at height, performing hot jobs, working in confined spaces etc. All these along with waste water generation from the operation can lead to degradation of the environment.

## 7.2. Impact appraisal criteria-impact significance

An interaction matrix has been developed based on internationally recognized environmental assessment methods by Larry W. Canter, 1991. The basic concept for impact prediction is to anticipate and quantify the change in the environmental and social baseline conditions as a result of the project or activity, and then to consider the difference in the conditions from the with- and without-project conditions as a measure of impact.

The criterion which has been employed to appraise the severity of impacts on various environmental and social components due to the development of the proposed project is as presented in the following Table.

**Table 85: Impact Appraisal Criteria**

Criteria	Sub-Classification	Defining Limit
<b>Spread:</b> Refers to area of direct influence from the impact of a particular project activity.	Insignificant / Local spread	Impact is restricted within the foot prints of the Project boundary or within 500m of the boundary
	Medium Spread	Impact is spread beyond 500m up to 2 km of the Project boundary
	High spread	Impact is spread up to 2 km to 5 km from footprint boundary of the Project.
<b>Duration:</b> Based on duration of impact and the time taken by an environmental component to recover back to its best possible pre-project state.	Insignificant / Short Duration	When impact is likely to be restricted for duration of less than 6 months;
	Medium Duration	When impact extends up to three years
	Long Duration	When impact extends beyond three years
<b>Intensity:</b> Defines the magnitude of Impact	Insignificant intensity	When resulting in changes in the environmental baseline conditions is up to 10%
	Low intensity	When resulting in changes in the baseline conditions up to 20%
	Moderate intensity	When resulting in changes in the baseline conditions for up to 30%
	High intensity	When change resulting in the baseline conditions beyond 30%
<b>Nature:</b> Refers to whether the effect is considered beneficial or adverse.	Beneficial	When impact will result in positive or beneficial change in the project area
	Adverse	When impact will result in negative or adverse change in the project area
<b>Frequency:</b> refers to extent of occurrence of any activity/ task	Intermittent	Activities which may be undertaken intermittently or have impact only when undertaken beyond certain intensity
	Frequent	Activities which may be undertaken on regular basis but may not be continuous and routine requirement
	Routine	Activities which will be undertaken routinely or daily as part of construction or operation of the project.

Once the magnitude of impact is characterized based on spread, duration, intensity and nature, the significance of overall impact is assigned based on frequency of occurrence of the activity leading to the impact. The outcome of magnitude of impact has been interpreted as Negligible, Small, Substantial or Major. Colour codes have been utilized to communicate information on anticipated overall impact significance (Insignificant, Minor, Moderate or Significant). Beneficial impacts have been displayed with shades of green; whereas, detrimental or adverse effects have been displayed with shades of red.

In addition to considering frequency of occurrence of activities in evaluating the overall impact, the other principal criterion considered is sensitivity or vulnerability of the impacted resource/ receptor to a particular impact. There are a range of factors to be taken into account while defining sensitivity of the receptor which may be physical, biological, cultural or human as per the following understanding:

- When the resource is physical (water body) its quality, sensitivity to change and importance, and stress or pollution levels are considered.
- When the receptor is biological or cultural, its importance (local, regional, national or international importance) and its sensitivity to the specific type of impact are considered.
- When the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

An impact significance assessment matrix was developed to assess the various impacts, based on the appraisal criteria developed above, which is as given in the following Table. The potential impacts from Pre-construction, Construction, Operation and decommissioning phases of the project is discussed in the subsequent sections.

**Table 86: Impact Significance Criteria**

Spread	Duration	Intensity	Magnitude of Impact	Overall Impact based on Frequency of Occurrence					
				Adverse			Beneficial Impacts		
				Intermittent	Frequent	Routine	Intermittent	Frequent	Routine
Local	Short	Low	Negligible	Insignificant	Insignificant	Insignificant*	Insignificant	Insignificant	Insignificant
Local	Short	Moderate	Small	Insignificant	Minor	Moderate	Insignificant	Minor	Moderate
	Medium	Low							
	Medium	Moderate							
	Long	Low	Substantial	Minor	Moderate	Significant	Minor	Moderate	Significant
Medium	Short	Low							
Local	Short	High							
	Medium	High							
	Long	Moderate							
Medium	Short	Moderate							
	Medium	Low							
	Medium	Moderate							
	Long	Low							
High	Long	Moderate							
	Short	Low							
	Short	Moderate							
	Medium	Low							
	Medium	Moderate							
	Long	Low							
Local	Long	High	Major	Moderate	Significant	Significant	Moderate	Significant	Significant
	Short	High							
Medium	Long	High							
	Short	High							
High	Medium	High							
	Long	Moderate							
	Low	Low							
	Low	High							

### **7.3. Impact assessment: pre-construction and construction phase**

Based on the activities involved, an impact interaction matrix for pre-construction and construction phase was prepared for the project. The impact identification matrix is presented in the following Table.

An impact interaction matrix for pre -construction and construction phase of the project has been identified on the following components and described further in separate sub sections:

- Ecology;
- Water Resources;
- Water Quality;
- Soil Quality;
- Ambient Noise Quality;
- Ambient Air Quality
- Traffic and Transport;
- Socio-economy;
- Occupational Health and Safety



**Table 87: Impact Identification Matrix for Construction Phase**

Potential Impacts										
S. N.	Main Activities	Ecology	Water Resource	Water Quality	Soil Quality	Ambient Noise Quality	Ambient Air Quality	Traffic and Transport	Livelihood	Occupational Health & Safety
1.	<b>Land Procurement</b>									
2.	<b>Site Preparation / Reclamation</b>									
	Site Clearing / Reclaiming									
	Dredging activities									
	Vegetation clearance									
	Transportation of Machinery									
3.	<b>Labour Engagement</b>									
	Setting up temporary facilities									
	Waste handling & its disposal									
	Sewage disposal									
4.	<b>Material Handling &amp; Storage</b>									
	Transportation and Unloading of construction material									
	Storage and Handling of construction Cement, Concrete, Bricks, Steel etc.									
5.	<b>Construction activities</b>									
	Preparation/Mixing of construction material									
	Supply of water, power, sanitation etc									
	Operation of construction machinery									
	Handling and Disposal of construction wastes									
6.	<b>Demobilization of Construction Equipment</b>									
	Dismantling of temporary support construction structures /equipment									
	Removal of construction machinery									
	Transportation of Construction/Dismantled wastes.									

### **7.3.1. Ecology**

The site is devoid of any vegetation cover, as significant part of it is inundated by water during high tides. The project proponent has reclaimed the southern portion of the site by sand filling. The project will not require clearance of vegetation as part of pre-construction activities. The dredging activities for construction of Jetties and dry dock (about 7 m and 13 m below existing ground level respectively) can lead to potential siltation. The construction works will require about 250-300 workers at site, which will generate sewage and domestic waste requiring adequate disposal. The construction activities will also generate noise coupled with intermittent loud peaks associated with forging and fabrication of metal sheets.

The potential impacts on the ecological resources of the study area due to construction activities are discussed below.

#### **Impacts**

##### **Dredging Activities and Run off from Construction Areas**

- The dredging will require removal of approximately 366,000 m<sup>3</sup> of sub-littoral/river bed area. The sediment to be removed will consist of mixed sediments with varying levels of sands and silts. The method of sediment removal will involve cutter suction dredger (CSD). Changes that will occur in community structure after dredging is likely to be medium spread and locally significant, as it will cause the complete removal of all communities present within the area of the proposed dredging works.
- It has been noted that the species found in the area are common species with a wide distribution along the Karnafuly River. The benthic community removed or damaged during the operation should begin to re-establish itself almost immediately after the cessation of the dredging, by emigration from adjoining areas (both upstream and downstream) and by larvae from the plankton.
- In addition, the dominant species present in the proposed dredge area are opportunistic species and can rapidly colonise from resident populations present in unaffected areas upstream and downstream of the site.
- Dredging can give rise to sediment blooms with high levels of suspended solids, especially close in to the dredger head and a depth in the water column. High levels of solids can damage fish gills and thereby contribute to bacterial gill disease or more rarely to direct fish mortalities. The latter situation is not common in nature and would only be expected where fish were exposed for extended periods to high solids levels in areas where they are unable to take avoidance actions. Other things being equal, juveniles are more susceptible than adults to suspended solids impacts. However, it is to be noted that the aquatic biota is already exposed to siltation due to the maintenance dredging undertaken in the Karnafuly river and daily vessel movement to and from the busy Chittagong Port. The project related dredging will be limited only to construction phase for short duration and is not expected to significantly increase the levels of siltation and adversely affect the aquatic biota.

- Runoff from construction area such as silt and debris, as well as disposal of sewage from toilets provided in construction areas can lead to deterioration of the water quality along the bank of the river, which would be aggravated by low tides.
- The river bank along the south of the project area (on the other side of the Marine Academy jetty) is observed to have mangrove plantations of species *Sonneratia apetala*, locally known as 'Kewra', although in a limited area. Mangroves are generally sensitive to pollution and excessive pollution loads result in loss of mangrove cover. The purpose of the 'Kewra' plantation, as reported by Forest officials, was to prevent erosion of the river bank. Studies suggest that this particular mangrove species is also tolerant of highly saline water and is able to sustain in waters having high concentration of heavy metals and total dissolved solids. As per IUCN Red List of Threatened Species, Kewra is identified as 'Least Concern. However improper disposal of construction wastes during project development is likely to affect the mangroves in an adverse manner.

#### **Impact on Gangetic Dolphins due to Piling Activities**

The Ganges River Dolphin is part of the super family Platanistoida which also includes the Amazon River, Chinese River, Indus River and La Plata Dolphins. The Ganges River Dolphin does not have a crystalline eye lens, rendering it effectively blind (Herald et al., 1969), and lives in an environment in which vision is not the primary sense because light does not penetrate far beneath the river surface. As such, the Ganges River Dolphin relies primarily on sound as its sense for communication and awareness of its environment.

Dolphins typically communicate with whistles, clicks and squeals at frequencies ranging from 1 to 20 kHz and most energy typically occurring around 10 kHz. The acoustic properties of the Ganges River Dolphin's communication signals have not been studied. Other river dolphin species are known to produce whistles, clicks and squeals.

The hearing sensitivity of dolphins generally varies with frequency. Audiograms are therefore used to represent a dolphin's sensitivity to sounds of different frequencies. An audiogram of a species relates the absolute threshold of hearing (in dB re 1  $\mu$ Pa) of that species to frequency. A species is most sensitive to sounds at frequencies where its absolute threshold of hearing is lowest.

The hearing sensitivity of the Ganges River Dolphin has not been investigated. Chinese and Amazon River Dolphins have most sensitive hearing between 20 and 80 kHz which overlaps with the dominant frequency range of their echolocation signals. Hearing thresholds are 50 to 60 dB re 1  $\mu$ Pa at the most sensitive frequencies and reduce significantly at lower frequencies.

Potential impacts of noise on dolphins include mortality, hearing damage, masking of communication and other biologically important sounds, and behavioural responses (Richardson et al. 1995). Mortality only occurs in the immediate vicinity of very high energy noise sources, such as blasting, and is unlikely to occur for the KDDSEZL.

Masking of biologically important sounds may interfere with communication and social interaction and cause changes in behaviour as well. The zone of masking impact will be highly variable and depends on many factors including the distance between the listener and sources of the signal and masking noise, the level of the signal and masking noise, and the propagation of noise from the signal and masking source to the listener (Richardson et al., 1995).

It is important to note that masking of communication and echolocation signals naturally occurs by the ambient noise environment. Man-made noise causes additional masking of a signal only when it is of a higher level than the ambient environment within the species' critical hearing bandwidth at the signal's dominant frequencies (Richardson et al., 1995). The critical bandwidth for dolphins is typically assumed to be one-third octave band wide (Richardson et al., 1995).

Echolocation clicks produced by the Ganges River Dolphin have dominant energy around 65 kHz (Sugimatsu et al., 2011). This is well above the dominant frequency range of most man-made noise, including piling.

Masking of echolocation signals is therefore not a significant issue for most man-made sources (Richardson et al., 1995). In other words, piling is not expected to significantly interfere with the echolocation ability of the Ganges River Dolphin.

The Ganges River Dolphin is likely to produce communication signals, such as whistles, squeals or clicks, based on communication signals produced by other river dolphins. These signals generally have energy at much lower frequencies than the echolocation clicks, i.e. as low as 1-6 kHz. Communication signals are therefore more likely masked by man-made noise than echolocation clicks.

However as Karnafully River is already exposed to various noise generating activities of man-made nature, it is expected that the Dolphins have adapted to communication in such an environment. It is also to be noted that piling will be a short-term activity.

### Mitigation

As per the World Bank's OP 4.04, the Bank supports protection, maintenance and rehabilitation of natural habitats. Although the project area does not comprise of any critical natural habitats such as internationally recognized protected areas or areas with local traditional community resources, as inferred from the baseline ecological assessment, the Bank suggests recommendation of appropriate mitigation measures.

ADB's Environmental Safeguards also states that projects in areas of natural habitats should not result in significant conversion or degradation of the habitat and necessitates appropriate mitigation measures in case of any conversion or degradation. The following mitigation measures are proposed for minimizing the adverse impacts on ecological resources of the area:

- The project shall ensure that the identified dredger type will result in minimizing the amount of silt and sediments that are re-suspended at the dredge site. By using a dredger with a cutter head attached to it the dredged material is removed directly from the burrow site to the dewatering site by means of discharge pipes. This will decrease the time that the spoils remain in the water. The sub-bottom profile shows the area to be predominantly sand which when excavated results in a significant amount of silt being produced. A silt curtain will be installed around the dredge site. This however needs to be moved to allow for the passage of ships through the channel.
- Dredge material will be utilized for the reclamation of the site to the extent possible, remaining material will be collected and used for filling of low lying areas. However, in order to rule out the possibility of contamination, dredged material should be analysed for their contamination potential and in order to select appropriate disposal sites. Though there are no national standards for testing the quality of sediments/dredged material, some international guidelines suggest that the dredged material should be tested for metals and metalloids (Cr, Cu, Hg, Ni, Pb, As, etc.), PAH, PCBs, TBT, etc. Materials exceeding the recommended levels of contamination should be transported with utmost care and isolated from the environment upon final disposal.
- Construction area will be bunded and provided with adequate drainage with silt traps to prevent runoff from construction area into the rivers. Sewage generated at site will be treated by using a package type sewage treatment plant of capacity 10KLD, based on membrane bio-reactor (MBR) technology, which will be subsequently replaced by the sewage treatment plant proposed for the project.
- Construction workers will be instructed about no disposal or dumping of any kind of waste into or in the vicinity of the Karnafuly River.
- KDDSEZL will ensure monthly monitoring of the river as well as groundwater quality for parameters such as pH, BOD and turbidity downstream of the site to ensure that the mangrove plantations are not severely affected.
- The size of piling rig shall be planned according to the requirement of the activity, rigs larger than requirement will be avoided.
- Immediately prior to the commencement of piling each day, observations will be carried over a 20 minutes period to verify sightings of any dolphin within a 500 m radius of the project area. Piling activity shall be put on hold if any sightings are made, till the animal moves away.
- A nylon or HDPE cushion will be used between the hammer and pile to reduce hammer impact noise.
- Soft start procedures shall be adopted (i.e. commencing with reduced noise level to allow animals to move away from the area before increasing the noise levels gradually);
- Where piles are driven or drilled through water, bubble curtain technology may be employed. Bubble curtain techniques introduce specifically sized air bubbles into the

water surrounding the pile in a controlled manner, thus dampening the shock waves and helping to minimize the effects on aquatic life.

### **Significance of Impact**

The extent of impact is short term with moderate intensity, the mangrove plantation close to site is vulnerable receptors identified and further enhances the potential impact. The aquatic biota is already exposed to high level of siltation due to various dredging activities in the river and has adapted to environment, hence vulnerability for them is low.

**Table 88: Impact Significance - Ecology**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Ecology	Without Mitigation	Local	Medium	Moderate	Routine	MODERATE
	With Mitigation	Local	Medium	Low	Frequent	Minor

The overall impact is considered to be **Moderate**; however, it can be kept to **Minor** with implementation of the proposed mitigation measures.

### **7.3.2. Water resources and quality**

It is estimated that about 25 KL of water will be required daily for the construction activities; this excludes the water for domestic requirements which will be about 8-10 KL per day. The fresh water requirement for construction will be sourced from ponds using tanker services. Packaged water will be provided to workers for drinking. Domestic wastewater of about 6-8 KLD will be generated during construction phase.

Testing of water samples collected from the Karnafuly River and samples taken from bore well at project site during primary baseline monitoring indicate major contamination due to untreated sewage and wastewater discharge from industrial operations along the river banks. Based on the best practice classification of Inland Water samples (as per ECR, 1997), the water samples from River Karnafuly cannot be classified into any of the classes of Inland Water.

The detailed impacts of the project development phase on the water resources and quality have been discussed below.

### **Impacts**

- The marine area around the dredge site may experience a temporary increase in sediment levels during the dredging operations, which will quickly revert back to normal levels. The high levels of silt on the river bed allows for the area to have elevated levels of suspended materials as the increments will be minimal. Reclamation operation will result in the re-suspension of fine particles due to erosion of the edges of the reclamation.
- Erosion would occur at the edges due to wave and current action and result in runoff. This would cause re-suspension of fines in the river. However, it is to be noted that KDDSEZL plans to undertake reclamation of the site prior to start of construction activities. Partial reclamation has already been undertaken. Hence there will not be any additional erosion due to the construction activities.



- The water quality could also be affected due to escape of excavated soil, as well as loose silt and sand which can be washed along the surface drainage into the water causing siltation. Use of machinery and equipment will require storage of materials such as fuels and other chemicals. Their use can lead to contamination of soil and groundwater through improper transport, storage or handling.
- Collecting water from ponds for construction activities may lead to additional pressure on the community resource as there could be other users. Inadequate disposal of sewage can lead to further deterioration of water quality in the river, resulting in high BOD and nutrient levels along the banks.

### Mitigation

According to World Bank's OP 4.07, the Bank encourages guarding against overexploitation of water resources, especially groundwater, in areas where they are fast depleting and are primarily used by the local community. The Bank also recommends control of water pollution through adoption on management measures. IFC Performance Standard 3 also emphasizes on abatement of pollution of natural resources and using them efficiently. ADB Environmental Safeguards also necessitate application of pollution prevention and control technologies and practices consistent with international good practices. The following mitigation measures are proposed for ensuring minimal impacts to water resources and quality:

- Area around excavated soil or loose construction material shall be bund to prevent runoff to nearby water bodies. All storage areas shall be kept away from the storm water drains to prevent any wash away into the river.
- A detailed mobilization plan shall be developed with details of location of storage areas for construction materials, and waste water facilities prior to commencement of work to minimize the impact of mobilization.
- All the debris resulting from construction activities shall be removed from the site and transported to designated areas, on regular basis to prevent any runoff. Oil and grease trap shall be provided to remove oil and grease from workshop effluents prior to discharge into disposal systems.
- The use of silt screens in dredging projects is suggested method for mitigating environmental impacts from fine sediments. Turbidity need will be measured regularly during the dredging activity and will be managed to restrict the turbidity levels within acceptable levels.
- It is suggested to enclose the reclamation site by building a peripheral bund around the edge of the site, using dredged material. This will be effective in limiting the re-suspension of fines at the reclamation site.
- A sewage treatment system is proposed for operation period which will be installed in the first eight months of construction, till that period a package type treatment of approximate 10KLD capacity will be used for sewage treatment from the labour facilities.
- The sourcing of water from pond will be undertaken only after assessing the feasibility and availability of water after considering the need of existing users.

### **Significance of Impacts**

The extent of impact is medium term with moderate intensity; Karnafuly River is the only receptor identified around the site. The river water quality is prone to high levels of BOD and sediments as observed from long term data and primary monitoring, most of which is due to the industrial operations upstream. The construction activity will only have localized impact on water quality within immediate vicinity of the site and dredging area.

**Table 89: Impact Significance - Water Resources and quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Water Resources and quality	Without Mitigation	Local	Medium	Moderate	Routine	MODERATE
	With Mitigation	Local	Medium	Low	Frequent	MINOR

The impacts on water resources and quality will thus be of '**Moderate**' significance and can be reduced to '**Minor**' with implementation of proposed mitigation measures.

#### **7.3.3. Soil quality**

Primary baseline assessment of soil and sediment quality in and around the project area and review of related secondary studies do not indicate any type of contamination. However improper management of activities related to the proposed development such as reclamation of project site, operation of machinery and equipment, generation of solid and hazardous waste, etc. is likely to result in contamination of soil quality in the area. The potential impacts on the soil quality of the study area due to construction activities are discussed below.

### **Impacts**

- The anticipated impact on soil includes loss of loose soil during site grading and excavation, which is vulnerable to erosion. The potential for runoff will be increased during heavy rains, which can result in loss of significant amount of soil from the site.
- There is potential for contamination of soil from landfilling wherein dredged material from riverbed will be used. The riverbed of Karnafuly River is exposed to various chemicals and heavy metals discharged by industries upstream of the river. Landfilling with potentially contaminated material can lead to degradation of the soil quality besides contamination.
- The maintenance of heavy machinery and equipment will involve replacement of machine oil, greasing and other such activities that may lead to soil pollution, if not handled properly. There is potential for contamination of soil due to accidental spills of lubricating oil, fuel oil, paint, thinner etc. during their handling and storage. Besides this storage of discarded containers of paint, varnish, thinner, grease, lubricating oil etc. can also lead to contamination.
- The expected solid waste during construction phase will include construction waste/debris; waste oil and chemicals from construction machinery and domestic solid waste etc. which in the absence of proper disposal can lead to contamination of soil.
- Runoffs from oil storage area, waste oil collection area, vehicle maintenance area can also lead to contamination of soil.

