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Bangladesh Regional Waterway Transport Project 1

Environmental and Social Impact Assessment

Final Report
May 2016

BANGLADESH INLAND WATER TRANSPORT AUTHORITY

Government of People's Republic of Bangladesh
Ministry of Shipping

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ACRONYMS AND ABBREVIATIONS

AAQ	Ambient Air Quality
ADB	Annual Development Budget
AIS	Alien Invasive Species
AR	Assessment Report
ARC	Accidents Research Centre
AUC	Asian Waterbird Census
AWC	Asian Waterfowl Census
Baor	Oxbow Lake
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDM	Biodiversity Management Consultant
BDT	Bangladeshi Taka
BECA	Bangladesh Environment Conservation Act
BETS	Bangladesh Engineering and Technological Services
BFRI	Bangladesh Fisheries Research Institute
BIPIWTT	Bangladesh India Protocol on Inland Water Transit and Trade
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BIWTMAS	Bangladesh Inland Water Transport MASTERPLAN
BLI	Birdlife International
BMD	Bangladesh Meterological Department
BOBLME	Bay of Bengal Large Marine Ecosystem
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantities
BRE	Brahmaputra Right Embankment
BUET	Bangladesh University of Engineering and Technology
BWA	Bangladesh Wildlife (Conservation and Security) Act 2012
BWDB	Bangladesh Water Development Board
CARINAM	Center for Advance Research in Natural Resources and Management
CBD	Conservation on Biological Diversity
CC	Climate Change
CE	Cumilitive Effect
CEAP	Construction Environmental Action Plan
CEGIS	Center for Environmental and Geographic Information Services
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
CMS	Convention on Migratory Species

COD	Chemical Oxygen Demand
CPA	Chittagong Port Authority
CPD	Conservancy and Pilotage Department
CR	Critically Endangered
CSC	Construction Supervision Consultants
DAE	Department of Agriculture Extension
DC	Deputy Commissioner
D-C corridor	Dhaka-Chittagong corridor
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Fisheries
DoS	Department of Shipping
DPHE	Department of Public Health and Engineering
DSC	Dredging Supervision Consultant
Duars	Deepest hole in the river
EC	Electric Conductivity
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ECDS	Electronic Chart Display Information System
EcIA	Ecological Impact Assessment
ECoPs	Environmental Codes of Practice
ECR	Environment Conservation Rules
EGIS	Environmental and Geographic Information Services
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMS	Environmental Monitoring System
EN	Endangered
ENRAC	Environment and Resource Analysis Center Limited
ES	Environment Specialist
E&S	Environment and Social
ESIA	Environmental and Social Impact Assessment
ESW	Economic and Sector Work
EU	European Union
FCDI	Flood Control Drainage and Irrigation
FD	Forest Department
FGD	Focus Group Discussion
FY	Fiscal Year
GDP	Gross Domestic Product
GIIP	Good International Industry Practice
GoB	Government of Bangladesh
GPS	Global Positioning System

GW	Ground Water
HIV	Human Immunodeficiency Virus
HSE	Health, Safety & Environment
IBA	Important Bird Area
ICM	Information and Consultation Meeting
IECs	Important Environmental Components
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IMO	International Maritime Organisation
IMTP	Integrated Multimodal Transport Policy
IPCC	Intergovernmental Panel on Climate Chance
IPPC	Integrated Pollution Prevention and Control
IUCN	International Union for Conservation of Nature
IWC	International Waterbird Census
IWM	Institute of Water Modelling
IWT	Inland Water Transport
KMC	Knowledge Management Consultants
LAD	Least Available Depth
LCC	Location Clearance Certificate
LGI	Local Government Institute
LRP	Land Reclamation Project
MARPOL 73/78	Marine Pollution 73/78
MCCI	Metropolitan Chamber of Commerce Industries
M&E	Monitoring & Evaluation
MES	Meghna Estuary Study
MOS	Ministry of Shipping
MPA	Mongla Port Authority
MSDS	Material Safety Data Sheets
NBSAP	National Biodiversity Strategy and Action Plan
NEDCO	The Netherlands Engineering Consultants
NGOs	Non-Governmental Organization
NLUP	National Land Use Policy
NOAA	National Oceanographic and Atmospheric Administration
NOCs	No Objection Certificates
NSPAR	National Strategy for Accelerated Poverty Reduction
NWA	National Water Act
NWMP	National Water Management Plan
NWP	National Water Policy
OHS	Occupational Health and Safety
O&M	Operations & Maintenance
OP	Operational Policy
OPRC	Oil Pollution Preparedness Response and Cooperation