### Mitigation

- Various mitigation measures for reducing adverse impacts on the soil quality of the area have been suggested below. The measures have been proposed in accordance with requirements of IFC Performance Standard 3 and ADB Environmental Safeguards towards abatement of pollution.
- Dredge material will be tested for heavy metals and other organic pollutant prior to use for landfilling in the remaining area of the site. Though there are no national standards for testing the quality of sediments/dredged material, some international guidelines 47 suggest that the sediments should be tested for metals and metalloids (Cr, Cu, Hg, Ni, Pb, As, etc.), PAH, PCB, TBT, etc. Other details have been discussed in Waste Management Plan. Construction waste shall be kept at dedicated waste management areas such that all construction wastes, including packaging, can be separated and later taken for disposal at the nearest municipal facility.
- A retention wall or bund will be provided around the storage areas for excavated soil and other construction material to check the flow of solid with storm water in case of rain. Also, the site will be properly fenced to keep project activities including receipt and storage of construction material within the project area.
- All storage facilities will be designed with paved surface, provided with covered shed and adequate containment facility at the construction site to prevent any contamination of soil due to accidental spills of lubricating oil, fuel oil, paints, thinner, varnishes, chemicals etc.
- Proper storage for machine oil, used oil and grease will be undertaken to avoid any soil contamination by providing adequate secondary containment. Training of workers on the correct transfer and handling of fuels and chemicals and the response to spills will also be undertaken. **A Chemical Management Plan** has been developed and provided as Annexure XX.
- The sub-contractors engaged for the project will be instructed about the need to train their workers on disposal of food and drink containers. Waste collection skips will be placed along the construction sites so that they can be disposed at regular intervals and in an organized matter.
- Inspection of oil storage areas, tanks, pipe, valves etc. will be undertaken on weekly basis to detect and plug any possibility of leak. Arrangement of drip pans, sealing material and require spares to made at site to negate any leak identified.
- All vehicles engaged for the project will be inspected for oil leaks and adequate maintenance will be undertaken to ensure the same.

### Significance of Impact

The extent of impact is local with minor intensity; the duration is also expected to be short as there is no continuous source of contamination. Soil at site is the identified receptor, the construction phase will not have significant volume of chemicals or fuel storage at site therefore the impact will always be minor.

**Table 90: Impact Significance – Soil Quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Soil quality	Without Mitigation	Local	Medium	Low	Frequent	MINOR
	With Mitigation	Local	Short	Low	Intermittent	INSIGNIFICANT

The impact significance without mitigation measures will be **‘Minor’** however the impacts can be made **‘Insignificant’** with the proposed mitigation measures.

#### 7.3.4. Ambient noise quality

##### Impacts

##### Noise from Construction Activities

Noise generation during construction phase will be primarily from:

- Operation of construction equipment and machinery like dozers, generators, pumps, compressors, pneumatic tools, saw, vibrators, concrete mixers, cranes etc.
- Vehicular movement in the project area.

The potential impact of the proposed construction activities on the ambient noise quality of nearby areas will include the following:

- **High noise levels will create** disturbance to the habitations in the proximity of the construction areas and the impact can lead to sleep disorders if the night time noise levels are very high.
- Workers working close to high noise areas can be exposed to occupational hazards of noise. This can affect their hearing and lead to loss of hearing depending on the duration of exposure.

It is expected that operation of the above mentioned construction machinery will generate noise levels between 75 – 80 dB (A). The combined effect of these sources may reach 95 dB (A) at the construction site, however noise dissipates as it spreads in area beyond. The sound pressure level generated by a noise source decreases with increasing distance from the source due to wave divergence.

The attenuation of noise with distance from construction activity is as shown in the following Figure. The noise generated from construction at the fence line of the site is about 62.5 dB (A). The baseline noise observed at Badalpura village is 60.2 dB (A). Thus, the resultant increase will be 64.5 dB (A), if no mitigation is provided.

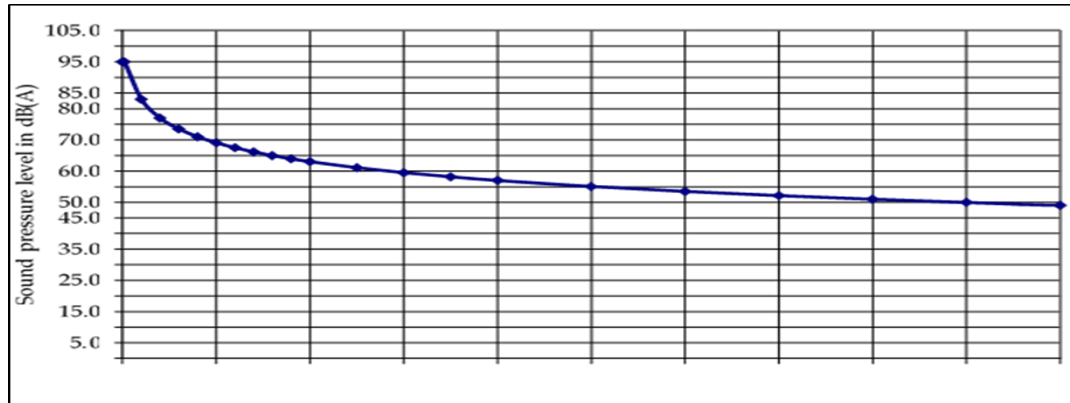


Figure 97: Construction Noise Attenuation with Distance

### **Noise Impact from Piling**

Piling noise varies with the size of the pile being installed and the pile driving method used. The most common pile driving methods include impact pile driving, where a pile is hammered into the ground by a hydraulic ram, and vibro-driving, where rotating eccentric weights create an alternating force on the pile, vibrating it into the ground.

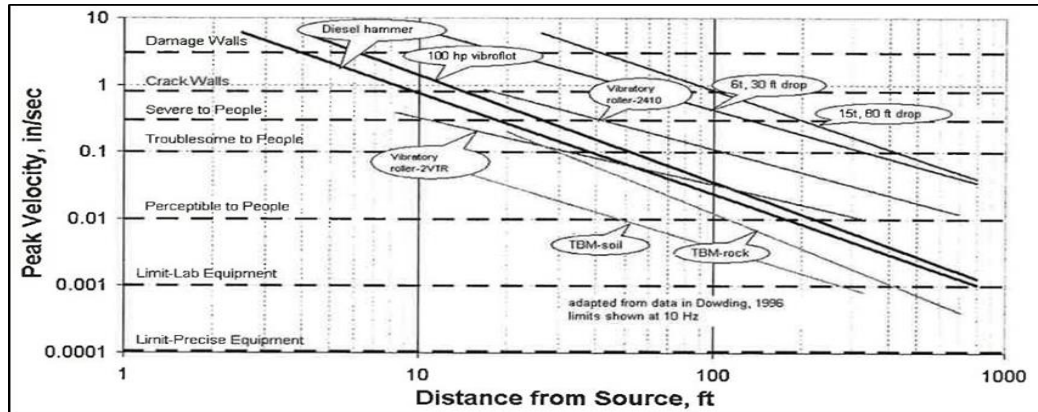
**Impact piling** – Impulsive in character with multiple pulses occurring at blow rates in the order of 30 to 60 impacts per minute. Typical source levels range from SEL 170–225 dB re 1  $\mu\text{Pa}^2 \cdot \text{s}$  for a single pulse, and peak level 190–245 dB re 1  $\mu\text{Pa}$ . Most of the sound energy usually occurs at lower frequencies between 100 Hz and 1 kHz. Factors that influence the source level include the size, shape, length and material of the pile, the weight and drop height of the hammer, and the seabed material and depth.

**Vibro-driving** – Continuous in character and usually of a much lower level than impact piling. Typical source levels range from 160–200 dB re 1  $\mu\text{Pa}$ , with most of the sound energy occurring between 100 Hz and 2 kHz. Strong tones at the driving frequency and associated harmonics may occur with the driving frequency typically ranging between 10 and 60 Hz. Sound propagation at such low frequencies is often poor in shallow water environments, such that the tones may not be noticeable at greater distances from the source.

The project will be involving impact piling, which will be for a limited duration and is expected to be completed over a period of 3-4 months. The activity will be discontinuous in nature and for a limited duration. Badalpura village and Marine Academy are the key receptors identified for the noise impact generated from piling operations. The potential impacts have been discussed below:

### **Structural damage**

Measured peak vibrations levels (as shown in Figure give below) from various construction activities as function of distances away from the vibration source show that particle velocity decreases rapidly with distance from source. It also indicates that if the activity is more than 15 feet (4.6m) from vibration source for typical pile driving, the vibration level is below the threshold which may damage a structure.



**Figure 98: Typical Vibration Levels**

All activities requiring piling are located at least 80-100 m from the village of Badalpura. The Marine academy will be about 180 m from the piling area for dolphin jetties. Thus, the potential for any structural damage from piling will be insignificant.

### **Disturbance to Community**

Pile driving is a noise generating construction activity. World Health Organisation (WHO) have indicated that the majority of people are moderately annoyed by steady, continuous sound levels above 50 dB (A) and seriously annoyed at continuous sound levels above 55 dB (A). The baseline noise observed in the Badalpura village is 60.2 dB (A) for day time and 57.5 dB (A) for night time, which is already higher than acceptable standards and can be attributed to the active navigational activities in the river.

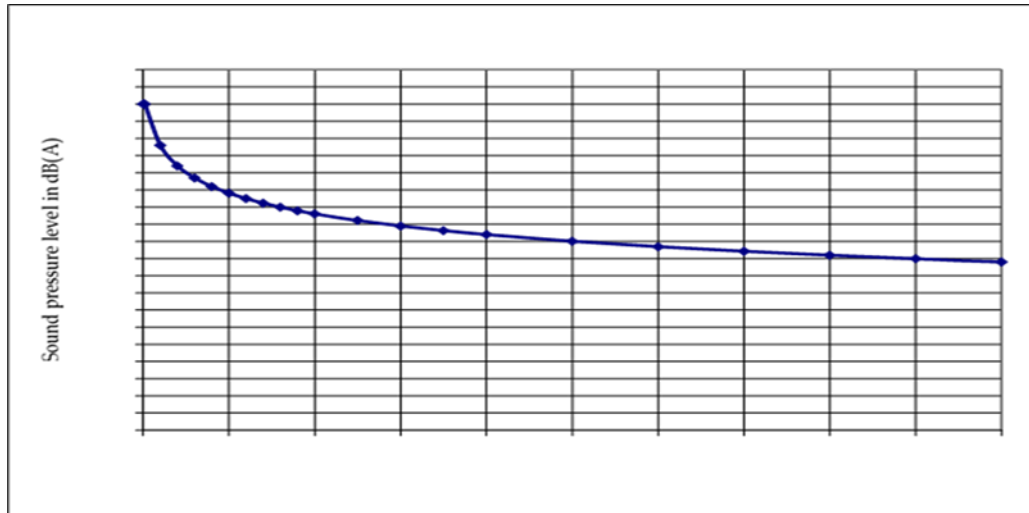
The typical noise from impact hammer is about 90 dB (A). Noise attenuation with respect to distance in all directions over horizontal distance can be given by the following equation:

$$L_p = L_w - 20 \log_{10} (R) - 8$$

Where,  $L_p$  = Sound pressure level at receiver,  $L_w$  = Sound power level of source, and  $R$  = Distance from source, m

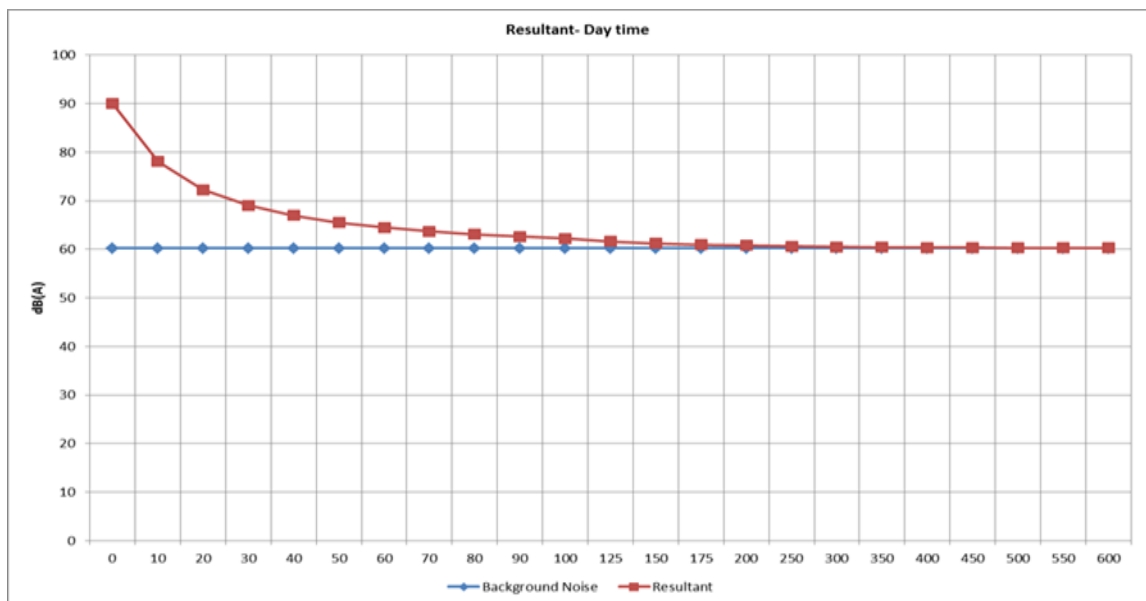
For an approximate estimation of dispersion of noise in the ambient air from the source point, a mathematical model for sound wave propagation was used by considering 95 dB (A) as the resultant noise level generated from the piling activities. The attenuation of noise with distance from piling activity is as shown in the following Figure. The noise generated from piling activity will attenuate to about 55 dB (A) in about 150 m from the source, while it will attain the 45 dB (A) levels at about 450 m.





**Figure 99: Piling Noise Attenuation with Distance**

The output of the sound wave propagation shows that noise generated during construction activities will be merged with the noise level of 60.2 dB (A) (during day time) at a distance of 150 – 200 m from the source and with the noise level of 57.5 dB(A) (during night time) at a distance of 250 m from the source.



**Figure 100: Resultant Noise from Construction Activities – Noise time**

### Mitigation

IFC Performance Standard 4 requires projects to ensure that adequate measures are taken to minimize any discomfort to the surrounding community. Care should also be taken for reducing occupational health and safety risks to workers by providing favourable working conditions, as per IFC Performance Standard 2. ADB Environmental Safeguards also suggest avoidance or at least minimization of adverse impacts and risks to the health of local

communities. The following mitigation measures have been proposed in line with these requirements:

- The project will ensure adequate planning to avoid high noise activities. Wherever it is unavoidable, provide acoustic enclosures, noise barriers in areas of high noise generating sources (such as generators, compressors, forging, cutting etc.).
- Movement of vehicles and operation of high noise activities shall be avoided during the night time to avoid any discomfort to the residents of Badalpura village.
- Intermittent high noises shall be avoided and the existing workshop shall be used for metal forging activities, so that the impact of noise is reduced on the village.
- Although the potential for long term exposure to noise is low, the construction workers will be provided with ear muffs in areas with potential for high noise generation.
- KDDSEZL shall provide sheet barriers all along the boundary of its project site to ensure reduction in noise levels.
- Noise absorbers and dampeners to be provided for each high noise generating activity.
- The size of piling rig shall be planned according to the requirement of the activity, rigs larger than requirement will be avoided.
- A nylon or HDPE cushion will be used between the hammer and pile to reduce hammer impact noise.

### Significance of Impact

The extent of impact is local with moderate intensity; the duration is expected to be short and intermittent. The nearest village of Badalpura and Marine Academy are the identified receptors, as they are located in immediate vicinity of the site.

**Table 91: Impact Significance - Water Resources and quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Noise Quality	Without Mitigation	Local	Medium	Moderate	Routine	MODERATE
	With Mitigation	Local	Medium	Low	Frequent	MINOR

The overall impact will therefore be **‘Moderate’** and can be reduced to **‘Minor’** with the application of proposed mitigation measures such as adequate noise barriers and reduction measures.

#### 7.3.5. Ambient air quality

Long term data and primary baseline studies indicate that the ambient air quality of the area is generally good with most of the parameters within the prescribed standards except for particulate matter levels. Project related construction activities are likely to add on to the existing PM and dust levels in the area. Therefore, appropriate mitigation measures need to be adopted by KDDSEZL. The impacts and corresponding mitigations have been discussed below.

### Impacts

- The potential sources of air pollution during the construction period include,
  - Fugitive dust emissions from excavation and other construction activities;
  - Emissions from onsite operation of diesel generators, construction equipment and vehicles/vessels at/to the site.
- Improper handling and storage of construction material can also lead to dust dispersion during high wind periods. The dust generated can be a nuisance to the residents of Badalpura village and staff and students of Bangladesh Marine Academy in the immediate vicinity.

### Mitigation

Mitigation measures have been proposed for controlling the amount of fugitive dust and other emissions released into the atmosphere during construction. The measures are in accordance with the requirements of IFC Performance Standards 3 and 4 and ADB Environmental Safeguards which recommend projects to ensure abatement of environmental pollution and minimal discomfort to community.

- Proper maintenance will be undertaken for machines and vehicles engaged at the site. KDDSEZL will ensure that all project related vehicles have Certificate of Fitness as issued by the Bangladesh Road Transport Authority;
- Paint, polishes, building fittings and flooring material etc. will be procured carefully to minimize emission of VOCs.
- Diesel generators meant for emergency power will be optimally operated and regularly maintained so as to ensure that emissions from fuel combustion remain at design levels. Provision of appropriate stack height shall be ensured;
- An equipment maintenance register will be maintained at site to ensure that construction equipment and machinery are maintained at regular intervals.

In order to keep dust and particulate matter within prescribed limits during construction phase, KDDSEZL shall implement management measures as detailed in the Annexure XII ***Construction Dust Management Plan***. Some of the key mitigation measures have been provided below:

- The project shall prepare a mobilization plan prior to commencement of construction which will delineate the location for stockpiles.
- Trucks /dumpers / vessels engaged for transportation of friable construction materials and spoil will be covered.
- Measures to suppress fugitive dust emissions will be employed, which includes:
  - Daily sprinkling of water within construction area, at least 3-4 times per day, Wetting of the stockpile,
  - Proper location of material stockpiles, especially sand and soil downwind from the habitations,
  - Wind breaks for stockpiles, covering of soil and material at the site,
  - Installation of wind break barrier such as tarp curtain or wind fence at the eastern boundary of the site towards Badalpura village and Marine Academy.

- Housekeeping of the site will be maintained by deputing sweepers to remove dirt/debris from the site on daily basis.

### Significance of Impact

The intensity of impacts due to the construction activities on the air quality of the project area will be moderate and spread locally. The only sensitive receptor will be the residents of the adjacent Badalpura village; however, with implementation of mitigation measures, the intensity will be further reduced to low as also the duration (limited occurrence) from medium to short.

**Table 92: Impact Significance – Ambient Air Quality Quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Air Quality	Without Mitigation	Local	Medium	Moderate	Frequent	MINOR
	With Mitigation	Local	Short	Low	Frequent	INSIGNIFICANT

The overall impact on traffic and transport is assessed to be ‘**Minor**’. Implementation of mitigation measure will ensure that the impacts remain ‘**Insignificant**’

#### 7.3.6. Traffic and transport

The project site is located on the bank of river with adequate space for movement of vessel and berthing. The river Karnafuly has adequate draft to allow vessels to directly deliver construction material to site. The site also has access through Chittagong – Anwara - Banshkhali road which will also be used for transportation of construction materials. Although impacts due to transportation are considered to be insignificant, the likely impacts on traffic and transport have been discussed below.

#### Impacts

- Transportation of machinery / vehicles and construction supplies/materials using river navigation and through roads will result in additional traffic, temporarily around the project site.
- Additional transportation may lead to congestion of the navigation channel during peak hours. There will be increase in potential for possible accidents and capsizing of boats/vessels and trucks and Lorries during road transport.
- Spill and leaks from poorly maintained boats /vessels may lead to contamination of water and sediments along the banks.
- There will be increase in traffic congestion on the roads which would lead to increased risk of traffic hazards.
- Disruption of traffic is anticipated on such the roads due unplanned entry to the site, parking of trucks, breakdowns, etc. The Chittagong – Anwara – Banshkhali is a busy road with appreciable daily traffic volume, disruption of regular traffic is anticipated.

#### Mitigation

The following mitigation measures have been proposed for handling the issues related to traffic and transportation:

- The project proponent will ensure that all vessel movement is undertaken as per the guidelines /norms laid down by the Chittagong Ports Authority. All unwanted movement of vessels will be avoided.
- Close consultation with community when unloading of construction machinery and material will obstruct ferry movement for requirement of local community.
- Necessary training will be imparted to the operators of construction vessels and drivers of construction vehicles for speed restrictions to ensure safe operations;
- All vessels engaged for construction shall be maintained at regular intervals to prevent leaks of oil.

A detailed **Traffic Safety Management Plan** (Annexure XIII) has been proposed for implementation during construction phase. The plan provides management measures related to haulage routes, road related accidents, parking facilities, driver training, vehicles management and maintenance and community safety.

### **Significance of Impact**

The spread of the impacts on traffic and transportation will be local however duration will be short and limited. However, the intensity of impacts without mitigation measures will be moderate and once the proposed measures are implemented, the impacts will be of low intensity.

**Table 93: Impact Significance – Traffic and Transport**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Traffic and Transport	Without Mitigation	Local	Medium	Moderate	Frequent	MINOR
	With Mitigation	Local	Short	Low	Frequent	INSIGNIFICANT

The overall impact on traffic and transport is assessed to be ‘**Minor**’. Implementation of mitigation measure will ensure that the impacts remain ‘**Insignificant**’

### **7.3.7. Socio- economic environment**

#### **Impacts**

The construction work for the project will extend to a total of 35 months as reported by the project proponent. In the construction phase, unskilled labourers from the surrounding areas and further on might come to the area to seek employment.

Though no labour camps will be provided, the labour will be accommodated in rented houses in nearby villages. The influx of labourers might bring about concerns related to scarce resources which might escalate into differences between them and the resident local population. This might get further aggravated if the local population are surpassed in favour of workers migrating to the area for work. The potential impacts that might arise in reference to labour related issues have been mentioned below,

**Influx of migrant labourers:** Once the construction activity for the project gets underway, there is a possibility that there will be an inflow of migrant workers from other parts of the country to this project area. This will create an economic impact to some extent as the

workers will be employed over the local population who might not possess the requisite skills required for undertaking the work. The local population might have to develop their skills in order to adapt themselves so that they can be incorporated within the workforce. Influx of labour from other parts of the country may also lead to socio-cultural differences. This can lead to stress in the social fabric, disruption in work, protests and in severe cases even violence.

**Impact on existing resources:** The influx of migrant workers might put pressure on the existing resources like water supply, supply of fuel, provision of basic facilities, waste handling and sewage disposal of the study area village which might create frictions between them and the resident population of the area. Crowding for share of limited resources could lead to law and order issues which need to be handled carefully with continuous consultation and interaction. There could be an increase in demand for local resources, leading to rise in rate of renting house, hotel, food, other consumables etc.

**Community health impacts from migrant workers:** With the inflow of migrant workers and their interaction with the local population, health issues among the local community might emerge. Health problems and communicable diseases like Typhoid, Malaria, Tuberculosis, Influenza, Jaundice, STD's, HIV, and AIDS etc. might spread in the area because of this floating population.

**Other beneficial impacts:** A positive impact through increase in livelihood opportunities from involvement in construction activities such as obtaining construction contract, renting machinery, providing construction machinery etc. is expected. Other beneficial impacts are anticipated through increase in sale of consumables, food, rented housings, hotels etc. This will directly boost the local economy and the income of the local population.

### **Mitigation**

- For unskilled work in the construction phase, the local population and its surrounding areas should be given first preference so that there is no ill feeling generated amongst the locals.
- The Project Proponent should be certain that prior to the commencement of the construction work, the Contractor is made to understand that the migrant labour to be engaged during this phase should not be hired from areas like Chittagong Hill Tract, Sylhet Division, Rajshahi Division and Mymensingh District which boast of population belonging to indigenous ethnic minorities. This should be undertaken to minimise the cultural difference between the local population and the migrant labour population consisting of ethnic minorities' population.
- If recruitment of migrant labourers in the construction phase takes place, KDDSEZL should be responsible in giving an orientation to the migrant labourers on the local custom and tradition followed by the local population. There is a significant population of migrant population already working in Chittagong and the local community has broadly accepted their presence. However, KDDSEZL shall ensure that there is a



detailed briefing on cultural background and behavioural requirement for all the migrant workers either directly or through subcontractors engaged.

- Prior to engagement of migrant labour, a medical check-up including a blood test should be conducted and copy of the medical certificate should be collected by KDDSEZL, through sub-contractors, and maintained as part of their records.
- Regular six monthly medical camps and health check-ups should be conducted amongst the labourers (and medical records should be maintained by the Contractor and Sub Contractors) and the local population to make them aware about communicable diseases like Typhoid, malaria, tuberculosis, STD's, HIV Aids etc. The positive impact can be further enhanced by committing an assured engagement level for the local community and by ensuring that priority is given those who contributed the land for project.
- KDDSEZL should maintain a medical centre at all times within the vicinity of the project area so that the labourers and community can avail its services whenever required. The medical centre should be staffed with a qualified and registered medical practitioner or Pharmacist so that minor emergencies and check-ups can be undertaken directly. In addition, a fully equipped ambulance should also be at the disposal of the medical centre. The centre should also have direct tie ups with a Government/ Private Hospital so that patients can be transported directly whenever a crisis arises.
- **Security Arrangements at Site:** The contractor shall be responsible for deploying adequate number of guards under supervision of KDDSEZL. Adequate training will be provided to the security personnel in dealing with domestic violence and the use of force. It will also be ensured that security staff should have a good understanding about the importance of respecting workers' rights and the rights of their respective communities.
- **Transportation to Site:** KDDSEZL should ensure that transportation from rental accommodation to worksite is safe and are accompanied by a local worker.

**A Construction Labour Management Plan** (Annexure VIII) and **Waste Management Plan** (Annexure IX) have been developed for the project. The plans should be adopted by the project proponents to minimise the impact created by the inflow of migrant workers in the area.

### **Significance of Impact**

The potential impact on the socio-economic conditions will be local spread for medium term and with medium intensity and low impact significance with the implementation of mitigation measures. The impact is summarised in the table below.

**Table 94: Impact Significance: Socio-economic Environment.**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Socio-Economy	Without Mitigation	Local	Medium	Moderate	Frequent	MINOR
	With Mitigation	Local	Medium	Moderate	Frequent	MODERATE

Overall, the project development will have positive impacts on the socio-economic conditions of the area. The significance of beneficial impacts is considered to be of '**Minor**'; however, it can be increased to '**Moderate**' with implementation of the proposed measures

### **7.3.8. Occupational health and safety**

The IFC Performance Standard 2 highlights the need for safe and healthy work environment taking into account inherent risks in its particular sector and specific classes of hazards with respect to a project, including physical, chemical, biological and radiological hazards. The need to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards. ADB Environmental Safeguards also necessitate project developers to provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease.

#### **Impacts**

##### **Over-exertion:**

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction.

##### **Slips and Falls:**

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction and decommissioning sites.

##### **Work in Heights:**

Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction site.

##### **Struck by Objects:**

Construction and demolition activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

##### **Moving Machinery:**

- Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise.
- Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle.

**Trespassing:**

Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and excavations and structures which may pose falling and entrapment hazards.

**Other Site Hazards:**

Construction site may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms. Hot jobs or electrical fittings can lead to fire hazards also.

**Mitigation**

KDDSEZL shall ensure adequate health and safety measures which shall include:

**Over-exertion:**

Training of workers engaged in lifting and materials handling techniques in construction projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary

**Slips and falls:**

- Implementing good house-keeping practices, such as the sorting and placing loose construction materials / debris in established areas away from foot paths.
- Cleaning up excessive waste debris and liquid spills regularly and locating electrical cords and ropes in common areas and marked corridors

**Work in Heights:**

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 100 kg, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 2500 Kg as well as fall rescue procedures to deal with workers whose fall has been successfully arrested.

**Struck by Objects:**

- Clear traffic ways shall be provided to avoid driving of heavy equipment over loose scrap which may result in scattering of objects.
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes shall be made mandatory.

**Moving Machinery:**

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes,

- Establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms. Use inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

#### **Trespassing:**

Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community

#### **Other Hazards:**

Use of waste-specific PPEs based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection.

#### **Degassing of Oil Tankers**

Oil tankers and barges transporting Oil and other related hydrocarbons often have gas build-ups (VOCs, H<sub>2</sub>S) in the tank, even after offloading the cargo. Gases flow to the leeward side, and are dangerous in that they may cause explosion at spaces other than where they are generated. Workers working on repair works such as welding, cutting and other hot jobs are prone to risk of fire and explosion.

#### **Significance of Impact**

The receptors who will be particularly vulnerable to occupational health and safety related impacts are the construction workers. The potential for impact on health and safety will be local spread for medium term and with moderate intensity during the construction works.

**Table 95: Impact Significance – Occupational health and Safety**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Occupational health and safety	Without Mitigation	Local	Medium	Moderate	Routine	MODERATE
	With Mitigation	Local	Medium	Low	Frequent	MINOR

The overall impact significance will be **‘Moderate’** and can be reduced to **‘Minor’** impact significance with the implementation of mitigation measures

### **7.4. Impact assessment–operation phase**

The likely activities that could lead to likely environmental impacts during operation phase are broadly covered in the following Table.

As per the table, operation phase of the proposed project would have impacts on the following.

- Water Resources and Quality
- Soil Quality
- Ecological
- Ambient Noise
- Traffic Volume
- Air Quality;
- Socio economic
- Cultural Impact
- Health and Safety Risk

**Table 96: Impact Identification Matrix for Operation Phase**

SL. No.	Environmental Aspects	Potential Impacts							
		Air Quality	Water Quality	Soil Quality	Noise Quality	Traffic	Ecology	Socio economic and Cultural Impact	Occupational Health and safety
1.	<b>Change in Sedimentation Pattern</b>								
2.	<b>Operation at the Dock/ Jetties</b>								
	Fabrication and Repair								
	Solid Waste Generation (sludge, paint, sand etc.)								
	Sewage and other effluents								
	Fuel storage- refueling								
	Blasting, Painting Power back-up								
	Oil spills								
	Engagement of workers								
	Cleaning of Storage Tanks for petroleum products, oil tankers								
	Ship Board Used Lubricant								
3.	<b>Increase in Movement of Vessels</b>								
	Disturbance to existing traffic								
	Potential for accidents/collisions								
	Other navigation hindrances								
	Flight path and mast height								
4.	<b>Community Involvement</b>								
	New business opportunities								
	Community resources								
	Migrant workers								



#### **7.4.1. Water resources and quality**

During operation phase, the routine (daily) requirement of water will be limited to drinking and flushing purposes only by the facility staff and workers. However, when a vessel will be docked in the facility and will be under maintenance/ repair, water will be required for domestic purposes, cleaning of vessel hull and inner compartments of the vessels, hydro blasting, etc. Wastewater will be generated as part of the overall operations and will need to be adequately managed to avoid any adverse impacts on the river water quality.

About 250 KLD of freshwater will be required during peaking operations, including 75 KLD of water for domestic purposes. Freshwater will be sourced from groundwater through two (2) 150 m deep tube wells proposed to be installed at site. About 1500 workers will be working during peaking operations which will lead to domestic sewage generation of approximately 60 KLD. Other wastewater sources will be oily bilge water and contaminated ballast water and is estimated at around 20KLD.

#### **Impacts**

The potential impacts on water resources and quality due to the operations of the proposed dry dock and jetties are as provided:

#### **Groundwater Resources**

It is envisaged that extraction of groundwater for peaking project operations can put additional stress on the local groundwater resources. The total population of the study area is about 4235 as per Census 2011 data. In terms of source of drinking water, the main source is tube wells. Due to the proximity of the area to Karnafuly River, water availability is not an issue at present, as the depth of tube wells is around 20-30 feet. However, it is likely that with growth of the city and development of industries in the area (KEPZ also being developed in Anwara), cumulative stress on groundwater resources will increase. It is also noteworthy that major requirement of groundwater will be only during peaking operations with duration of about 15 days.

#### **Hydrodynamic changes**

The establishment of KDDSEZL may alter the localized sedimentation pattern of river around or in immediate vicinity of the project. This will affect the bathymetry, depth and velocity of the river, which may affect the navigation in the river. Potential cumulative impacts are also expected from construction of the 1 km long Bulk Terminal proposed by Chittagong Port Authority located on the opposite side in the right bank of the Karnafuly River in the Laldiar Char area.

#### **Water Quality**

Wastewaters and storm water runoff from KDDSEZL facilities may contain elevated concentrations of a variety of constituents that, under certain conditions, may be adverse to the beneficial uses of the receiving water for the discharge/runoff. Of particular concern

are heavy metals, oil and grease, and potentially toxic organics. Many of the constituents of concern in discharges/runoff are in particulate forms and, therefore, tend to accumulate in the receiving water sediments to cause these sediments to contain elevated concentrations of potentially toxic chemical constituents.

As a result, there may be need to control both dissolved and particulate forms of chemical constituents in dry dock wastewater discharges and storm water runoff in order to protect the designated beneficial uses of the receiving waters for these discharges/runoffs.

There are a variety of activities associated with vessels that could contribute trace metals including antifouling paint hull coatings, sacrificial anodes, motor exhaust, and hazardous material spills. Of all the vessel related activities, antifouling bottom paints are amongst the largest source of trace metals, in particular copper. Current day hull coatings are impregnated with copper and sometimes co-biocides whose goal is to retard the growth of algae and other encrusting organisms. These encrusting organism's foul hulls and other underwater parts that impede progress underway, lengthening transit times and increasing fuel consumption (WHOI 1952). The copper impregnated coatings are designed to slowly release copper, in the dissolved and most toxic form, so as to retard growth and maintain a smooth underwater surface.

Vessel maintenance and overhaul work generates numerous sources of pollutants. Vessels that are dry docked for repairs are generally carrying bilge and contaminated ballast water that needs to be disposed of properly. Ballast water is typically seawater that has been pumped into the vessel's ballast tanks to provide necessary stability. In most cases, the ballast water is discharged overboard prior to entering the dry dock. Potentially oily bilge and ballast water can lead to contamination of river water and sediments. Tank and compartment cleaning within the vessel interior shall also generate discharges of cleaning water. Non-contact cooling water, black and gray waste water (sanitary wastewater) also require appropriate management.

Other pollutants generated during vessel maintenance and repair works include blast abrasives, paint, paper trash, discarded construction materials, sediment, marine growth, oil, solvents, and plastics. Since these pollutants fall upon the dock floor, the possibility increases that pollutants will be discharged with wash water, accidental discharges, or storm water that is collected in the dry-dock discharge sumps.

About 1500 workers will be working during peaking operations. The workers will not be residing at site; however, workers amenities building, having shower rooms, toilets, canteen, etc., will be constructed. It is estimated that about 60 KLD of sewage will be generated during peak operation; release of untreated sewage will deteriorate the water quality along the river bank significantly.

**Oily Sludge and Shipboard Used Lubricant**

Oily sludge generated from cleaning of oil tankers and used lubricants collected from ship repairing activities are hazardous in nature.

**Maintenance Dredging**

KDDSEZL will also undertake maintenance dredging at the site on annual basis. The volume of dredged material that will be generated during maintenance dredging is estimated to be about 74,000 m<sup>3</sup> per annum. The dredged material will be used for filling low lying areas.

Dredging activity will result in disturbance to the river bed, leading to a marginal increase in turbidity around the area of activity. Such increased turbidity and the possible release of organic matter, nutrients and or contaminants depending upon the nature of the material in the dredging area can affect the local river bed fauna and flora. The settling of these suspended material along with loss of material during transport to the surface, overflow from the dredger whilst loading and loss of material from the dredger and/or pipelines during transport can lead to blanketing of the benthos. There will be increase in turbidity around the dredge area during dredging operations, but is usually of very short duration and quickly revert back to normal levels.

During dredging operation, surface water may also be contaminated due to spillage of oil, grease, machine oil, etc. from the dredging equipment. Unplanned dredging may also lead to erosion at some places.

The area where maintenance dredging will be carried out will be based on the final report of “Mathematical model study for the proposed Dolphin jetties and dry dock at the left bank in the Karnafuly River (October, 2013)” undertaken by BUET, which identified particular areas prone to high siltation. Moreover, the Karnafuly River, being a tidal river, is not considered prone to high levels of siltation. The Chittagong Port Authority however undertakes limited maintenance dredging in the navigation channels. Therefore, the impacts of maintenance dredging on the river water quality will not be significant.

**Mitigation****Mathematical Model (Hydrodynamics)**

A mathematical model study for the proposed Dolphin Jetties and the Basin for the Dry Dock with regard to possible adverse effects on channel navigability and morphological changes in the Karnafuly Channel were undertaken by BUET, the Department of Water Resources Engineering (WRE), Dhaka. The conclusion from the mathematical modelling is summarised below:

- The overall impact of the proposed Karnafuly jetty and dry dock basin construction on siltation in the Karnafuly Channel (including the impact on Laldiar Char jetty) is considered to be negligible for spring and neap tides during normal, flood and dry flow conditions with monitoring required at grid nos. 249 and 251 for siltation.

- The overall impact of the proposed Karnafuly jetty and dry dock basin construction on erosion in the Karnafuly Channel (including the impact on Laldiar Char jetty) is considered to be negligible for spring and neap tides during normal, flood and dry flow conditions with monitoring required at grid no. 250 for erosion on both banks.
- The clear channel between the proposed Karnafuly jetty and Laldiar Char jetty will be sufficient for surface navigation to and from upstream port. The movement water crafts in and out of the proposed Karnafuly jetty and Dry Dock will be controlled by CPA. In addition, berthing at the proposed jetty will conform to CPA regulations.

As the impact is assessed to negligible to no impact, no specific mitigation measures are suggested.

### **Water Resources**

KDDSEZL should install a metered bore well on site and maintain records of groundwater extraction to assess the stress on resources due to project operations.

### **Wastewater Treatment Systems**

It is not feasible to collect and store a large volume of hull washing waters on the dock and have a zero discharge. All industrial wastewater generated from the dock operations will be passed through a fine mesh screen system before discharge into the sea.

The mesh screen system will be cleaned regularly to ensure it is fully functional. A settling system for further treatment will be installed on board the Dock wherein wastewater generated on the Dock will flow to the existing conduit on the side wings. A new bilge well will be fixed permanently on the Dock to collect the wastewater inside the conduit. Portable air driven pumps with flexible pipes will be used to transfer the wastewater from the bilge well to the portable sedimentation tanks. A chemical dosage and flocculation process will be provided to the above treatment system to further remove the fine particles and soluble form of the contaminants.

Bilge and contaminated ballast water discharge ports will be connected to a land based treatment system, land based collection and treatment system, or an approved temporary holding tank or vessel. All bilge and contaminated ballast water will be treated to remove the potential pollutants that may be present. Use of alternative treatment technology such as coagulation, emulsion breaking and flotation type treatments shall be undertaken. All pumping, valves, metering and coupling equipment will be watertight and monitored for leaks.

The KDDSEZL drainage system designs will comprise of networks of gutters, trenches, and/or culverts which will serve to collect the heavier settle-able solids transported in industrial wash water flows.

KDDSEZL will put in place adequate systems and techniques to segregate, collect, and transfer contaminated and uncontaminated wastewater streams (and materials causing contamination) to environmentally acceptable treatment systems. This will include

segregation of clean water flows from both spent abrasive and any already polluted wastewaters

#### **Effluent treatment Facilities Proposed**

- An Effluent Treatment Plant (ETP) will be put in place for treatment of KDDSEZL wash water, including hull washing. It is estimated that the total capacity of the plant will be 80KLD, with a stand by storage tank of 25 m<sup>3</sup>. The treatment plant will have a mesh to remove suspended material, sedimentation chamber to remove grit and other suspended matter. Traces of heavy metals will be removed by coagulation and flocculation; the water will be chlorinated to remove any microorganism before disposal.
- An Oil Water Separator of 20KLD capacity will be provided for treatment of Bilge and other oil contaminated water. The treated water will be chlorinated prior to disposal.
- Ballast water will not be discharged from the dock facility, however in case of emergency it will be collected in emergency storage facility of 50 m<sup>3</sup> each. The water collected will be gradually treated and disposed off.

Sewage generated at site will be treated in a Sewage Treatment Plant (60KLD) located within the site premises. The sewage treatment plant will preferably be based on Sequential Batch Reactor Technology (SBR); it will be connected with all toilets, hand wash and shower rooms to ensure treatment of all domestic waste water from the site before disposal into the river.

#### **Measures during use of anti- fouling paints**

The pesticides tributyltin (TBT) and copper are the most common anti-fouling biocides, although the shipping industry is moving away from TBT systems. Antifouling paint with biocides should be avoided. For vessels operating in marine environments, paint with the minimum effective copper concentration should be used, taking into account the characteristics and expected use of the vessel. Use of alternative non-toxic coatings, such as silicone-based, epoxy, and other low-friction paints should be considered.

The following environmental control measures and practices should be adopted during the application or removal of antifouling paints in order to minimise the release of antifouling biocides to the surrounding environment:

- During application of antifouling paint
  - Provision of a bounded area for the preparation of antifouling paints to avoid accidental spillage into the river;
  - Treating any spillage with a suitable absorbent, which would be disposed of as chemical waste;
  - Not performing paint spraying in high winds; and
  - Provision of sheeting to prevent spray drift.
- During removal of antifouling paint
  - Segregating wash waters from non-contaminated water;
  - Proper segregation and control of wastewater stream and abrasive blasting grits;
  - Avoid washing residues directly into the river; and
  - Treating the paint scrapings as chemical waste and dispose accordingly.

**Measures during other Repair and Maintenance activities**

The following measures shall be undertaken to ensure that discharges from the docked vessel does not come into contact with the dock floor.