OSPAR	The Conservation for the Protection of Marine Environment of the North-East Atlantic (The OSPAR Convention) was adopted in Paris, France in September 1992 and entered into force in March 1998
PBC	Performance Based Contracting
PCBs	Polychlorinated Biphenyl
PD	Project Director
PIA	Project Influenced Area
PIs	Performance Indicators
PIU	Project Implementation Unit
PMU	Project Management Unit
PMBP	The Padma Multipurpose Bridge Project
POPs	Persistent Organic Pollutant
PPE	Personnel Protective Equipment
ppt	parts per thousand
PRA	Participatory Rural Appraisal
PRRA	Participatory Rapid Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
PWD	Public Works Department
Ramsar	Convention on Wetlands of International Significance
RAP	Rapid Action Plan
RDB	Red Data Book
RETF	Recipient-Executed Trust-Funded
RMIP	The River Management Improvement Program
RPF	Resettlement Policy Framework
RRA	Rapid Rural Appraisal
RTW	River Training Works
SCC	Site Clearance Certificate
SES	Socio-Ecological System
SIA	Social Impact Assessment
SMPs	Social Management Plans
SRDI	Soil Research and Development institute
SSC	Species Survival Commission
SSC	Suspended Sediment Concentration
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infections
SWOT	Strengths, Weaknesses, Opportunities and Threats
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
ToC	Table of Contents
TOR	Terms of Reference
TSS	Total Suspended Solids
UNEP	United Nations Environment Program
VECs	Valued Environmental Components

VESCs	Valued Environmental and Social Components
VU	Vulnerable
WB	World Bank
WBG	World Bank Group
WI	Wetland International
WPE	Waterbird Population Estimate
WWF	World Wide Fund for Nature

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1 INTRODUCTION

1.1 Background

There are hundreds of rivers in Bangladesh with a large network of navigation routes. Transportation through waterways has always been a natural, environment friendly and relatively cheap mode of transport. Inland waterways have become the very important mode not only for maintaining transport link between various remote parts of the country; it is a means of transporting export-import cargo as well. Over the decades the navigability during dry season in many rivers of the country has been deteriorating because of morphological processes and for withdrawal of water from the rivers beyond the border and within the country. The navigability has been further aggravated by poor or no maintenance of inland waterways. Navigability of inland waterways is intensely influenced by river morphology and hydraulics. River systems in Bangladesh exhibits high seasonality over a year i.e. abundant of water during monsoon and scarcity of water during dry season from December to May. Navigability becomes very critical during dry season in many river routes and ferry crossing. A total length of 12,000 km. of waterways during monsoon was estimated by NEDCO, The Netherlands Engineering Consultants. Currently the total length of navigable waterways during monsoon is about 4,000km and 2,000-2,500 km is navigable during the low water period (IUCN, 2012). The Government of Bangladesh has recently formulated sound IWT related policies which recognized to meet the poverty alleviation and to attain the millennium development goals a well-developed sustainable and accessible multimodal transport network with special focus on inland navigation is of fundamental requirement for movement of people and goods. It is worthy to mention that the transport system of Bangladesh has changed substantially over the last four decades. Prior to independence in 1971 there were no national or regional highways, but only a few roads connecting Dhaka with rest of the country. And Inland Water Transport is now playing an increasingly important role in the social and economic development of the country by maintaining communication between various remote parts of the country which are inaccessible by other modes of transport; particularly during the periods of peak monsoon. Over the decades transport demand in Bangladesh has grown faster than the GDP growth of the country. However, the shares of different transport modes particularly IWT and railway did not increase in the same proportion. The road sector carried the majority of the increase in passenger traffic, with a share of 73% by 1996. In the freight sector where IWT had been playing a dominant role, its share also eroded from 37% in 1974 to 30% in 1996 and 16% in 2005. A World Bank study on Revival of inland Water Transport conducted in 2006 estimated that 102 million passengers and 30 million metric tons of freight were transported by inland waterways in 2005. This is quite an achievement when compared with other modes, particularly in view of the fact that IWT suffered persistently from short-term policy decisions and low budgetary allocations. It is also an indication of its prospects and potentialities that can be exploited in future.

The vision for the inland water transport (which includes coastal waterways) is to develop and operate the system safely and efficiently and in accordance with the IWT sector policy and integrated multimodal transport policy (IMTP) to ensure economic development within the framework of the Poverty Reduction Strategy Paper (PRSP).Bangladesh Inland Water Transport Authority (BIWTA) under the ministry of Shipping is responsible for operation and maintenance navigation routes. Navigation routes in Bangladesh are categorized as Classes I through IV depending on their advertised depths, the navigation depth in each class is presented in Table 1.1. The Government has identified 65 main river navigation routes that are essential to passenger and freight transport within Bangladesh. Of these, 12 have been clearly identified as high priority. A study to prioritize the remaining 53 routes is underway under the World Bank-supported Bangladesh Trade and Transport Studies Recipient-Executed Trust-Funded (RETF) project.