- Clean-up of the graving dock floor to remove trash, blast abrasive, oil and other potential pollutants shall be undertaken on a regular basis.
- Records of each cleaning occurrence shall be maintained. The materials or fluids shall be disposed of in the appropriate disposal bins or containment tanks as identified prior to commencement of work.
- After a vessel has been docked in a graving dock, all dock floor drains should be completely covered with tight fitting plywood, heavy tarpaulin or other similar device.
- The floor channels and sediment traps shall be checked weekly and cleaned of all blast abrasive and refuse. Water should not be used to wash grit or other materials into the channels.
- Before the graving dock is flooded, clean-up of the dock floor shall be completed. Floor clean-up will be accomplished with the use of the following equipment:
  - Front end loaders
  - Tractor sweepers
  - Mechanical blowers
  - Mobile sweepers
  - Mobile vacuums
  - Hand brooms
  - Stationary vacuums
- If an area is inaccessible to a front-end loader or mechanical sweeper, vacuums, shovels or brooms will be used to complete the clean-up of blast abrasives and other solid pollutants.
- Any non-contact cooling water may be piped, through flexible hosing, to an acceptable discharge point. Hydrostatic leaks and gate leakage must be collected and diverted to dock channel drains.
- Blasting residues (abrasive grit and paint flakes) will be cleaned up immediately after the sand/hydro blasting activities to avoid these washing into the river. Wastewater drains on the dock will be closed off whenever there are cleaning and blasting activities.
- Oil/water separators, booms, skimmers or other methods should be employed to minimize oil contaminated storm water discharge. Whenever possible, storm water should be diverted away from materials manufacturing, storage and other areas of potential storm water contaminants.
- Oily sludge received from cleaning of oil tanks and used ship board lubricant will be collected in drums and will be sent off to nearby kiln and cement industries for incineration at a land based treatment facility. Some Cement industries identified are Diamond Cement Ltd and Heidelberg Cement Bangladesh Ltd.

**A Chemical Management Plan** has been developed and provided as **Annexure XX** that would be implemented during construction and operation phases of the project.



**Degassing of Oil Tankers**

The dock management shall verify certificate of degassing of tankers as obtained from relevant agencies. The details of degassing of the tanker shall be verified along with details of the last cargo transported. In case degassing has not been undertaken, the dock shall provide for inerting the empty tank. When inerting empty tanks that are gas free, for a dry docking, inert gas should be introduced through the distribution system while venting the air in the tank to the atmosphere. This operation should continue until the oxygen content throughout the tank is not more than 8% by volume.

Thereafter, the oxygen level will not increase if a positive pressure is maintained by using the inert gas system to introduce additional inert gas when necessary. If the tank is not gas free, the precautions against static electricity should be taken until the oxygen content of the tank has been reduced to 8% by volume. When all tanks have been inerted, they should be kept common with the inert gas main and the system pressurised with a minimum positive pressure. If individual tanks have to be segregated from a common line (e.g. for product integrity), the segregated tanks should be provided with an alternative means of maintaining an inert gas blanket. In order to undertake hot work on oil tankers the concentration of flammable gas should not be more than 1% of the lower flammable limit, as recommended by the International Safety Guide for Oil.

**Tankers and Terminals:** The following conditions shall be taken into account for any operation where flammable mixtures are displaced to the atmosphere or where mixtures are displaced which could become flammable on dilution with air, such as on inerted tankers:

- An unimpeded vertical discharge at a high efflux velocity.
- Positioning the outlet sufficiently high above the deck.
- Placing the outlet at an adequate distance from the superstructure and other enclosed spaces.

When using a vent outlet of fixed diameter, usually designed for 125% of the maximum cargo loading rate, the efflux velocity will drop at lower loading rates. Vent outlets with automatically variable areas (high velocity vent valves) may be fitted to maintain a high efflux velocity under all loading conditions.

**Maintenance Dredging**

- The requirement of maintenance dredging shall be minimised to the extent possible. The necessity of dredging during operation phase shall be reviewed by the dock operator through regular monitoring of the siltation levels, in order to estimate the actual amount of siltation caused by abnormal natural conditions.
- Regular monitoring should be undertaken during the dredging activities. Maintenance dredging shall be restricted only to areas experiencing siltation, in order to avoid excessive erosion in the river.
- Erosion control measures along the banks shall be considered either directly or through the relevant agency to retard siltation in the river.

- Dredging vehicles shall be well maintained and verified for leaks and spills prior to engagement.

### ***Significance of Impact***

The potential for impact on water quality will be local spread for long term and with moderate intensity. The river Karnafuly is the key receptor, which is already prone to heavy metal and high BOD concentrations due to industries upstream.

**Table 97: Impact Significance – Water Resources and Quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Water Resources and Quality	Without Mitigation	Local	Long	High	Frequent	SIGNIFICANT
	With Mitigation	Local	Long	Low	Frequent	MINOR

The overall impact significance will be **‘Significant’** however with adequate monitoring sediment transport and treatment of waste water generated the impact can be kept to **‘Minor’**

### **7.4.2. Soil environment**

The potential impacts of the KDDSEZL facility operations on the quality of the soil environment are as provided below:

#### **Impacts**

- Vessel maintenance generally involves some amount of abrasive blasting with nickel slag (Green Diamond), copper slag, iron slag, iron shot or other materials, followed by painting. These operations may be carried out on the ship’s interior tanks and compartments or on the exterior hull and upper decks. The use of blast abrasive or paint represents a potential pollutant source which may be lost to the water surface or on land during the repair work.
- Dry docks are a continual source of empty paint cans and oil or solvent containers. Some vessels may require as many as eight applications of primer and paints. Ship maintenance and shop fabrication of materials require solvents, paints, heavy lubricants and oil. General maintenance of vehicles, motors, generators, pumps, engines and boilers can also generate numerous leftover fluid containers and cans which must be discarded. Improper disposal will lead to contamination of soil.
- Vessels arriving at the dock at times carry slop oil and tank sludge, which needs to be handled, stored and disposed of from the dry dock. Handling and storage of such waste in significant quantities leads to spills and lead which results in contamination of soil.
- There are various types of disposables generated at site, improper disposal which can lead to contamination; such materials include Tyrex Suites, Rollers, Brushes, Filter Masks, Paint Stirrers, Drop Clothes, Masking Tape, sand papers etc.
- There will be storage of fuel for power generator, project vehicles/vessels etc. at site. Inadequate handling and storage of fuel at site can also lead to contamination of soil.

#### **Mitigation**

The Basel Convention establishes a global control system for hazardous wastes being shipped from one country to another. States which are Parties to the Convention must not

trade in hazardous wastes with non-Parties but an exception to this is provided for in Article 11 of the Convention, whereby Parties may enter into agreements or arrangements either with other Parties or with non-Parties (particularly where a Party is not a generator of hazardous waste and does not have the technical skills nor infrastructure to handle its disposal).

These agreements or arrangements can also set out controls which are different from those prescribed by the Convention itself, provided such controls do not reduce the level of environmental protection intended by the Convention. Considering the requirements of international conventions and IFC Performance Standard 3, following mitigation measures are proposed:

- The facility will involve use of shrouds to prevent blast abrasives and paint overspray from exiting the top of the dock. Shrouds will be erected between the vessel deck to the dock walls. Vessel deck abrasive blasting and painting tasks will be shrouded in a dome-like fashion to prevent the scatter and loss of pollutants.
- Empty cans containing, but not limited to, paints, solvents, lubricants and oil will be disposed of daily in designated waste disposal bins. The disposal bins will be sold or exchanged by KDDSEZL personnel to a professional refuse collection service. Disposal bins will be placed in designated areas and will be large enough to adequately store waste cans generated on site between scheduled pickups. Excess paint in cans will be given to boat owners in the community for use as touch-up paint.
- Slop oil and bottom sludge from tanks will be collected in drums at site, then stored in paved area with a secondary containment. The containment area shall be provided with oil traps to avoid run off from the area. It is proposed to sell the slop oil / bottom sludge to the existing brick kiln operators in the area. The waste is already used by many kiln operators as fuel. KDDSEZL can also explore potential buyers in cement industries of the region to dispose of larger volumes. Temporary Hazardous Waste Storage Facility will be maintained to preserve all other hazardous wastages until further arrangement towards proper processing and disposal is identified.
- KDDSEZL must continually promote the general concept of good housekeeping and will undertake the following:
  - Remove and properly dispose of general yard refuse, including but not limited to paper, plastics, cans, drink bottles, used welding materials and discarded fabrication and construction materials.
  - Clean-up spent blast abrasive and placed in appropriate container. Clean lighters, drip pans and drip platforms.
  - Immediately clean-up spills of oil, paint, solvents, etc. and properly remove and dispose of saturated soils.
  - Ensure that trash cans and trash bins are in the appropriate yard locations and are emptied when full. Trash bins shall be located on piers and on vessels.
  - Remove and dispose of any refuse found on the land or water surface within the areas adjacent to the piers, bulkheads, dry docks or shorelines.
- It is recommended that the following oil spill containment and clean-up materials are kept on site for spill emergencies to limit the spread of contamination.

- Permanent Boom - 1000 feet
- Temporary Absorbent Boom
- Deployment Boat
- Vermiculite
- Absorbent blankets and pillows
- Empty Drums
- Sand Bags
- Filter Fence Material
- Miscellaneous Items such as: Rope, Flashlights, Metal Fence Stakes, Straw Bales, and Weighted spill mats (for covering storm drains)

**A Chemical Management Plan (Annexure XX)** has been developed and will be implemented at during both construction and operation phases.

### Significance of Impact

The potential for impact on soil quality will be local spread for long term and with moderate to high intensity. The project site and land in immediate vicinity are the key receptor which will be prone to contamination with each operation. The probability of soil contamination is high; however, it can be contained with good housekeeping and implementation of the proposed mitigation measures.

**Table 98: Impact Significance – Soil Quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Soil Quality	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	Low	Frequent	MINOR

The overall significance of impacts on soil quality is therefore assessed to be ‘**Moderate**’, however can be kept as ‘**Minor**’ with the proposed mitigation measures

### **7.4.3. Ecology**

The impact on ecology of the area will be mainly because of the generation of pollutants mentioned under water and soil quality sections above. The details are discussed below.

#### Impacts

- Release of heavy metals into Karnafuly River will lead to bio-accumulation, whereas release of bio-toxins associated with antifouling can lead to increased mortality or elimination of algal group and related species.
- Release of oil contents on to water will result in formation of a shining film on the surface of water which prevents dissolution of oxygen across the surface of water. Dust trapped in oil can also lead to reduction in penetration of sunlight which is critical for planktons and flora near the shallow area.
- Release of sewage and operational waste can lead to loss of mangrove plantation south of the project site (next to Marine Academy Jetty) as mangroves are highly sensitive.
- The Karnafuly river records sightings of Gangetic dolphins, which is categorised as Endangered as per the IUCN red data list and is placed in the Third Schedule of Bangladesh Wildlife (Preservation) (Amendment) Act 1974. However, as per discussion with experts on Gangetic Dolphins, dolphins of this area use the River

Sangu as their breeding ground and core habitat and not River Karnafuly. Presently the population is divided by dams into isolated groups and has a much reduced range. It is understood that river dolphins are particularly vulnerable to industrial pollution because their habitat in counter-current pools downstream of confluences and sharp meanders which often places them in close proximity to point sources. Although Gangetic Dolphins were observed during survey near the Marine Academy Jetty Ghat and near Kalurghat Bridge area (at a distance of more than 25 km from the project site), none of the Gangetic Dolphin species were observed to inhabit near the proposed project site. Therefore, the impacts on Gangetic dolphins due to the project operations will not be significant.

- There will be disruption of benthic ecology during maintenance dredging activities, however it will be of very short duration and is not likely to have significant ecological impacts.

### **Mitigation**

Implementation of the various mitigation measures suggested under the water and soil quality impacts will keep the impact on river water to minimal and therefore prevent any impact on aquatic ecology. In addition, to ensure that the project has minimal impacts on the mangrove plantation and on Gangetic dolphins, the project will also ensure that:

- All operational waste water is treated prior to disposal;
- Potential oil contaminated run offs are trapped and treated prior to disposal into river; Sewage generated at site is treated before disposal;
- Hazardous waste is handled and stored adequately to avoid any runoffs;
- Periodic monitoring of water quality is undertaken to ensure that the BOD, TSS, pH and heavy metal concentration are retained close to the baseline conditions as observed in this report.
- The employees and workers will be strictly prohibited from hunting of dolphins sighted in the river.

### ***Significance of Impact***

The potential for impact on ecology will be local spread for long term and with moderate intensity. The project site does not have any commercial fishing activity and is not known for any important fish breeding/spawning area. Except for the Gangetic dolphin and patch of mangrove, no sensitive receptors were identified during the survey. The impact on ecology can be mitigated with implementation of the proposed measures.

**Table 99: Impact Significance – Ecology.**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Soil Quality	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	Low	Frequent	INSIGNIFICANT

The overall impact on ecology is considered to be of ‘**Moderate**’ significance; however, it can be kept to ‘**Minor**’ with implementation of the proposed mitigation measures.

#### 7.4.4. Ambient noise levels and vibration

##### Impacts

The assessment of the impacts of noise on the surrounding community depends upon:

- Characteristics of noise source (instantaneous, intermittent, or continuous in nature, with the latter contributing the least to noise pollution);
- Time of day at which noise occurs; and
- Location of noise source with respect to noise sensitive receptor.

For the purposes of predicting noise emissions impacts from the activities associated with dry dock operations, the noise emission sources present at the site were examined. The main contributors to the daytime noise environment in this area are local traffic on nearby roads and maintenance activities from the dry dock area that will create additional noise. The character and level of the docks-generated noise is highly variable and dependant on the type of works taking place. During normal operation of ship repairing within proposed dry dock, following noise generation sources have been considered:

**Workshop:** Four workshops viz. plate shop, pipe shop, electrical/instrumentation shop and machine shop are proposed to be constructed in the west direction of the basin of the dry dock area. Different kind of activities like cutting, welding, repair of pipes, milling, drilling, shaping rewinding of motors will generate noise.

**Steel Fabrication:** Noise will be generated during fabrication-forging of metal sheets. Space for fabrication has been demarcated in north side of the dry dock basin area.

**Pump House:** Dewatering pumps proposed in pump house will also be a source of noise. Shot-blasting and angle-grinding to be undertaken during cleaning of ships in the basin area will also generate significant noise.

There are 10 noise sources identified in total, wherein two (2) working pumps, two (2) hydro blasting, electrical/ instrumentation shop, machine shop, plate and pipe shop, steel fabrication yard which are located at the site. Table given below presents the coordinates of the noise sources with effective noise generation level and distance.

**Table 100: Major Noise Generating Sources during Operation Phase**

Noise Sources	X – Coordinate	Y- Coordinate	Effective Noise Level d(B)A	Distance from the coordinate
Hydro blasting and sand blasting-1	0	0	90	2 m
Hydro blasting and sand blasting-2	2	2	90	2 m
Workshop	50	-20	80	1 m
Pump 1	80	20	85	1 m
Pump 2	82	20	85	1 m
Steel fabrication	20	80	85	1 m
Machine shop	-40	60	75	1 m
Electrical/ Instrumentation shop	-100	-40	80	1 m



Noise Sources	X – Coordinate	Y- Coordinate	Effective Noise Level d(B)A	Distance from the coordinate
Plate shop	-120	60	85	1 m
Pipe Shop	-80	60	80	1 m

**Note: Effective noise levels have been taken from the following files:**

[http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide\\_ref/files/pump\\_sys.pdf](http://www.epd.gov.hk/epd/english/environmentinhk/noise/guide_ref/files/pump_sys.pdf)

[http://www.hse.gov.uk/research/hsl\\_pdf/2004/hsl0415.pdf](http://www.hse.gov.uk/research/hsl_pdf/2004/hsl0415.pdf)

<http://www.hse.gov.uk/engineering/noise.htm>

[http://www.s2egroup.com/wp-content/uploads/2014/09/120-WorkplaceNoiseSurveys\\_OSHTech.pdf](http://www.s2egroup.com/wp-content/uploads/2014/09/120-WorkplaceNoiseSurveys_OSHTech.pdf)

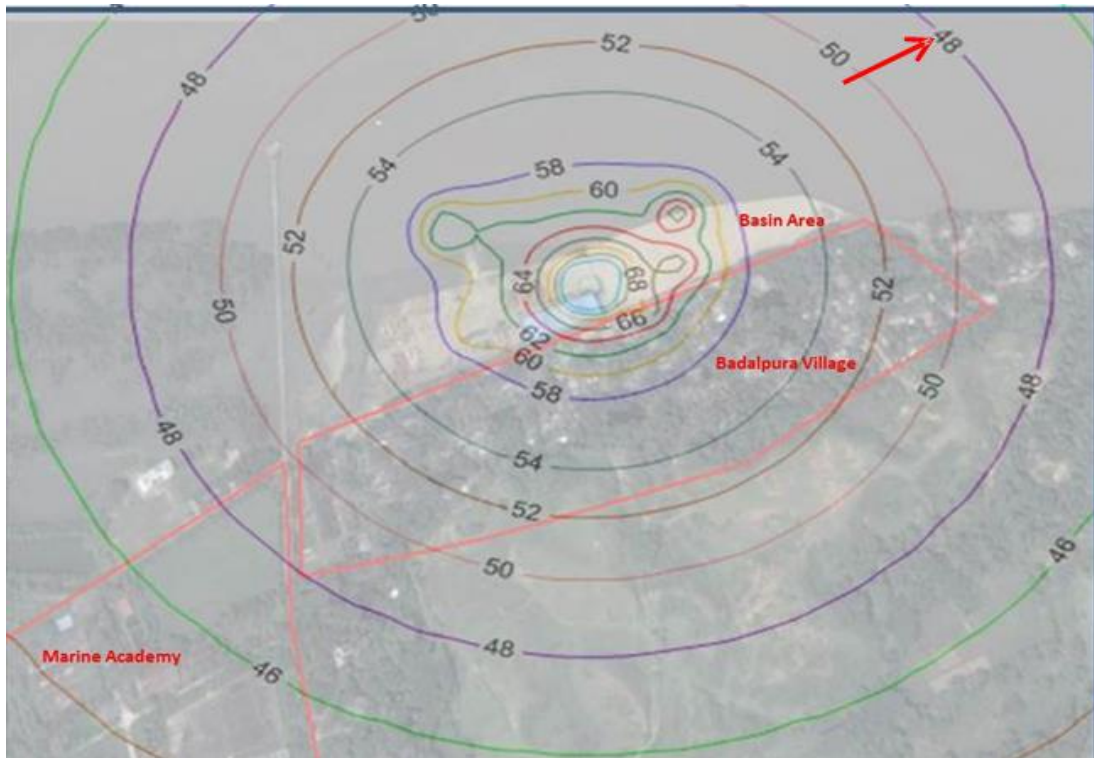
The major noise sources identified for the proposed project, as given in the following Table, have been considered for prediction of impact on ambient noise levels at nearby human settlements as well as the occupational exposure to workers within the project premises. The following Figure illustrates the potential noise generation sources within the proposed dry dock area.

### **Noise Modelling Results**

In order to predict the likely impact of operations of KDDSEZL the ambient noise, it is necessary to estimate noise levels associated with equipment and components of proposed KDDSEZL which will provide the basis for assessment of impact of noise generation.

Mathematical noise model was used for predicting impacts due to operations of proposed facility on ambient noise. The potential sources of noise emission have been provided in above table. A noise modelling exercise was carried out to estimate the incremental noise levels due to repairing of ships in dry dock basin and its associated facilities and the spatial variations in incremental noise levels have been provided in the following Figure. Equivalent noise level contours have been plotted corresponding to the incremental noise level results obtained from the mathematical modelling.

The baseline noise levels at Badalpura Village and Marine Academy have been observed to be 60.2 d(B)A in day time and 57.5 d(B)A during night time. The modelling results indicate that the maximum noise levels within site premises will be within the range of 70 - 65 d(B)A while minimum noise levels will be in the range of 40-45 d(B)A. The maximum noise was observed to be at a distance of approx. 25m from the centre of site in north direction while minimum noise levels were perceived at a distance of approx. 700 m in south direction from the centre of the site.



**Figure 101:** Incremental Noise Levels due to operations of Dry Dock

Note: Hydro blasting point 1 has been considered as centre of site (0, 0)



### **Impact on Community (Badalpura Village and Marine Academy)**

The day and night time monitored noise levels exceeds the prescribed standards at the noise receptors owing to the temporary ship building and construction works being taken place by the developer within the project site. Resultant noise level at both the noise receptors after addition of incremental noise levels are well within the limit 3 d(B)A<sup>51</sup> except resultant noise level at Badalpura Village during night time which is 4 d(B)A more than the baseline noise levels. Marine Academy witnessed an increase of 0.5 d(B)A in noise levels due to incremental noise and is well within the limit of 3 d(B)A. The impact will be intermittent but may occur regularly during the period when vessels/ships are present in the basin area for repairing.