Table 1.1: Classes of navigation routes and the draught/ depth of each class

Class	**Draught in m /(In Feet)**
Class- I	3.66-3.96 and above (12-13 and above)
Class- II	2.13-2.44 & less than 3.66 (7-8 & less than 12)
Class- III	1.52-1.83 & less than 2.13 (5-6 & less than 7)
Class- IV	Less than 1.52 (Less than 5)

The Government of Bangladesh has prioritized the improved development and maintenance of the Class I routes and linked Class II and III routes along the Dhaka-Chittagong corridor. For this purposes “Bangladesh Regional Waterway Transport Project 1“has been undertaken with the support of World Bank. The proposed project requires carrying out an Environmental and Social Assessment in accordance with the Environment Conservation Act 1995 (subsequent amendment), the Environment Conservation Rules 1997, and the World Bank Safeguard Policies. The implementing agency Bangladesh Inland Water Transport Authority (BIWTA) has engaged Institute of Water Modelling (IWM) to carry out the Environmental and Social Impact Assessment (ESIA) for the Bangladesh Regional Waterway Transport Project 1.

According to Environmental Conservatio Rule 1997 of Department of Environment (DOE), and Word Bank Operation Policy (OP) 4.01 the project is categorized as ‘Red’ and Category ‘A’ respectively. For Red Category project, DOE requires apporoval of TOR for ESIA before commencement of the study. Therefore, IWM prepared a TOR for ESIA study and got approval of the same with comments from DOE. This ESIA is prepared following the guidelines of both OP 4.01 and the approval letter of DOE (**Annex-A**) on Exemption of IEE and Approval of Terms of Reference dated February 29, 2003 for EIA study of the project.

1.1 Rationale of the Project

Need for Improvement of Navigability of Rivers in Bangladesh: Bangladesh lies predominately within the Bengal basin, the world's largest delta formed by the Ganges, Brahmaputra and Meghna river systems. Navigation is complicated by the braided nature of the rivers, which are characterized by high sediment delivery and - due to extremely low gradients - very low sediment throughput. This makes the rivers extremely sensitive to flooding with rapid geometry (boundary and channel) changes. Further, river systems in Bangladesh exhibits high seasonality over a year i.e. abundant of water during monsoon and scarcity of water during dry season from December to May. Navigability becomes very critical during dry season in many river routes and ferry crossing. Problems of navigation are compounded by the growth of inland water vessel size and the IWT fleet now comprises dry and liquid bulk ships of up-to 3,000 deadweight tons, mainly trading on the class 1 river routes. Moreover, the size of the IWT fleet is growing and currently there are over 22,300 registered vessels which carry over 50% of all freight traffic and one quarter of all passenger traffic. In addition, there are some 750,000 country (traditional) boats, a substantial part of which have been mechanized. Approximately 65% of these are passenger boats, where demand is predominantly generated by rural communities, a substantial proportion of which only have access to river transport.

Need for Improvement of Dhaka – Chittagong – Ashuganj IWT Corridor: The GoB has identified 65 main river navigation routes that are essential to passenger and freight transport within Bangladesh. Of these, river corridors between Dhaka and Chittagong; and between Dhaka and Ashuganj (with extensions to Narayanganj and Barisal) are identified as high priority routes for domestic trade and bilateral trade with India. About 80% of country's IWT transport is routed through these corridors and daily about 200,000 passengers use these routes. Inland river terminals at Dhaka, Narayanganj, Chandpur and Barisal along these routes play very important role in transporting and handling passenger and cargo. Food grains, fertilizers and consumer goods are the main commodities which are transported by cargo vessels and cargo-cum-passenger launches. The cargo terminal at Ashuganj is a key terminal for Bangladesh – India trade and it is connected by road to the north eastern states of India.

Cargo transport is heavily orientated towards imports and in volume terms, most is trafficked on the Class 1 river routes, primarily between Chittagong, Narayanganj and Dhaka. Cargo is mainly: dry bulks (including clinker, fertilizers, food grains, coal, salt, gypsum and fly ash); liquid bulks (petroleum products); and, general dry cargo (bagged cargo, machinery and steel). The main dry and liquid bulks are typically offloaded at private jetties or terminals, most of which are equipped with dedicated bulk handling equipment. Some break bulks and other smaller general cargoes are handled at limited number common user facilities or directly over the riverbanks by manual labour. There is some cross-border traffic on protocol routes between Bangladesh and India, however bilateral trade volumes are very small, accounting for just 3% of total IWT freight traffic in Bangladesh. Most of this consists of fly ash (and some wheat), mostly collected from India on Bangladesh registered vessels. Improved maintenance of advertised depths along the protocol route waterways will ideally spur increased trade.