**Table 101: Resultant Noise Levels at the Nearest Noise Receptors**

Noise Receptor	Distance from site and Direction	Baseline noise Levels	Range of incremental noise level after modelling in d(B)A	Resultant noise level at Noise receptor
<b>During Day Time</b>				
Badalpura village	50m in east direction	60.2	59.3 - 50.1	62.78 - 60.6
Marine Academy	300m in south-east	60.2	46.8 - 43.8	60.7 - 60.3
<b>During Night Time</b>				
Badalpura village	50m in east direction	57.5	59.3 - 50.1	61.5 - 58.2
Marine Academy	300m in south-east direction	57.5	46.8 - 43.8	58.3 - 57.8

\*The direction of noise receptors has been taken with respect to site

\*\*Logarithmic addition of noises  $(10 \times \log \{ \sum (10^{(\text{noise levels})/10} ) \})$

### **Occupational Impact on Workers**

The workers in the KDDSEZL area are likely to be exposed to high noise levels for short term. Workers working in hydro blasting area, workshop, electrical/ Instrumentation shop, pump house and fabrication yard are more susceptible to increased noise levels due to operations of machines. This short-term exposure may have impact on these workers if proper care is not taken which may result in hearing damage. It may cause loss of concentration, fatigue, a reduced capacity to work due to increased physical strain, attention deficit, and an impaired ability to communicate verbally. The following Table provides the permissible noise exposures and respective limit of durations of hours a worker should be exposed.

**Table 102: Permissible Noise Exposures**

S. No.	Duration per day, in hours	Sound Level dB(A) slow response
	8	90
	6	92
	4	97
	3	95
	2	100
	1.5	102
	1	105
	0.5	110

S. No.	Duration per day, in hours	Sound Level dB(A) slow response
	0.25 or less	115

Source: [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=standards&p\\_id=9735](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9735)

### **Vibrations**

Vibrations are expected to be generated by various activities associated with the proposed project activities. The impact of vibrations beyond the project site would be negligible in view of aerial distance. However, the impact of vibrations on workers engaged in the KDDSEZL area would be considerable due to occupational exposure depending on work places. The fixed major equipment/units such as pumps, operation of various motors in machine shop, hydro blasting operations etc. will generate vibrations during operation phase and may cause exposures to the workers/operators engaged at these units.

### **Mitigation**

Noise generated from the KDDSEZL will be slightly attenuated as the dock wall will serve as barriers for the activities undertaken in the docking area. It is recommended that a number of noise mitigation measures, such as staggering the timing of activities to reduce the cumulative noise impact and confining potentially noisy activities to workshop buildings, should be implemented by KDDSEZL.

Following mitigation measures have been proposed to reduce impacts due to high noise levels during operations:

- KDDSEZL will ensure mitigation of noise through control measures such as acoustic enclosures for Diesel Generators, rubber paddings for motors, pumps and compressors. All machinery and equipment, provided with adequate maintenance to ensure reduction of unwanted noise from loose components.
- KDDSEZL will put in place a state of art computer aided cutting machine, which reduces the noise generation from cutting and forging activities;
- High Noise generating activities will be prevented during night time to avoid disturbance to the local community. KDDSEZL will also explore the possibility of a vegetative belt along the western periphery to reduce noise reaching the village.
- All workers engaged in the dry docking area with high noise will be provided with ear plugs and ear muffs as required.

### ***Significance of Impact***

The potential from Noise will be local spread for long term and with minor to moderate intensity. The village of Badalpura and the Marine Academy will be the key receptors. Noise levels generated will be totally dependent on kind of repair work or maintenance activity undertaken, which will also be subject to the type of vessel received at the dock. The impact on noise can be mitigated with implementation of the proposed measures.

**Table 103: Impact Significance – Noise Levels**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Noise Level	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	Low	Frequent	INSIGNIFICANT

The overall impact on noise levels is considered to be of **‘Moderate’** significance; however, it can be kept as **‘Minor’** with implementation of the proposed mitigation measures.

#### **7.4.5. River traffic navigation**

Though the operations of the dry dock will involve vessels coming in for repair and maintenance at the facility, it will not significantly add to the existing river traffic volume on Karnafuly. However, the vessels coming to the dry dock are likely to affect the navigation on the river and create navigational issues for other vessels heading to or from the Chittagong Port. The impacts have been discussed in detail below:

##### Impacts

In general, the main navigational issues for vessel movements in the Karnafuly River, including movements to and from the KDDSEZL are as following.

- Strong cross-currents at the entrance of the river
- Strong currents within the river
- Shallow bars across the river
- The proximity of the airport flight path
- Traffic in river
- Small craft crossing the river
- Lighters anchored in the river
- Limited navigational window for marine movements
- Poor visibility caused by heavy rainfall or fog
- Available turning circle
- Angle of the dry dock to the river currents
- Obstruction of transit marks
- Reduced sea room for night navigation
- Conduct of “dead ship” movements

The vessel proceeding to the dry dock will need to swing to enter the dock. It is therefore likely that the vessel will be at the ‘tail end’ of the inbound convoy in order not to impede the other vessels proceeding further upstream, which would require adequate planning, without which there will be potential for chaos and collision.

If the vessel proceeding into the dry dock was berthed at one of the shipyard’s jetties, it could be shifted into the dry dock after the port’s inbound vessels have passed.

Vessels berthing at the shipyard’s jetties during the flood current and vessels entering the dry dock may need to swing around in the river. Appropriate measures and long-term planning is required to be taken for unfavourable conditions such as freshets. In favourable conditions, if the movement is conducted in slack water or very weak currents, a 253 metres long vessel will require a turning circle of about 375 metres. This sea room is currently available off the shipyard. However, there are jetties proposed on the opposite bank at Laldiar Char. These jetties and the vessels berthed alongside them will reduce the available



sea space to swing a large vessel around. Based on availability of the required draft, the vessels will then have to swing in the wider area slightly upstream of the shipyard.

The proposed KDDSEZL extend close to the navigation channel that has night navigation transit marks. There is potential that vessels at the jetties/yard or equipment may obstruct the Batten's and Coombs Pillar transit marks that are used for navigation in the river.



**Figure 103: Dry dock and Jetty layout with indication of turning circle**

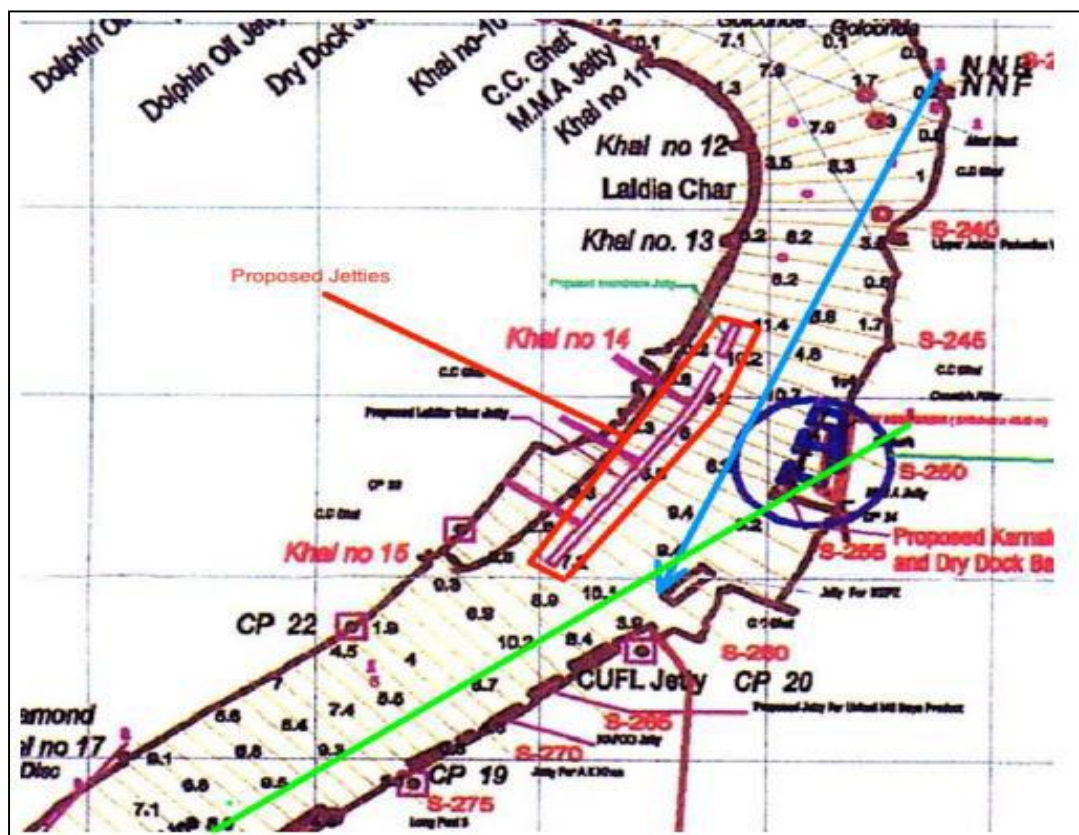
*Source:* Feasibility Study for Dry Dock Project, Conceptual Design and Cost Estimation, BMT Asia Pacific, April 2014

### **Mitigation**

Following measures will be considered by KDDSEZL for managing the navigational issues during operations:

- The CPA has longstanding procedures to address the environmental conditions affecting navigation in the Karnafuly River. According to the CPA guidelines, the maximum permissible draft for entering Chittagong Port is 9.15 metres and the maximum permissible length is 186 metres. The maximum size of the vessels expected to call at the proposed dry-dock is 253 metres. Vessels proceeding to the dock yard generally are in lightship condition and the maximum vessel size designed to be handled at the Dry dock should be able to meet the present draft requirements; but not the length requirements. However, as the proposed dock yard is closer to the mouth of the Karnafuly River and before the Gupta and Naval Bends, the Chittagong Port Authority (CPA) may set new requirements for the shipyard.
- Adequate planning of vessel arrival will be made to ensure that the vessels proceeding to the dry dock can swing to enter the dock without impeding other vessels proceeding further upstream.

- Ship movements generally commence about 4/5 hrs before the day's High water. The movement of vessels is controlled by the Harbour Master and generally depend upon draught, rise of tide, availability of berth & available day light. Generally, the outbound vessels proceed through the channel stemming the flood current and the inbound vessels enter in the flood stream. Priority of vessel movements will likely be given to vessels calling at the Chittagong Port and movements will be monitored by the port's vessel traffic control centre.
- The Chittagong Port Authority (CPA) also stipulates that the permissible height of mast above water level is limited to 52 metres due to overhead cable for berthing at jetties from 2 to 13. The overhead line is located upstream of the Naval Bend, well clear of the proposed dock yard location. The dock yard is also clear of the flight path of the airport. KDDSEZL shall ensure that the dock yard's vessels movements are properly controlled and emergency procedures are in place, so that vessel do not stray into the flight path of an aircraft as it approaches over the river. It is unlikely that the CPA will impose a height restriction for vessels calling at the shipyard.
- Vessels at the dockyard or dock yard buildings or equipment shall be planned to prevent any obstruction to the Batten's and Coombs Pillar transit marks that are used for navigation in the river. If this is not possible, alternative transit marks will be installed. Consideration would also be given to installation of a 'sector light' on the roof of a tall fixed dockyard structure.



**Figure 104: Navigational Transit Routes on Karnafuly**

Source: Feasibility Study for Dry Dock Project, Conceptual Design and Cost Estimation, BMT Asia Pacific, April 2014

Note: Battens and Coombs Pillar transit is indicated by green line and night navigation transit is indicated by blue line and Boundary of proposed Laldiar Char jetties opposite the shipyard are indicated in red

### Significance of Impact

The potential from traffic will be local spread for long term and with minor to moderate intensity. There are no insurmountable navigational issues with the proposed project. There is a need however to work with the authority at an early stage to address the impact of this new development in the Karnafuly River, resolve any concerns, obtain support for vessel movements and safeguard the sea space around the dock yard from encroachments that may affect dock yard movements.

**Table 104: Impact Significance – River Navigation**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
River Navigation	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	Low	Frequent	INSIGNIFICANT

The overall impact on river navigation is considered to be of **‘Moderate’** significance; however, it can be kept as **‘Minor’** with implementation of the proposed mitigation measures

#### 7.4.6. Air environment

Long term data and primary baseline studies indicate that the ambient air quality of the area is generally good with most of the parameters within the prescribed standards except for particulate matter levels. Although no major air emissions are envisaged during project operations, use of primers, paints, coatings, abrasive blasting, use of DG sets, etc. may result in generation of particulate matter and dust. The impacts and corresponding mitigation measures have been discussed below.

#### Impacts

- Conventional primers and paints contain solvents and pigments with heavy metals. Many solvents contain volatile organic compounds (VOC) and/or Hazardous Air Pollutants (HAPs). All HAPs and some VOCs are shown to cause cancer, so exposure to workers is a critical issue. Some HAPs and VOCs also contribute to the formation of ground level ozone (smog).
- Coating application processes produce overspray, which may become airborne because of the outdoor work and the huge pieces or ship hulls that are coated. Overspray can contain heavy metals, particulate, and volatiles.
- Potential exposure to dust and air contaminants is a primary health hazard associated with abrasive blasting. Abrasive blasting can generate large quantities of dust that can contain high levels of toxic air contaminants. The source of the air contaminants includes the base material being blasted, the surface coating(s) being removed, the abrasive being used, and any abrasive contamination from previous blasting operations. This means that employees can have exposures to multiple air contaminants from both the abrasive and the surface being blasted.

- Particulate matter (PM) and particulate HAP are the major concerns relative to abrasive blasting. Higher wind speeds increase emissions by enhanced ventilation of the process and by retardation of coarse particle deposition.
- Ships generally contain asbestos and asbestos containing materials (ACMs) in floors, walls, ceiling panels, fire insulation, heat insulation, lagging, electrical cables, gaskets, etc. Asbestos is known to be a Category 1 carcinogen. When ACMs are damaged or disturbed, asbestos fibres become air-borne. Due to the small particle size, these fibres are respirable by humans and result in serious, and often fatal, diseases. O&M workers and the adjacent community will be at high risk to asbestos exposure during repair and maintenance of ships.
- The project operations will require power back up through Diesel Generators (500KVA x 2, 250KVA x 1), operation of DG sets will generate air emissions which may hamper the air quality in the immediate vicinity. Since the village of Badalpura is located downwind of the site the potential for impact is high.

### Mitigation

Following mitigation measures have been considered:

- A number of different methods have been used to control the emissions from abrasive blasting. These methods include: blast enclosures; vacuum blasters; drapes; water curtains; wet blasting; and reclaim systems. Wet blasting controls include not only traditional wet blasting processes but also high pressure water blasting, high pressure water and abrasive blasting, and air and water abrasive blasting. For wet blasting, control efficiencies between 50 and 93 percent have been reported.
- Vessel deck abrasive blasting and painting tasks should be shrouded in a dome-like fashion to prevent the scatter and loss of pollutants. Tasks that will involve handling of asbestos containing materials should also be performed within shrouds to prevent scatter of airborne asbestos fibres. It is suggested that shrouds should be erected between the vessel deck to the dock walls.
  - The shroud may have screened flaps or openings to lessen wind stresses. The material can also be manufactured with grommets and securing (spring type) hooks which are used to hang the shroud.
  - Typically, the shroud can be fastened to cables connected to the dock wing walls or cables which are strung from the top of one wing wall to the other wing wall. Ropes or cables can be fastened to grommets on the centre of the shrouds to enhance vertical hanging stability.
  - For work on upper sides of vessels, the shroud fastened from the ship decks to the dock wing walls. The bottom of the shroud should hang sufficiently upon the dock floor to allow it to be weighted down or fastened.
  - Periodically, scattered abrasive will be blown and trapped under the shroud. This should be swept up daily to prevent it from escaping into the water.
- The use of Diesel Generators will be limited to periods of power failure, which may vary from 2-6 hours daily. The Diesel Generators shall be located in appropriate location downwind to ensure that the emissions are not carried to the village of

Badalpura. The generators will be provided adequate stack height to ensure dispersion of the emissions.

### **Significance of Impact**

The potential impact from air emissions will be mainly on the workers and the village of Badalpura. The use of abrasives and paints will be a routine activity and will have local spread for long term and with minor to moderate intensity. The impact on workers will be adequately handled by putting in place a robust occupation health and safety plan, while the mitigation measures proposed will limit the intensity of impact on the community.

**Table 105: Impact Significance – Air Quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Air Quality	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	Low	Frequent	INSIGNIFICANT

The overall impact on ambient air quality of the project area is considered to be of ‘**Moderate**’ significance; however, it can be kept as ‘**Minor**’ with implementation of the proposed mitigation measures.

### **7.4.7. Occupational health and safety**

#### **Impacts**

Ship repairing and maintenance requires a safe and healthy work environment. KDDSEZL facility will involve in ship repairs and maintenance activities can generate many work hazards. The potential impacts associated with operation of a dry dock facility include but are not limited to the following:

- Hazards associated with accessing a dry dock are falling and tripping while boarding a vessel, falling into river water from unguarded ends of the dry dock;
- Accessing vessels from dry dock or a jetty can lead to structural failure of ladder or gangway causing the worker to fall or workers getting struck by a moving cargo or material loads;
- Fall from heights during works involving spray painting, blasting, steel-works repairs etc.
- Leakages of flammable gas from Faulty valves cylinders may cause fire hazards;
- Working in confined spaces can lead to hazards such as inadequate supply of air and lighting;
- Hot works and its applications while working with hand-held electric arc and gas operations, and automatic profile-cutting machines can produce toxic gases and metal fumes which is a potential hazard for the health of the workers;
- Unauthorised personnel can cause serious injury or damage by driving forklift trucks without the necessary training or qualification;
- Water jetting and steam cleaning used to dislodge surface particles can be propelled through the air. This may cause injury (particularly to the eyes) to the worker or to other persons nearby;
- Hearing impairment due to pneumatic chippers used in descaling which generate high levels of noise;



- Workers may be injured by being struck by, caught in, or caught between machinery and other objects (such as tail and intermediate shafts, propellers, and gears).
- Workers such as painters, mechanics, electricians, welders, cutters, pipe fitters, etc. are all at risk of disturbing ACMs and so could potentially be exposed to asbestos fibres.

### Mitigation

A comprehensive occupational health and safety plan including all the impacts associated with various activities during operation of KDDSEZL along with specific mitigation measures have been proposed for the project and is attached as Annexure X of this report.

### **Significance of Impact**

The workers/staffs involved during ships repairs and maintenance activities are prone to hazards associated with their occupation. This is a routine activity and will have local spread for long term and with minor to moderate intensity. The impact on workers will be adequately handled by implementation of a robust occupation health and safety plan, while the mitigation measures proposed will limit the intensity of impact.

**Table 106: Impact Significance – Air Quality**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Occupational health and safety	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	Low	Frequent	INSIGNIFICANT

The overall impact on occupational health and safety of the project area is considered to be of '**Moderate**' significance; however, it can be kept as '**Minor**' with implementation of the proposed mitigation measures and occupational health and safety plan

### **7.4.8. Socio-economy**

#### Potential Adverse Impacts

The potential impacts that might take place in the operational phase has been mentioned below,

**Influx of migrant workers:** With the commencement of operational activities, skilled workers from other areas will migrate to the area of operation seeking employment. This will bring about a change in the demographic pattern of the area. The project affected population (Badalpura village) might be overwhelmed because of the sudden spurt of activities. In addition, the project affected population because of dearth of resources in the area might depend heavily on surrounding areas, thus bringing about a pressure on the resources of the adjoining areas.

**Impact on existing resources:** The influx of skilled workers might put pressure on the existing resources like water supply, supply of fuel, provision of basic facilities, waste handling and sewage disposal of the study area village which might create frictions between them and the resident population of the area.



**Increase of Traffic:** With the project activities underway in the operational phase, traffic in the area will increase. The development of roads in the area will lead to an increase of vehicles which will not only emit fumes but also create noise and dust pollution in the area. This increase of traffic would also lead to an increase of road mishaps.

**Disturbance due to Noise and Lighting:** The operation phase will involve heavy maintenance and repair works thus generating significant amount of noise, though for limited duration only. The facility will also have significant lighting arrangements during operation phase in order to guide ships entering the dock during night time. This might pose as a nuisance for the residents of Badalpura village just adjacent to the boundary of the KDDSEZL.

**Mitigation**

- The project proponents while developing the area and opening opportunities to skilled workers from outside should keep in mind the limited available resources in the area. They should develop the various amenities so that the local population in the area can also enjoy the benefits.
- The project proponents should encourage and advice the local population to initiate steps in developing small businesses in the area so that a constant supply of resources can flow to the area to supplement the expected population growth. This will help generate employment amongst the local population as well. In addition, an orientation should be given to all workers not from the area on the local resources available and where they should frequent to get their regular supplements.
- With the development of project, and the increase of traffic, the project proponents while hiring or contracting vehicles should maintain that the drivers of the vehicles are to possess driver's license. In addition, a certain speed limit should be mandated for all vehicles of the company when it passes through the villages.
- The mitigation measures for reducing impacts due to high noise levels have been discussed in previous Section. KDDSEZL should consider installation of low lighting structures instead of tall towers in order to avoid any disturbance to the residents during night time. The direction of lights should be kept away from the village, to the extent possible. Sufficient height of boundary wall should be maintained to prevent discomfort to villagers due to glare from the light sources.
- During Operation Phase, approximately 100 security personnel will be deployed. KDDSEZL should ensure that security personnel are aware about the community traditions so that they can be more responsive to the prevailing cultural milieu around them. Security personnel should have clear instructions on the objectives of their work and permissible actions. KDDSEZL should communicate their security arrangements to all the workers (local and migrant) and affected communities through meetings with them.

**Positive Impacts for the Local Economy**

Besides the adverse potential impacts that might affect the population in the study area village, there are certain positive potential impacts that might benefit the population which will get triggered by the development activities around the proposed KDDSEZL. The possible positive impacts have been detailed in the following,

**Employment Opportunities:** The construction and operation phase will throw open a varied set of job opportunities for the population belonging to the study area. Direct and indirect jobs including construction jobs, apprenticeship positions, welding, fabrication work, chemical cleaning etc. will need to be filled. At present there are eight employees from Badalpura village that are currently recruited in KDDSEZL. Once, the proposed works commences in the construction phase, the land contributors of the project affected village should be given priority in employment (both, skilled and unskilled) opportunities that will arise. This step will help in the required capacity building of the local population as well.

Work opportunities will not be limited to employment at the construction area only. Instead, job opportunities will also be created to those individuals who are interested in providing services as local contractors for small work. In turn, subsidiary employment in the form of small businesses like shop keepers, tea shops, plumbers, electricians, drivers, vegetable & fruit vendors etc. would also be established in providing stable employment opportunities to the local population to a considerable extent.

**Development of Infrastructure:** The project implementation will help in developing the road accessibility and drainage facility in the area. This will bring about connectivity and accessibility of movement in the area which was minimal prior to the coming of the proposed project in the area. The local population will indirectly be benefitted with the roads that will be developed in the area, thus, making movement to other areas effortless for them. This will also alternatively benefit a certain section of the local population by providing a source of employment to those that will be interested in developing and operating the local (private) transport system in the area.

**Barrier from Flooding:** The proposed project has already benefitted the study area village by acting as a barrier in preventing the flood water from entering the village. By reclaiming the land and positioning itself between the river and the village this has brought about a drastic change in the area wherein flood waters used to inundate the local population's households earlier on.

**Corporate Social Responsibilities (CSR) Benefits:** Inclusive of the potential positive impacts that will take place in the area due to the project activities, there are certain activities which will be undertaken by the project proponents as part of their corporate social responsibility (CSR) that will be initiated for the development of the area. A specific budget will be allotted by the project proponent to undertake the activities associated with proposed CSR activities. The benefits that can be meted out by the project proponents have been mentioned below,

- **Alternate source of employment:** The project besides creating direct employment for the population, indirect employment opportunities in terms of contractors, transport of equipments, value added services, tertiary service sector and independent small scale enterprises will also be generated in the area. This will benefit the local population in the long term and create a source of generation of sustenance for them.

- **Skill Development:** Vacancies will be made available in the construction and operation phase for the population belonging to the study area. Direct and indirect jobs including construction jobs will need to be filled. With these vacancies, skill development will be a major factor in making the population employable. The project proponent should be responsible in training individuals in the area to make them eligible to take up jobs in the KDDSEZL facility.
- **Educational Services:** With the trickling down of development effect to other sectors, educational services in the area would be eventually developed. As part of the CSR initiative, the project proponent can provide services and aid to the existing schools in the area in terms of infrastructural aid, reading room, science camps, health camps, environmental camps and in addition, encourage the Government to open schools of high school level in the area.
- **Health Services:** The project proponent at the onset can provide services developing a medical centre that will cater to the community in the area. In addition, mobile health vans can be introduced in the area with a set of medical professionals accompanying it so that the study area and its neighbouring population can be benefitted by this step.
- **Vocational Centres for women:** Vocational centres providing skills like tailoring, pickle making, mushroom cultivation, handicraft making etc. can be introduced in the area to give a platform to the women population to engage themselves in other areas besides household activities. This step will bring about women empowerment wherein effects will be noticed in areas like employability, education and health aspects thus, bringing them at equal par with their male counterpart. The prospects of women becoming decision makers by being financially independent will change the gender role in the community and secure their place in the workplace and family alike.
- **Construction of Cyclone Shelter:** As per the needs assessment conducted, mention of construction of a cyclone shelter was highlighted by the community as a necessity. KDDSEZL along with the community members are required to plan and discuss the feasibility options of such a shelter in the area. Once a consensus has been arrived at, KDDSEZL should formulate a plan wherein the local people can work to build the shelter so that a sense of ownership can be built amongst the community members.
- **Water Treatment Facility:** As per the groundwater sampling conducted during the environment assessment process, it was noted that the groundwater which is used for consumption process by the local residents is contaminated with high level of sewage and presence of faecal coliforms. The quality is not fit for human consumption which also proves the case as to the huge number of diarrhoea and other stomach ailments that the local population suffers. Due to this, KDDSEZL should make the local population aware of the findings of the study and initiate step in construct a biological water treatment facility in the area for the benefit of the local population. The process can be initiated by distribution of Chlorine tablets and subsequently putting up a chlorination unit.
- **Drainage Facility:** Awareness of building drainage facility and connecting each household is required to be undertaken so that an outlet of sewage water can be properly channelized. KDDSEZL should initiate this step so that people in the area are

aware of the importance of drainage facility and discuss the same with the local authorities working in the area.

- **Construction of Sluice Gate:** As per the consultations held with the present member of Badalpura Village, it was noted that due to proposed KDDSEZL facility the area which would not be covered by the facility and open to the river would result in water continuously inundating the nearby households situated in the area. In order to curb this, he has requested that KDDSEZL should construct a sluice gate to stop the water inflow. Taking his view into perspective, KDDSEZL should discuss the same with the community members of Badalpura village and initiate steps in constructing a sluice gate to benefit the community as a whole.

The proposed CSR activities should be planned every year along with the proposed budget detailing out the activities to be undertaken. These activities should be undertaken by a social division which should fit within the organizational structure of the project proponent. Collaboration with Non-Governmental Organizations (NGOs) in the study area villages can be undertaken to initiate the implementation of these activities and for its eventual success.

### ***Significance of Impact***

The type of impact the project is likely to have on the socio-economic conditions of the project area is considered to be beneficial. The impact on the population during operational phase will be local spread for long term and with moderate intensity and high intensity with the implementation of proposed measures. The impact is summarised in table below.

**Table 107: Impact Significance – Socio-economic Environment.**

Aspect	Scenario	Spread	Duration	Intensity	Frequency	Overall
Socio-economic condition	Without Mitigation	Local	Long	Moderate	Frequent	MODERATE
	With Mitigation	Local	Long	High	Frequent	SIGNIFICANT

## Chapter 8

# ENVIRONMENT AND SOCIAL MANAGEMENT AND MONITORING PLAN

### 8. Environment and social management and monitoring plan

This section of the report describes the importance of managing the social and environmental performance of the proposed project as per the requirement of *World Bank OP 4.01, Annex C*. KDDSEZL is committed to implement an effective social and environmental management plan in order to continuously manage and communicate the potential social and environmental impacts and risks likely to be imposed on construction workers and the local community residing in the immediate vicinity of the project area.

#### 8.1. Introduction

An interactive process of management and monitoring environment, social, health and safety need to be incorporated by KDDSEZL into all its activities during the construction and operation of the proposed Project. The Environment and Social Management and Monitoring Plan (ESMMP) intend to delineate management measures to minimize such impacts by allocating management responsibility for implementation of these measures during construction and operation phase.

The ESMMP is formulated to mitigate the adverse environmental and social impacts that have been delineated and quantified through the ESIA process and presented in the previous sections. The ESMMP is aimed at managing and monitoring the environmental parameters in a sustainable manner. The ESMMP section is organized as follows:

- **HSE organizational structure**– This subsection describes the role and responsibilities of personnel belonging to KDDSEZL and contractors who will be responsible for implementing this ESMMP.
- **Environmental Management Plan** – This Plan consists of a detailed description of the positive and negative environmental impacts anticipated from the proposed project, mitigation measures and the persons/ parties responsible for ensuring implementation of the mitigation measures. Additional plans such as Construction Labour Management Plan (Annexure VIII), Waste Management Plan (Annexure IX), occupational H&S Management plan (Annexure X), Emergency Response Plan (Annexure XI), Construction dust management plan (Annexure XII), Traffic Safety Management Plan (Annexure XIII) and Stakeholder Engagement Plan (Annexure XIV) have also been provided.
- **Environmental Monitoring Plan** – The Environmental Monitoring Plan details the locations, parameters and frequency of environmental monitoring, detailing the minimum requirements for testing and analysis of environmental parameters.

- ESMMP implementation review process – This subsection describes the requirements for periodic review and updating of the ESMMP to address any new impacts due to change or modification of the project.
- Documentation and record-keeping – Specifies the requirements for documents to be maintained for HSE aspects.
- Budgetary allocation for ESMMP implementation – Provides the details of budget allocation for the various mitigation measures proposed for the Project.

## **8.2. HSE management organization structure**

KDDSEZL has established a Board of Directors which is headed by a Chief Executive Officer. The present structure of board consists of Respective Director of various departments namely Workshop & Repair, Marketing & Logistics, HR & Administration, Planning New Building & Quality Control, and Project Department. Chief Safety Officer of Department of Safety Health & Environment and Chief Finance & Accounts Officer from Finance & Accounts Department also form the part of the board.

The department of HR & Administration comprises of Senior Executive for appointment of staff and an Executive has been employed for each facility of staff development, store, office management and workshop. The department of Finance & Accounts is headed by a Director, followed by a Chief Finance & Accounting Officer (CF & AO). One Account Officer for banking facilities, an accountant, a cashier and a separate Accounts Officer are also present in the structure being formulated. Department of Marketing and Logistics is headed by a Director, followed by respective General Manager/ Deputy General Manager of Marketing and Logistics sections. Two senior Executives and Executives are present in marketing section, wherein two senior executives and five Executives are present in logistics section.

Department of Planning, New Building & Quality Control is headed by a Director followed by a GM/DGM for each section of planning, Quality Control and New Building. Planning section comprises of a Naval Architect, Economist and a Statistician. Each of them is supported by an Assistant. Quality Control section constitutes a Naval Architect, Executive Electrical Engineer and Mechanical Engineer. Each of them is provided by an assistant for provision of support services. Section of building is headed by a Chief Naval Architect, followed by Naval Architect for fabrication and installation services. Project Department is supervised by a Project Director/ Chief Engineer, followed by an Executive Marine Engineer and an Executive Civil Engineer. Two assistant Naval Architect and two assistant Civil Engineer also form the part of department.

A significant portion of the project activities (civil and mechanical works, dredging etc.) will be undertaken by contractors. It is to be ensured by KDDSEZL that the contractual documentation emphasizes the need to comply with all HSE legal requirements and the Environment Management and Monitoring Plan (EMMP). KDDSEZL, either directly or through its contractors, arrange for periodic training of the project crew on legal requirements and EMMP. KDDSEZL will also undertake regular inspections of the installation

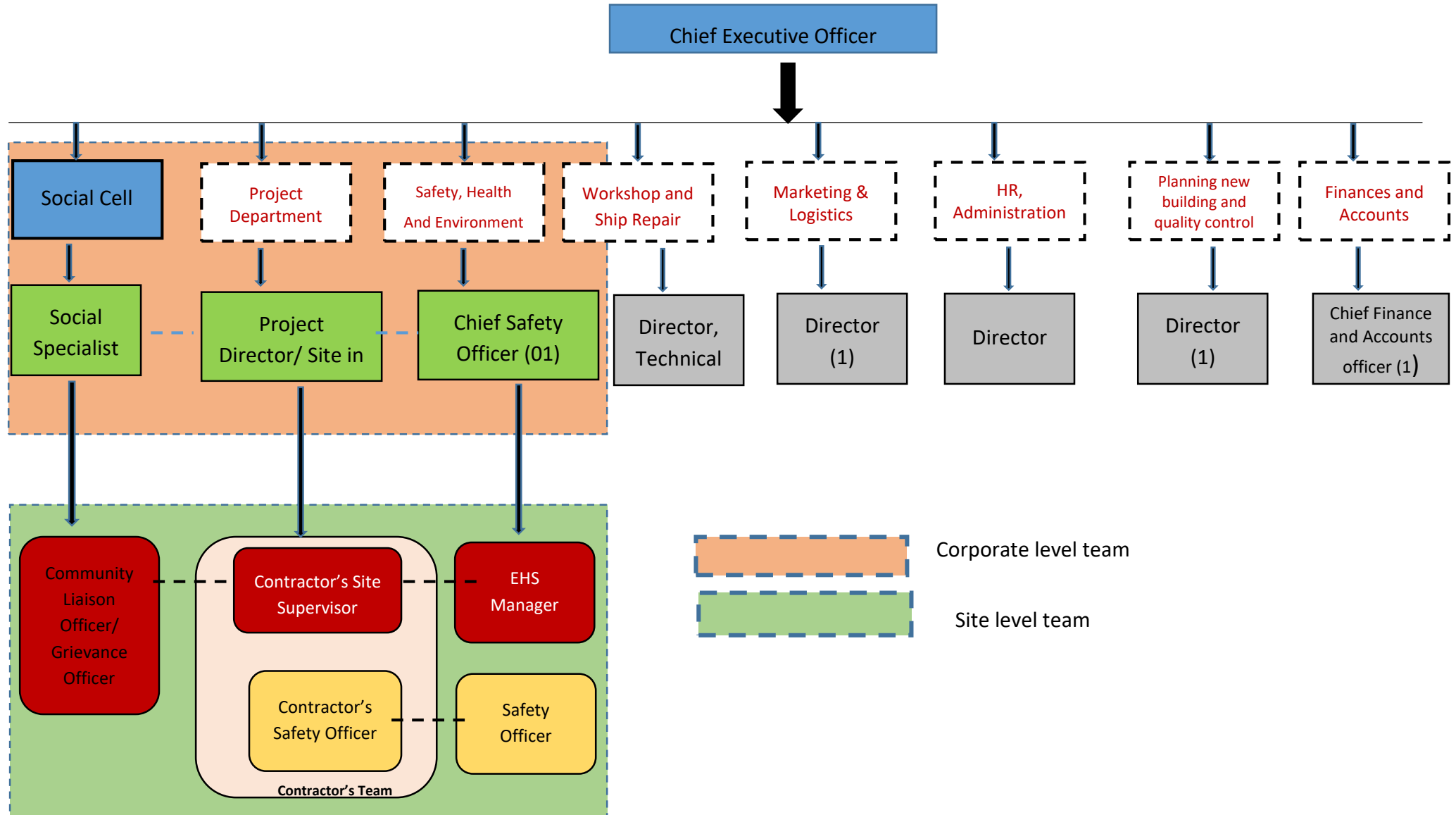


works and construction labour management to ensure compliance to legal requirements and the provisions of EMMP and document them.

The overall management of the project will be undertaken through coordination between departments of KDDSEZLL namely Project Department, and Safety Health & Environment. The activities will be managed through Project Director/ Site –In charge, Chief Safety Officer and a Social Specialist at corporate level who will be supported by the EHS Manager and Safety Officer and a Liaison Officer at the site.

To align the proposed members with existing organisation structure of KDDSEZL, additional responsibilities will be allocated to current designated officers in the existing organisation structure. The corporate level team will comprise of Chief Safety Officer, Project Director/ Site in Charge and a Social Specialist who will be appointed. The Chief Safety Officer will overview, monitor and control the activities of EHS Manager, and Contractor's EHS Supervisor at the site. The Site In-Charge will coordinate with Chief Safety Officer and EHS Manager regarding the operations of the project. The site team comprised of EHS Manager, Site in- Charge, Safety Officer and a Community Liaison Officer/ Grievance Officer who will regularly interact with the contractor's HSE team. The contractor will be required to have a Site/EHS Supervisor followed by Safety Officer in their team. The proposed organization structure is presented in Figure given below.

**Figure 105: Proposed Organizational Structure**



The site team will have the following responsibilities:

- Ensure effective implementation of the Environmental Management and Monitoring Plan (EMMP) through review and periodic updation;
- Ensure compliance with legal requirements and strive to incorporate the best international industry practices;
- Ensure availability of resources and institutional arrangements for the above;
- Impart regular trainings and awareness program to the project crew in a planned manner; and
- Undertake periodic inspections of activities, with special focus on contractors.

The specific responsibilities that have been assigned to the key personnel as mentioned in proposed organization structure has been detailed out below.

### **Chief Executive Officer**

The additional responsibilities that will be handled by KDDSEZL's senior management pertaining to implementation of ESMP are as follows:

- Chief Executive Officer will work closely with corporate level team to ensure that adequate resources have been committed for effective implementation of the ESMP and procedures;
- Implementation of ESMP through the respective project EHS team after prior customization as required; and
- Act as a corporate guidance cell for all issues related to Environment, Health and Safety and Social.

### **Site –In-Charge / Project Director**

Project Director of Project Department will act as Site-In-Charge and will look after day to day activities related to the construction at site. He will report to Chief Executive Officer. His primary duties will include:

- Act as the primary interface between the corporate staff and all the contractors working at site;
- Collect, review, and disseminate information regarding all activities at site;
- Process and prepare a summary on weekly basis from feedback, complaints and comments received from other team members; and
- Evaluate the performance feedback of corporate and operational site staff and subcontractors on issues and include it in decision making at all stages as required;

### **Social Specialist**

A new person shall be hired at corporate level to manage social issues pertaining to the management of the project in construction and operation phase. The key responsibilities of the person will be:

- The person will act as a Chief Grievance Officer to manage grievances at corporate level in coordination with Community Liaison Officer/ Grievance Officer;

He will be responsible for overhauling the implementation of CSR activities;

- Review the performance of contractors with respect to the adherence of contractual provisions pertaining to labour hiring and management;

- Develop and organise training programs for staff and contractors regarding for implementation of ESMP;
- Coordination with Site In-Charge and EHS Manager to ensure that adequate resources have been committed for effective implementation of the ESMP and procedures; and
- To keep a check on quality of services provided by contractor and raw materials received on the site;

**EHS Manager**

A new person well qualified in environment, health and safety, shall be appointed as an EHS Manager for site level team. The key responsibilities allocated to the person will comprise of:

- Dissemination of information about the aspects of environment, health and safety as per IFC guidelines applicable to the project to labour and contractors;
- Responsible for implementation of safety measures at labour camps and throughout construction site;
- Organise capacity building workshops and training programs for the construction labour such as mock drills, emergency evacuation procedures;
- Work in association with Safety Officer for addressing issues related to working environment and safety of the labours.
- Periodically review the EHS performance of the project during construction phase.

A detailed Term of Reference for EHS Manager with key Roles and Responsibilities has been annexed as Annexure- XVI.

**Community Liaison Officer/ Grievance Officer**

A new person will be hired to act as Community Liaison Officer/ Grievance Officer at the site level. The responsibilities of the person will be:

- Act as a member of Grievance Redressal Committee (GRC) and will address the grievance after getting information from Contractor's Site supervisor;
- The person will be responsible for implementation of proposed CSR activities at the ground level with assistance from Social Specialist.
- To assist Safety Officer in identification of key issues at the site and providing him with all the information required to detect the root cause of issue identified.
- Providing support services for closure of issues and review the feedbacks provided by safety officer on various activities during construction phase of the project.

**Safety Officer**

Safety Officer will report to the EHS Manager and will be responsible for handling the safety aspects of the site. He will work in close conjunction with the contractor. His key responsibilities will be;

- Carry out regular safety audits and inspections of the site and labour camps;
- Check implementation of security, fire, first aid and safety facilities and procedures at construction work areas;
- Check and ensure that all agreed safety standards and applicable safety regulations are observed and adhered to;
- Prepare periodic reports on the health and safety status;

- Report to the EHS Manager on daily basis concerning the health and safety issues of the labours.

Every contractor engaged by KDDSEZL for construction works will appoint a Site/EHS Supervisor who will be responsible for supervising the implementation of ESMP at site and managing of various activities. The Site/EHS Supervisor will be supported by a Safety Officer at the site. The key responsibilities of the contractor team will be;

- Issuing the PPE to workers and keeping records of all the protection equipment;
- Maintaining the registers of wages, overtime and advances;
- Keeping the daily in/out records of workers working at site;
- Taking action on the workers without PPE and indiscipline;
- Inspecting the site/workshop/tools/machinery for safety;
- Keeping the records of accidents/incidents/injuries;
- Inspecting the hygiene and housekeeping at work place;
- Recording grievances of workers and addressing them.

To manage EHS and social issue related to activities of the contractors, EHS Manager and Site –In Charge will be responsible to check the capability of the contractors to manage EHS and Social risks, their legal compliances, licenses, their implementing procedures etc.

### **8.3. Proposed environment and social management plan**

The environment and social management plan covering various aspects is provided in the following Table.

**Table 108: Environment and Social Management Plan**

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
<b>PRE-CONSTRUCTION AND CONSTRUCTION PHASE</b>						
1.	<b>Ecology</b>	<ul style="list-style-type: none"> <li>Complete removal of all communities presents within the area of the proposed dredging works;</li> <li>Damage to or removal of benthic community;</li> <li>Fish mortalities due to bacterial gill disease caused as result of high levels of suspended solids due to Dredging;</li> <li>Deterioration of the water quality along the bank due to runoff from construction area;</li> <li>Adverse impacts on existing mangrove plantation due to improper disposal of construction wastes;</li> <li>Potential masking impacts on the communication signals of Gangetic Dolphins found in the Karnafuly River, due to piling activities.</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>The identified dredger type will result in minimizing the amount of silt and sediments that are re-suspended at the dredge site;</li> <li>Dredge material will be utilized for the reclamation of the site to the extent possible;</li> <li>Construction area will be bunded and provided with adequate drainage with silt traps to prevent runoff from construction area into the rivers;</li> <li>Sewage generated at site will be treated by using a package type sewage treatment plant of capacity 10 KLD which will be subsequently replaced by the sewage treatment plant proposed for the project;</li> <li>Construction workers will be instructed about no disposal or dumping of any kind of waste into or in the vicinity of the Karnafuly River;</li> <li>KDDSEZL will ensure monthly monitoring of the river as well as groundwater quality for parameters such as pH, BOD and turbidity downstream of the site to ensure that the mangrove plantations are not affected severely.</li> <li>Size of piling rig shall be planned according to the requirement of the activity.</li> <li>Verify sightings of dolphins over a 20-minute period within 500 m of the project area immediately prior to the commencement of piling each day. Piling activity shall be put on hold if any sightings are made, till the animal moves away.</li> <li>Soft start procedures shall be adopted (i.e. commencing with reduced noise level to allow animals to move away from the area before increasing the noise levels gradually);</li> <li>Where piles are driven or drilled through water, bubble curtain technology may be employed to dampen the shock waves minimize effects on aquatic life.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>KDDL's Site Team-Manager</li> <li>Contractor's Site Team</li> </ul>



S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
2.	<b>Water Resource and Quality</b>	<ul style="list-style-type: none"> <li>• Increase in sediment levels during the dredging operations around the dredge site;</li> <li>• Reclamation will result in the re-suspension of fine particles due to erosion of the edges due to wave and current action;</li> <li>• Improper storage and handling of fuels and other chemicals can lead to contamination of groundwater and surface water if drained along with the runoff from site;</li> <li>• Untreated disposal of sewage can lead to further deterioration of water quality in the river, resulting in high BOD and nutrient levels along the banks.</li> </ul>	Moderate	<ul style="list-style-type: none"> <li>• Area around excavated soil or loose construction material shall be bund to prevent runoff;</li> <li>• All storage areas shall be provided paved surface with a secondary containment and kept away from the storm water drains to prevent any wash away;</li> <li>• Prior to commencement of work, a detailed mobilization plan shall be developed with details of location of storage areas for construction materials, and waste water facilities;</li> <li>• All the debris resulting from construction activities shall be removed from the site and transported to designated areas;</li> <li>• Oil and grease trap shall be provided to remove oil and grease from workshop effluents prior to discharge into disposal systems;</li> <li>• It is suggested to install silt screens in dredging projects;</li> <li>• Concentration of turbidity to be measured regularly during the dredging activity;</li> <li>• A sewage treatment system is proposed for operation period which will be installed in the first eight months of construction, till that period a package type treatment of approximate capacity of 10 KLD will be used for sewage treatment from the labour camp.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>• KDDSEZL's Site Team- EHS Manager</li> <li>• Contractor's Site Supervisor</li> </ul>
3.	<b>Soil Quality</b>	<ul style="list-style-type: none"> <li>• Site grading and excavation can lead to loss of loose soil;</li> <li>• Degradation and contamination of the soil quality due to landfilling with potentially contaminated material;</li> <li>• Soil contamination can also be due to ✓ accidental spills of lubricating oil, fuel oil,</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>• Dredge material should be tested for heavy metals and other organic pollutant prior to use for landfilling in the remaining area of the site;</li> <li>• Construction waste shall be kept at dedicated waste management areas such that all wastes can later be taken for disposal at the nearest municipal facility;</li> <li>• A retention wall or bund will be provided around the storage areas for excavated soil and other construction material to check the flow of solid with storm water in case of rain;</li> <li>• All storage facilities will be designed with paved surface, provided with covered shed and adequate containment</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>• KDDSEZL 's Site Team</li> <li>• Contractor's Site Supervisor</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		<p>paint, thinner etc. during their handling and storage;</p> <ul style="list-style-type: none"> <li>✓ Improper management of solid waste;</li> <li>✓ Runoffs from oil storage area, waste oil collection area, vehicle maintenance area.</li> </ul>		<p>facility at the construction site to prevent any contamination of soil due to accidental spills of lubricating oil, fuel oil, paints, thinner, varnishes, chemicals etc.;</p> <ul style="list-style-type: none"> <li>• Training of workers on the proper transfer and handling of fuels and chemicals and the response to spills will also be undertaken;</li> <li>• The sub-contractors engaged for the project will be instructed about the need to train their workers on disposal of food and drink containers;</li> <li>• Inspection of oil storage areas, tanks, pipe, valves etc. will be undertaken on weekly basis to detect and plug any possibility of leak;</li> <li>• All vehicles engaged for the project will be inspected for oil leaks and adequate maintenance will be undertaken to ensure the same.</li> </ul>		
4.	Noise Quality	<ul style="list-style-type: none"> <li>• Disturbance to the habitations in the proximity of the construction areas leading to sleep disorders;</li> <li>• Occupational hazards of noise for workers;</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>• Provision of acoustic enclosures, noise barriers in areas of high noise generating sources (such as generators, forging, cutting etc.);</li> <li>• Movement of vehicles and operation of high noise activities shall be avoided during the night time to avoid any discomfort to the residents of Badalpura village;</li> <li>• Intermittent high noises shall be avoided and the existing workshop shall be used for metal forging activities, so that the impact of noise is reduced on the village;</li> <li>• The construction workers will be provided with ear muffs in areas with potential for high noise generation.</li> <li>• KDDSEZL shall provide sheet barriers all along the boundary of the of its project site to ensure reduction in noise.</li> <li>• Noise absorber and dampeners to be provided for each high noise generating activity.</li> <li>• The size of piling rig shall be planned according to the requirement of the activity.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>• KDDSEZL 's Site Team-EHS Manager</li> <li>• Contractor's Safety Officer</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
				<ul style="list-style-type: none"> <li>A nylon or HDPE cushion will be used between the hammer and pile to reduce hammer impact noise.</li> </ul>		
5.	Air Quality	<ul style="list-style-type: none"> <li>Fugitive dust emissions from excavation and other construction activities;</li> <li>Emissions from onsite operation of diesel generators, construction equipment and vehicles/vessels at/to the site;</li> <li>Improper handling and storage of construction material can also lead to dust dispersion during high wind periods causing nuisance to the residents of Badalpura village in the immediate vicinity.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Proper maintenance to be undertaken for machines and vehicles engaged at the site. KDDSEZL will ensure that all project related vehicles have Certificate of Fitness as issued by the Bangladesh Road Transport Authority;</li> <li>Paint, polishes, building fittings and flooring material etc. will be procured carefully to minimize emission of VOCs.</li> <li>Diesel generators meant for emergency power will be optimally operated and regularly maintained with provision of appropriate stack height;</li> <li>An equipment maintenance register will be maintained at site to ensure that construction equipment and machinery are maintained at regular intervals.</li> <li>Preparation of a mobilization plan prior to commencement of construction which will delineate the location for stockpiles away from the nearest habitation;</li> <li>Trucks /dumpers / vessels engaged for transportation of friable construction materials and spoil will be covered;</li> <li>Measures such as spraying of water, wetting of the stockpile etc. to suppress fugitive dust emissions will be employed;</li> <li>Housekeeping of the site will be maintained by deputing sweepers to remove dirt/debris from the floors/ sites on daily basis;</li> <li>Proper implementation of Construction Dust Management Plan at site.</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>KDDSEZL 's Site Team-EHS Manager</li> <li>Contractor's Safety Officer</li> </ul>
6.	Traffic and Transport	<ul style="list-style-type: none"> <li>Additional traffic, temporarily around the project site due to transportation of machinery / vehicles and construction supplies/materials using</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>The project proponent will ensure that all vessel movement is undertaken as per the guidelines /norms laid down by the Chittagong Ports Authority;</li> <li>Close consultation with community when unloading of construction machinery and material will obstruct ferry movement for requirement of local community;</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>KDDSEZL 's Site Team-EHS Manager</li> <li>Contractor's Safety Officer</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		<p>river navigation and through roads;</p> <ul style="list-style-type: none"> <li>• Congestion of the navigation channel during peak hours along with increase in possible accidents and capsizing of boats/vessels and trucks and lorries during road transport;</li> <li>• Disruption of traffic on Chittagong – Anwara – Banshkhali road due to unplanned entry to the site, parking of trucks, breakdowns, etc.</li> </ul>		<ul style="list-style-type: none"> <li>• Necessary training will be imparted to the operators of construction vessels and drivers of construction vehicles for speed restrictions to ensure safe operations;</li> <li>• All vessels engaged for construction shall be maintained at regular intervals to prevent leaks of oil.</li> <li>• Ensure proper implementation of Traffic Safety Management Plan during construction phase.</li> </ul>		and Site Supervisor
7.	<b>Socio-Economic</b>	<ul style="list-style-type: none"> <li>• Influx of migrant workers and community health impacts from them;</li> <li>• Stress on existing resources such as water supply, fuel, generation of wastes and discharge of sewage;</li> <li>• Other beneficial impacts such as boosting of local economy due to increased sales of food, other consumables, rented housing etc.</li> </ul>	MINOR (BENEFICIAL)	<ul style="list-style-type: none"> <li>• Local population and its surrounding areas will be preferred for unskilled work in the construction phase;</li> <li>• KDDSEZL should be responsible in giving an orientation to the migrant labourers on the local custom and tradition followed by the local population;</li> <li>• Prior to engagement of migrant labour, medical check-up should be carried out and copy of the medical certificate should be collected by KDDSEZL, through sub-contractors, and maintained as part of their records;</li> <li>• Regular medical camps should be conducted amongst the labourers and the local population to make them aware about diseases like Typhoid, malaria, tuberculosis, STD's, HIV Aids etc.;</li> <li>• The positive impact can be further enhanced by committing an assured engagement level for the local community and by ensuring that priority is given those who contributed the land for project.</li> </ul>	MODERATE (BENEFICIAL)	<ul style="list-style-type: none"> <li>• KDDSEZL 's Community</li> <li>• Liaison Officer KDDSEZL 's Safety Officer</li> <li>• Contractor's Safety Officer</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
				<ul style="list-style-type: none"> <li>A checklist for social audit has been annexed as Annexure XVIII which can be used for periodic review of status of various socio-economic issues associated with the project.</li> </ul>		
8.	<b>Occupational Health and Safety</b>	<ul style="list-style-type: none"> <li>Over-Exertion</li> <li>Slips and Falls</li> <li>Working in Heights;</li> <li>Struck by Objects and moving machinery and their parts;</li> <li>Trespassing</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>Imparting adequate training of workers engaged in lifting and materials handling techniques in construction projects;</li> <li>Implementation of good house-keeping practices, such as the sorting and placing loose construction materials / debris in established areas away from foot paths;</li> <li>Training and use of temporary fall prevention devices, such as personal fall arrest systems etc.;</li> <li>Usage and wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes shall be made mandatory;</li> <li>Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling;</li> <li>Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>KDDSEZL 's EHS Manager and Safety Officer</li> <li>Contractor's safety officer</li> </ul>
<b>Operational phase</b>						
1.	<b>Water Resources and Quality</b>	<ul style="list-style-type: none"> <li>Alteration of the sedimentation pattern of river around or in immediate vicinity of the project affecting the bathymetry, depth and velocity of the river, which may affect the navigation in the river leading to Hydrodynamic changes in the River water;</li> </ul>	Significant	<ul style="list-style-type: none"> <li>The mathematical model study results with regards to possible adverse effects on channel navigability and morphological changes in the Karnafuly Channel suggests that overall impact is negligible for spring and neap tides during normal, flood and dry flow conditions;</li> <li>All industrial wastewater generated from the dock operations will be processed and treated before discharge into the sea;</li> <li>All bilge and contaminated ballast water will be treated to remove the potential pollutants that may be present;</li> </ul>	Minor	<ul style="list-style-type: none"> <li>KDDSEZL 's HSE Department – EHS Manager</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		<ul style="list-style-type: none"> <li>Change is water quality of River water due to run-off/discharge from various sources such as storm water, vessels coming for maintenance works carrying bilge and contaminated ballast water and discharge of untreated sewage of the working population during operation phase of the project.</li> <li>Disturbance to river bed, marginal increase in turbidity and potential contamination due to annual maintenance dredging works.</li> </ul>		<ul style="list-style-type: none"> <li>An Effluent Treatment Plant of 50KLD and an Oil Water Separator of 20KLD will be provided at site.</li> <li>Sewage generated at site will be treated in a Sewage Treatment Plant of 60 KLD capacity and Sequential Bio Reactor Technology located within the site premises;</li> <li>No ships using TBT-containing paint shall be received at the Karnafuly Dry Dock special economic zone;</li> <li>During application of antifouling paint, bounded area to be provided to avoid accidental spillage into the river;</li> <li>Spillages and paint scraps to be treated with suitable absorbent which again is to disposed-off as chemical waste;</li> <li>Clean-up of the graving dock floor to remove trash, blast abrasive, oil and other potential pollutants shall be undertaken on a regular basis;</li> <li>Records of each cleaning occurrence shall be maintained;</li> <li>Blasting residues (abrasive grit and paint flakes) will be cleaned up immediately after the hydro blasting activities to avoid these washing into the river;</li> <li>Oil/water separators, booms, skimmers or other methods should be employed to minimize oil contaminated storm water discharge.</li> <li>Requirement of maintenance dredging shall be minimised to the extent possible and necessity to be reviewed by dock operator through regular monitoring of siltation levels.</li> <li>Monitoring of dredging activities in order to restrict to areas experiencing siltation and avoid excessive erosion in the river.</li> <li>Erosion control measures to be employed along the river banks close to dry dock.</li> <li>Proper maintenance of dredging vehicles to prevent leaks and spills.</li> </ul>		



S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
2.	<b>Soil Quality</b>	<ul style="list-style-type: none"> <li>Use of blast abrasive or paint during the repair works can lead to land contamination;</li> <li>Improper disposal of empty paint cans and oil or solvent containers etc. can lead to contamination of soil;</li> <li>Handling and storage of waste such as slop oil and tank sludge from incoming vessels can lead to spills and in turn contaminate the soil;</li> <li>Inadequate handling and storage of fuel at site can also lead to contamination of soil.</li> </ul>	Moderate	<ul style="list-style-type: none"> <li>Usage shrouds to prevent blast abrasives and paint overspray from exiting the top of the dock.</li> <li>Empty cans will be disposed of in designated waste disposal bins. The disposal bins will be sold or exchanged by KDDSEZL personnel to a professional refuse collection service;</li> <li>Slop oil and bottom sludge from tanks will be collected in drums at site, and then stored in paved area with a secondary containment. The containment area shall be provided with oil traps to avoid run off from the area;</li> <li>KDDSEZL must continually promote the general concept of good housekeeping including cleaning-up spills and remove and dispose of any refuse found on the land or water surface;</li> <li>Recommended that oil spill containment and clean-up materials are kept on site for spill emergencies to limit the spread of contamination.</li> </ul>	Minor	<ul style="list-style-type: none"> <li>KDDSEZL 's HSE Department – EHS Manager</li> </ul>
3.	<b>Ecology</b>	<ul style="list-style-type: none"> <li>Release of heavy metals and bio-toxins associated with antifouling can lead to increased mortality or elimination of algal group and related species in River Karnafuly;</li> <li>Release of oil contents on to water will result in formation of a shining film on the surface of water which prevents dissolution of oxygen across the surface of water;</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>All operational waste water is treated prior to disposal;</li> <li>Potential oil contaminated run offs are trapped and treated prior to disposal into river;</li> <li>Sewage generated at site is treated before disposal;</li> <li>Hazardous waste is handled and stored adequately to avoid any runoffs;</li> <li>Periodic monitoring of water quality is undertaken to ensure that the BOD, TSS, pH and heavy metal concentration are retained close to the baseline conditions as observed in this report.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>KDDSEZL 's HSE Department – EHS Manager</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		<ul style="list-style-type: none"> <li>Dust trapped in oil can also lead to reduction in penetration of sunlight which is critical for planktons and flora near the shallow area;</li> <li>Release of sewage and operational waste can lead to loss of mangrove plantation south of the project site.</li> <li>Potential impacts on the Gangetic dolphins found in the area which are particularly vulnerable to industrial pollution.</li> </ul>				
4.	Noise Quality	<ul style="list-style-type: none"> <li>Noise from operation of vessels, forging, fabricating, loading-unloading, operation of pumps motors, sand blasting, grinding etc. can affect the communities in the close vicinity;</li> <li>Loud noise of intermittent peaks during operations can disturb sleep, frighten cattle/animals and birds in the area;</li> <li>Workers will be exposed to continuous occupational noise but for limited duration.</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>KDDSEZL will ensure installation of noise control measures such as acoustic enclosures for Diesel Generators, rubber paddings for motors, pumps and compressors;</li> <li>All machinery and equipment, provided with adequate maintenance to ensure reduction of unwanted noise from loose components;</li> <li>KDDSEZL will put in place a state of art computer aided cutting machine, which reduces the noise generation from cutting and forging activities;</li> <li>High Noise generating activities will be prevented during night time to avoid disturbance to the local community;</li> <li>KDDSEZL will also explore the possibility of a green belt along the western periphery to reduce noise reaching the village;</li> <li>All workers engaged in the dry docking area with high noise will be provided with ear plugs and ear muffs as required.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>KDDSEZL 's HSE Department – EHS Manager, Safety Officer</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
5.	<b>River Traffic Navigation</b>	<ul style="list-style-type: none"> <li>Limited navigational window for marine movements;</li> <li>Disturbance to port bound vessels due to turning circle;</li> <li>Obstruction of navigation transit marks;</li> <li>Reduced sea room for night navigation.</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>Vessels proceeding to the dock yard should be able to meet the present draft requirements; but not the length requirements of CPA. However, as the proposed dock yard is closer to the mouth of the Karnafuly River and before the Gupta and Naval Bends, the Chittagong Port Authority may set new requirements for the shipyard;</li> <li>Adequate planning of vessel arrival will be made to ensure that the vessels proceeding to the dry dock special economic zone can swing to enter the dock without impeding other vessels proceeding further upstream;</li> <li>KDDSEZL shall ensure that the dock yard's vessels movements are properly controlled and emergency procedures are in place, so that vessel do not stray into the flight path of an aircraft as it approaches over the river;</li> <li>Vessels at the dockyard or dock yard buildings or equipment shall be planned to prevent any obstruction to the Batten's and Coombs Pillar transit marks that are used for navigation in the river.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>KDDSEZL 's HSE Department – EHS Manager</li> </ul>
6.	<b>Air Quality</b>	<ul style="list-style-type: none"> <li>HAPs and VOCs contribute to the formation of ground level ozone (smog).</li> <li>Coating application processes produce overspray containing heavy metals, particulate, and volatiles, which may become airborne because of the outdoor work and the huge pieces or ship hulls that are coated.</li> <li>Potential exposure to dust and air contaminants is a primary health hazard</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>Emissions can be controlled by providing blast enclosures; vacuum blasters; drapes; water curtains; wet blasting; and reclaim systems;</li> <li>It is suggested that shrouds should be erected between the vessel deck to the dock walls;</li> <li>Use of Diesel Generators will be limited to periods of power failure, which may vary from 2-6 hours daily;</li> <li>DGs shall be located at an appropriate location downwind with adequate stack height to ensure dispersion of the emissions.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>KDDSEZL 's HSE Department – EHS Manager</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		<p>associated with abrasive blasting.</p> <ul style="list-style-type: none"> <li>• Particulate matter (PM) and particulate HAP are the major concerns relative to abrasive blasting.</li> <li>• Risk of exposure to asbestos and asbestos containing materials (ACMs) on board incoming ships.</li> <li>• Operation of DG sets for power backup will generate air emissions which may hamper the air quality in the immediate vicinity.</li> </ul>				
7.	<b>Occupational Health and Safety</b>	<ul style="list-style-type: none"> <li>• Falling and tripping while boarding a vessel, falling into river water from unguarded ends of the dry dock;</li> <li>• Structural failure of ladder or gangway causing the worker to fall or workers getting struck by a moving cargo or material loads;</li> <li>• Fall from heights during works involving spray painting, blasting, steel-works repairs etc.</li> <li>• Leakages of flammable gas from Faulty valves</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>• Provision of an adequate gangway, ramp, or permanent stairway to access to dry docks with adequate guarding;</li> <li>• Safety harness must be worn and anchored to the basket guard rails;</li> <li>• Ensure that the valve is protected by a valve cap or collar or that the valve has been designed to withstand impact if the cylinder is dropped;</li> <li>• A confined space permit to work procedures should be established;</li> <li>• Arrangements must also be made to ensure that workers do not become dehydrated whilst working in excessive temperatures;</li> <li>• Specify the PPEs to be used by workers which includes waterproof clothing, waterproof boots and goggles or face mask and ear plugs;</li> <li>• Provision of adequate and regular training on usage of PPEs and hazards associated with industry.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>• KDDSEZL 's HSE Department – EHS Manager and Safety Officer, supervised by Chief Safety Office</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		<p>cylinders may cause fire hazards;</p> <ul style="list-style-type: none"> <li>Inadequate supply of air and lighting while working in confined spaces;</li> <li>Injury (particularly to the eyes) to the worker or to other persons nearby while working with water jetting and steam cleaning;</li> <li>Hearing impairment due to pneumatic chippers used in descaling which generate high levels of noise.</li> <li>Risk of exposure to asbestos fibres in ACMs on board incoming ships.</li> </ul>		<ul style="list-style-type: none"> <li>Ensure proper implementation of the Occupational Health and Safety Plan.</li> </ul>		
8.	<b>Socio-Economic</b>	<ul style="list-style-type: none"> <li>Influx of migrant workers;</li> <li>Impact on existing resources such as water supply, fuel, waste and sewage generation;</li> <li>Increase in traffic.</li> <li>Disturbance to community due to noise and lighting</li> <li>Positive impacts for the local economy such as generation of new employment opportunities, development of infrastructure, flood</li> </ul>	MINOR (BENEFICIAL)	<ul style="list-style-type: none"> <li>KDDSEZL shall develop the various amenities so that the local population in the area is also benefitted;</li> <li>KDDSEZL to support generation of employment amongst the local population by providing small business opportunities like supply of resources for the project etc.</li> <li>An orientation should be given to all workers not from the area on the local resources available and where they should frequent to get their regular supplements;</li> <li>KDDSEZL while hiring or contracting vehicles should maintain that the drivers of the vehicles are to possess driver's license;</li> <li>A certain speed limit should be mandated for all vehicles of the company when it passes through the villages.</li> <li>Periodic review of status of socio economic issues is to be undertaken as per the Checklist for Social Audit (Annexure XVIII).</li> </ul>	SIGNIFICANT (BENEFICIAL)	<ul style="list-style-type: none"> <li>KDDSEZL 's Community Liaison Officer/Grievance Officer and Safety Officer, supervised by Social Specialist</li> </ul>

S.N	Aspects	Potential Impacts	Impact significance without mitigation	Proposed management/ Mitigation measures	Impact significance without mitigation	Responsibility
		barrier, enhanced educational facilities, health facilities and upliftment of status of women in the society, adequate and safe drinking water for the community.		<ul style="list-style-type: none"> <li>KDDSEZL should consider installation of low lighting structures instead of tall towers in order to avoid any disturbance to the residents during night time. The direction of lights should be kept away from the village, to the extent possible. Sufficient height of boundary wall should be maintained to prevent discomfort to villagers due to glare from the light sources.</li> </ul>		



## **8.4. Disclosure and grievance redressal**

Disclosure of Information and Grievance Redressal are important components of transparency and accountability that a project proponent should maintain with its stakeholders which in turn, would benefit in the improvement of project implementation and strengthen development outcome. World Bank as per its World Bank Environment Assessment Policy (OP 4.01) recognizes that in all Category “A” projects, the stakeholders are required to consult formally twice with the stakeholders, one, in a meeting held during the screening and scoping stage and second, when a draft EIA has been developed. ADB as per its Safeguard Policy Statement recognized that for Category “A” projects, the stakeholders are required to undertake meaningful consultations with affected persons and communities at the project preparation stage as well as throughout the project cycle on an ongoing basis. Timely dissemination of information to the affected people in an atmosphere free of intimidation and coercion is essential.

### **8.4.1. Information disclosure**

The project being categorised as ‘Category A’, KDDSEZL is required to undertake the requirements as set down by the World Bank Guidelines on Information Disclosure and ADB Safeguard Policy Statement. To initiate the process, KDDSEZL has undertaken two public hearings, one, on its premises in Badalpura village wherein notices of the public hearing were advertised in two newspapers, one, The Daily Star, a national daily and second, in The Daily Azadi, a local daily. The second public hearing was held at the premises of Badalpura Primary School. Notice of this public hearing was published in an English Daily, ‘New Nation’ and a Bengali Daily ‘Dainik Azadi’. Besides these notices, announcements and information were relayed to the population of the village, NGO, opinion leaders, local governing units via discussions held during the socio-economic survey exercise, focus group discussions, through announcements made at the two village mosques after the evening prayers and dissemination of project brief prior to the commencement of the second public hearing.

A total of 53 attendees attended the public hearing held on the premises of KDDSEZL while there were 99 attendees that attended the second public hearing held at the premises of Badalpura Primary School. Details of the public hearing have been provided in *Section 5.5.2* of the report. In addition, KDDSEZL is required to display of all project related information on the company’s website. Information on the website is to be made available in both languages, Bangla and English.

The following documentation is required to be made available to the public and NGO at Badalpura village under Bairag Union Parishad and displayed on the website and in hard copies:

- A) Summary of the Project
- B) Summary of the Stakeholder Engagement Plan (SEP)
- C) Summary of the Environmental and Social Management Plan (ESMP)

Besides, these above mentioned documents, a gist of the following plans in local language is also required to be disclosed to the various stakeholders who are directly and indirectly impacted by the project activities whenever a need arises.

- a) Construction Labour Management Plan
- b) Waste Management Plan
- c) Occupational Health and Safety Plan
- d) Emergency Response Plan
- e) Stakeholder Engagement Plan
- f) Grievance Redressal Mechanism
- g) Environmental and Social Management Plan

Consequently, once these activities have been undertaken and KDDSEZL formally transfers the EIA Report to the Bank, KDDSEZL is required to provide an endorsement letter to the Bank giving them the permission to post the report on their Info Shop for public disclosure and awareness purposes.

#### **8.4.2. Grievance redressal**

Grievance Redressal Mechanism (GRM) is an important criterion for development projects wherein ongoing risks and impacts of projects are probable. The GRM provides a way to reduce risks for projects, offer communities an effective avenue for expressing concerns and achieving remedies and promote a mutually constructive relationship. It is an important tool through which the affected communities' concerns and complaints are registered and addressed. This mechanism is a significant pillar of the stakeholder engagement process as it creates opportunities for the project proponent and communities to identify problems and determine solutions together. The mechanism tends to meet the requirements of stakeholder engagement process, prevent and address community concerns, reduce risk, and assist the processes that create positive social change.

The GRM prepared by Shahidul Consultant has been developed with an intention of it being an effective tool for early identification, assessment and resolution of complaints during project implementation. It is a means through which acceptance, assessment and resolution of community complaints concerning the performance or behaviour of the project proponent are ascertained and addressed. The GRM prepared should be implemented to the entire life cycle of the proposed dry dock special economic zone project prior to the construction phase. Consultations, communication and disclosure of this plan are mandated by World Bank as per World Bank's Approach to Grievance Redress in Projects (Dispute Resolution and Prevention).

The steps for developing a Grievance Mechanism for the community have been provided in details in Annexure XV of the report. KDDSEZL is required to adopt and follow these steps of grievance redressal to make the procedure effective.

Once the procedure for Grievance Mechanism has been developed by KDDSEZL, it has to be publicised through various communicative methods like printed materials, displays, face to

face meetings, website updation etc. as detailed out in the Stakeholder Engagement Plan provided in Annexure XIV of the report. A gist of the procedure should in addition, be translated in the local language and provided to the to the Chairman of Bairag Union Parishad and a board reflecting the name, designation and contact numbers of the contact point from KDDSEZL side in receiving grievances from the public should be publicised at the gate of KDDSEZL site office as well as on the Company's website.

KDDSEZL is required to inform the local community about the GRM and subsequently remind them of this mechanism on a regular basis during the project construction and operation phases. KDDSEZL in order to implement the Grievance Redressal Mechanism is required to identify the contact person/grievance officer involved at the site level for registering the grievances, the process of registering and action taken thereon for the resolution of the grievance, the timeline required in each step and criteria in escalation of the case to the higher level.

A two-level approach is proposed to be developed for all cases of grievances. As per the severity of each case, resolution of the grievances can be undertaken at each level. Details of each level and the process of grievance redressal have been provided in Annexure XV of the report.

A Grievance Redressal Committee is to be formed at Level I (Corporate Office) to support the Level II (Site Office) officials if the grievance does not get addressed at Level II. It is imperative to mention here that to maintain ultimate transparency and accountability for the grievance mechanism process, third parties which are neutral and independent should also be included within the structure. To realize these criteria, two members from the local administration and public representative side have been identified by KDDSEZL to be a part of the GRC, namely, the Present Member of Badalpura village and Chairman of Bairag Union Parishad. To keep the GRC transparent and neutral, the Chairman of Bairag Union Parishad is to be made the Chairman of the GRC and he will chair the meetings whenever any grievances come to the Level I if Level II has failed to resolve the grievance at their level. The list of members to be included within the GRC has been provided below in the following Table.

**Table 109: List of Members of Grievance Redressal Committee**

S. No.	Members	Role
1.	Chairman of Bairag Union Parishad	Head of the Grievance Redressal Committee
2.	Present Member of Badalpura Village	Member
3.	Social Specialist	Chief Grievance Officer of KDDSEZL
4.	Chief Safety Officer – Environment, Health & Safety	Member
5.	Director – Human Resource & Administration	Member

Besides the above mentioned members, through the stakeholder engagement process with BRAC (NGO), community opinion leaders and community members, KDDSEZL should also initiate steps in involving these groups as facilitators or advisors when grievances from

communities emerge. This will build the trust of the community members and they will rely on the effectiveness of the project proponent's grievance mechanism.

## 8.5. Environment and social monitoring plan

The section below furnishes the monitoring program for the proposed project in accordance to the regulatory requirements. The personnel to be responsible for undertaking monitoring of environmental and social aspects have also been mentioned.

**Table 110: Environment and Social Monitoring Plan**

S. No.	Sources/ Locations	Parameters	Frequency	Responsibility	Yearly budget Allocated (USD)
<b>Construction phase</b>					
<b>Ambient Air Monitoring</b>					
1.1	Two sampling locations as per prevalent wind direction of the season	SPM, PM <sub>2.5</sub> , PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>x</sub> , CO, O <sub>3</sub>	Twice in a week for 24 hours each at each location (twice a year)	EHS Manager of KDDSEZL	5000
<b>Noise monitoring</b>					
2.1	Monitoring at two locations in Badalpura village	LAeq (Night), LAeq (day), LAeq (24 hourly)	24 hours continuous quarterly, preferably during docking period	EHS Manager of KDDSEZL	500
<b>Water Quality Monitoring</b>					
3.1	Surface Water at two points of Karnafuly River	pH, TDS, Dissolved Oxygen, Biological Oxygen Demand, turbidity, Total Coliforms and electrical conductivity	Twice a year	EHS Manager of KDDSEZL	700
3.2	Ground Water at two locations, from project site and Badalpura village	Physical, Chemical and Biological parameters of drinking water standards as specified in Schedule 3 of ECR, 2007	Twice a year	EHS Manager of KDDSEZL	800
<b>Soil and Sediment Quality Monitoring</b>					
4.1	One soil sample representative of project area and one sediment sample from Karnafuly river	pH, CEC, NPK values, heavy metals	Annually	EHS Manager of KDDSEZL	500
<b>Workers Health and Safety Monitoring</b>					
5.1	Monitoring of point sources such as diesel generator sets	Noise in dB(A) measured at 1 m distance from the point source	Quarterly	EHS Manager of KDDSEZL	500
5.2	Occupational Health and Hygiene	Exposure to chemicals and occupational noise	Twice a year	Site Safety Officer of KDDSEZL	300

*Environment and Social Management and Monitoring Plan*

S. No.	Sources/ Locations	Parameters	Frequency	Responsibility	Yearly budget Allocated (USD)
	within construction site				
Social Aspects					
6.1	Grievance Redressal	Grievances raised, actions taken, number of grievance cell meetings	Quarterly	Community Liaison Officer/ Grievance Officer	Included in budget allocated for monitoring, reporting, and statutory compliance during construction phase
6.2	Proposed CSR Activities	Implementation of proposed CSR activities	Twice a year	Social Specialist of KDDSEZL	
Operational phase					
Air Quality					
1.1	Two sampling locations as per prevalent wind direction of the season	SPM, PM <sub>2.5</sub> , PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>x</sub> , CO, O <sub>3</sub>	Twice in a week for 24 hours each at each location (twice a year)	EHS Manager of KDDSEZL	5000
Noise Monitoring					
2.1	Monitoring at two locations in Badalpura village	LAeq (Night), LAeq (day), LAeq (24 hourly)	24 hours continuous quarterly, preferably during docking period	EHS Manager of KDDSEZL	500
Water quality monitoring					
3.1	Surface Water at two points of Karnafuly River	pH, TDS, Dissolved Oxygen, Biological Oxygen Demand, turbidity, Total Coliforms and electrical conductivity	Twice a year	EHS Manager of KDDSEZL	700
3.2	Waste Water at discharge points	Physical and Chemical parameters as specified in Schedule 10 of ECR, 2007	Twice a year	EHS Manager of KDDSEZL	500
3.3	Ground Water at two locations, from project site and Badalpura village	Physical, Chemical and Biological parameters of drinking water standards as specified in Schedule 3 of ECR, 2007	Twice a year	EHS Manager of KDDSEZL	800
Soil and Sediment Quality Monitoring					
4.1	One soil sample representative of project area and one sediment sample from Karnafuly river	pH, CEC, NPK values, heavy metals	Annually	EHS Manager of KDDSEZL	500
Ecological Monitoring					

S. No.	Sources/ Locations	Parameters	Frequency	Responsibility	Yearly budget Allocated (USD)
5.1	Aquatic Monitoring at two points of Karnafuly River	Abundance and Frequency of species	Annually	EHS Manager of KDDSEZL	500
Workers Health and Safety Monitoring					
6.1	Monitoring of point sources such as diesel generator sets	Noise in dB(A) measured at 1 m distance from the point source	Quarterly	EHS Manager of KDDSEZL	
6.2	Occupational Health and Hygiene within project site	Exposure to chemicals and occupational noise	Annually	Site Safety Officer of KDDSEZL	300
Social Aspects					
7.1	Grievance Redressal	Grievances raised, actions taken, number of grievance cell meetings	Twice a year	Community Liaison Officer/ Grievance Officer	Included in budget allocated for monitoring, reporting, and statutory compliance during operation phase
7.2	Proposed CSR Activities	Implementation of proposed CSR activities	Twice a year	Social Specialist of KDDSEZL	

#### 8.5.1. Monitoring guidelines

It is recommended that KDDSEZL undertakes the environmental monitoring activities through a government approved/ recognised laboratory. The monitoring locations will be identified and finalized by the Site In-charge (Project Director) in consultation with the monitoring agency. The sampling and sample collection shall be carried out as per the standard guidelines of DoE, Bangladesh and compared with the applicable standards. The monitoring report shall include the following:

- Sampling locations (description, including nearest village and geographical coordinates and map showing location);
- Date and time of sampling;
- Sampling procedures followed;
- Analysis procedures followed;
- QA/QC procedures;
- Observations and analysis of the results.

#### 8.5.2. Budget allocation for ESMP implementation

The following table provides the capital cost and recurring cost of implementation of environmental management and monitoring measures, including waste water treatment facilities, for both construction and operation phases.



**Table 111: Budget Allocation for Construction and Operation Phase**

Sl. No.	Equipment Name	Capital Cost USD (Budgetary)	Recurring Cost USD per annum
<b>Construction Phase</b>			
1.	Provision of adequate drainage and bunds/ diversion dykes, water sprinkling etc. to prevent soil/raw material escape	60,000	8,000
2.	Sanitation facility – package type STP	8,000	800
3.	Construction of suitable masonry bins with concrete floors for waste collection and for further disposal	3,500	800
4.	Provision of tin sheets acting as noise barriers	7,000	1000
5.	Miscellaneous expenses for construction phase ESMP implementation	1,20,000	60,000
6.	Environment monitoring	-	40,000
7.	Manpower for implementation of construction phase ESMP	Integrated in project cost	-
Subtotal A		1,98,500	1,10,600
<b>Operation Phase</b>			
1.	Sewage Treatment Plant (STP)	80,000	40,000
2.	Effluent Treatment Plant and Oil Water Separator	1,00,000	50,000
3.	Online Ballast Water Treatment Facility	-	50,000
4.	Pollution monitoring from external agencies	50,000	50,000
5.	Environment, health and safety training for staff development and ESMP evaluation	50,000	50,000
6.	HSE Department monitoring, reporting, and statutory compliance	50,000	50,000
Sub Total (B)		3,60,000	2,80,000
Total cost (A+B)		5,58,500	3,90,600

### **8.6. ESMMP implementation and review process**

This ESMMP is an environment management tool which needs to be reviewed periodically to address any changes in the organization, process or regulatory requirements. This ESMMP would be reviewed after receiving all the necessary clearances and permits to include their requirements. The ESMMP shall be reviewed and updated every six months.

Following a review, the Chief Executive Officer, after discussion with Site-In charge and EHS Manager will be responsible for making the amendments in the ESMMP and seeking approval from the senior management. The amended ESMMP would be communicated to all the staff, who are responsible for its implementation. A Department of Environment (DoE) approved laboratory will be appointed for carrying out proposed monitoring during construction and operation phase of the project. All environmental and social monitoring results will be reviewed by the Chief Safety Officer and Social Specialist respectively. Any deviation from the prescribed national standards that might be observed in the results shall require review and updation of the mitigation/management measures.

### **8.7. Formation of environment and social committee**

An Environment, Social and Grievance Management Committee to be formulated comprising of Chief Executive Officer, Social Specialist, EHS Manager and Site In-Charge. The

committee is required to internally review the implementation of mitigation measures pertaining to Environment, Health Safety and Social on quarterly basis. The report based on review will cover the schedule, shall be based on the EHS importance of the activities concerned and results from previous reviews. The review procedures will cover the review criteria, scope, frequency and methods, as well as responsibilities and reporting results and retaining associated records. KDDSEZL shall also submit the review reports on the progress of implementation of the ESMP to the World Bank and ADB on quarterly basis.

The committee should ensure that the management of KDDSEZL will provide funds on time for implementation of ESMP and waste water treatment facilities. Management shall also be committed for provision of recurring budget as required on yearly basis. KDDSEZL should provide an undertaking to the lenders upon finalization of release of funds.

### **8.8. Documentation and record keeping**

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in ESMMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMMP documentation system is maintained and that document control is ensured through access by and distribution to identified personnel in form of the following:

- Documented Environment management system;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Quarterly Auditing reports; and
- Complaints register and issues attended/closed.

## **Chapter 9**

# **CONCLUSION AND CATEGORIZATION OF PROJECT**

### **9. Conclusion and categorization of project**

Chittagong Port being in close proximity to Bay of Bengal is the principal seaport catering to 92% of import-export handled in Bangladesh. Most industries like steel production, food processing, textile, petroleum products, chemical manufacturing have been built near the Bay of Bengal and the Karnafuly River. The port is estimated to handle 70% of the country's total imports and exports. The port is situated in lower estuarial section of the Karnafuly River, approximately at a distance of about 17 km from the mouth of the River. It is observed that the number of vessels coming at the port has remained steady over the years, with increase or reduction in number of vessels ranging between 3-8%.

KDDSEZL is a development initiative launched in accordance with the requirement of seaport and vessel movement. The ability of the proposed KDDSEZL to cater vessels up to capacity of 100,000 DWT, will make a significant contribution to attract more vessels to the port and which may otherwise target another port in the region, besides providing support to the vessels already operating around the Chittagong port. The KDDSEZL will be graving or basin type and will have dimensions of 255m in length, 48m in width and 15m in depth. Basin or graving docks are large, fixed basins built into the ground at water's edge, separated from the water by a dock gate.

The Project site is located on open land along the river with no resettlement issues and no loss of livelihood to the local community. The project intends to treat all its waste water before disposal into river. Vessels will be required to have a Ballast Water Management Plan or treatment facility on board before being considered for docking. A SBR type sewage treatment plant will be put at site for treatment of domestic waste water generated at site. A Central Effluent Treatment Plant (CETP) will be provided to treat dock wash water, an Oil Water Separator will be provided to treat all oil contaminated waste water and bilge water from the vessels at the dock yard.

As per World Bank categorization system, the project is categorised as Category A as it is likely to have significant adverse environmental impacts that are sensitive and diverse. As per ADB categorization system, the project has been categorized as Category B based on Environmental Safeguards as the impacts assessed during the study are site-specific and can be managed through implementation of recommended mitigation measures and Category C as per Involuntary Resettlement and Indigenous Peoples Safeguards. This ESIA study has examined the project's potential negative and positive environmental impacts, compared them with feasible alternatives (including the "without project" situation), and recommended measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and to improve environmental performance.

KDDSEZL will establish an environmental management system for the project based on a project-specific ESMP. This will be overseen, monitored, and audited by KDDSEZL and implemented by a dedicated team. The Project will make its best effort to minimize the environmental and social impacts unavoidably associated with the Project during its entire life cycle by implementing suggested mitigation measures and management plans with the required management system in place as described in this ESIA to ensure compliance with the requirement of IFC Performance standards and EHS guidelines. KDDSEZL will ensure that the Project conforms to all the legal, regulatory and policy objectives and also ensure that all the necessary permits are obtained and renewed from time to time.

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## 11. DISCLOSURE AND EIA TEAM COMPOSITION

A multidisciplinary team of professionals were involved for conducting this Environmental Impact Assessment Report (EIA) report. The following professionals were engaged in preparation of the report with specific inputs as mentioned below:

**Table 112: EIA Team Composition**

SN	Name of the Professionals	Area of Expertise	Qualifications	Position Assigned
<b>Shahidul Consultant Team</b>				
1.	Dr. Md. Tauhid Ur Rahman	Final Approval of the ESIA Report	PhD in Environmental Engineering	Team Leader
2.	Prof.M. Reaz H Khondokar	Environment Impact Assessment, Environmental Management Plan, Dredging and ICT Architecture	PhD in Naval Architecture	Deputy Team Leader, Naval Architect, ICT& Dredging Expert
3.	Muhammad Abul Foyzal	Environment and Social Impact Assessment & Environment Management Plan	M. S in Forestry and Environment	Sr. Socio-Environmental
4.	Md. Khyer Ali	Land use and GIS Mapping	M.S.S. in Geography & Environmental Studies	GIS Expert
5.	Ms. Nasrin Jahan	Social Consultations and Social Impact Assessment, preparation of stakeholder engagement plan and grievance redressal mechanism	Master of Social Sciences	Social Expert
6.	Enggr. Md. Shahidul Karim	Land Use, Planning and Architecture	M. Sc in Civil and Environmental Engineering	Urban Planner