Need for Improvement of Inland River Ports and Landing Stations: Inland river terminals at Dhaka, Narayanganj, Chandpur and Barisal along the Project routes play very important role in transporting and handling passenger and cargo. These four river ports together transport annually about 53 million tonnes of cargo and 22 million passengers (in

2013-2014). The facilities built at these terminals are not sufficient to meet the growing demand of IWT as they lack in adequate facilities for berthing, parking and storage areas, and passenger comfort. The port facilities at Sadharghat terminal at Dhaka and surrounding areas are highly congested with commercial and residential development leading to traffic congestion and inefficient use of port facilities, and also there is no space around the current terminal for further expansion. The GoB would like to augment the facilities at Sadarghat terminal in Dhaka by building a new passenger terminal at Shasanghat (2.5 km downstream), develop a cargo terminal at Pangaon, and augment and modernize the existing facilities at Ashuganj, Narayanganj, Chandpur and Barisal river terminals.

In addition to river terminals, there are a number of landing stations along the Project corridor which are very important for people living in the rural and remote areas. The landing stations (also known as launch ghats) are berthing points of high importance for the local communities that they serve, yet lack proper infrastructure and other essential facilities such as toilets and drinking water, as well as basic safety features for users, and many are in a highly dilapidated state. They usually consist of one pontoon with shore connection for embark and debark passenger and cargo. They play an important role in the lives of the rural people, as without them vessels would not berth and they would not receive much needed food, medicines, fuel and other consumer essentials.

1.2 Project Development Objectives

The Dhaka-Chittagong corridor is the main trafficked route for inland water transport and carries approximately 80 percent of all Inland Water Transport (IWT) traffic. Realizing the importance of this corridor and the need to fully utilize all transport modes to reduce demand on roads, the Government has prioritized the improved development and maintenance of the Class I routes and linked Class II and III routes along this corridor. The main trunk route is about 300km, of which it is initially estimated that about 40km currently require dredging and channelization to maintain the advertised depth for the existing traffic. Another 110-130km of linked routes is part of this corridor, of which about 33-50km requires constant maintenance. The proposed Bank financed project aims to pilot a new approach to (i) Dhaka-Munshigonj-Gajaria-Chandpur-Chittagong corridor and two key connecting routes to Barisal, and Ashuganj, (ii) maintenance of three priority ferry crossings along these corridors, and (iii) construction and maintenance of an estimated six vessel shelters along the corridors for use during cyclones/storms. Specifically, the proposed project will utilize a performance based contracting scheme to carry out the above activities. BIWTA is expected to be responsible primarily to verify that performance targets are being met by the contractors including maintenance of specified depths and compliance with related technical, environmental and social requirements, specify dredge spoils disposal, acquire land for spoils disposal where applicable, and manage the onshore dredge spoils deposits including facilitating use of spoils based on demand. The proposed activities might result in significant environmental impacts, if the investment activities are not properly planned, designed, executed, and maintained. Further to that, the project will provide an opportunity to improve the institutional capacity for environmental management, social management, and safety in overall IWT sector. IWT in

Bangladesh is the life line of transport system, while Dhaka-Chittagong corridor and adjoining routes under study is the artery of IWT network. Being the main consumption and distribution area, i.e., Dhaka-Narayanganj in an apparent centralized country, is connected by rivers with almost two –third area of the country by rivers. Two maritime ports of Chittagong and Mongla and the upcoming third maritime port of Payra are connected with Dhaka-Chittagong completely or mostly by these routes. As many as 200,000 passengers are transported daily by these routes. Transport output of these routes is further augmented by inflow and outflow of traffic from and to other IWT routes. Importance of Dhaka-Chittagong corridor and adjoining routes under study has further been increased by sub regional traffic flow. D-C corridor and adjoining routes are considered to be the common and main routes under Bangladesh-India Protocol on Inland Water Transit and Trade (PIWTT).

Bangladesh is proceeding gradually from lower middle income country to be an upper middle income country by 2021. To this end, facilitation of trade and commerce is inevitable. And for the growth and facilitation of trade an efficient multi-modal transport network is the main pre requisite. Only revival of IWT may ensure such efficient and cost effective network. Being the main artery D-C corridor cannot demonstrate efficiency in terms of efficient navigation. Existing navigational quality does not ensure uninterrupted navigation. Vessels are to wait for high tide or to plan navigation adjusting time of high tide at different hot spots. In both cases, cost and time of transportation increase. Groundings of vessels and subsequent accident have become more frequent. Users lost confidence on IWT and looking for modal shift.

There are also passenger services operated by BIWTC. Thus around 200,000 passengers use services in these routes daily. Chittagong port alone handles more than 90% sea-borne trade, and distribution of cargo towards main sink-places lilke Dhaka, Narayanganj, Chandpur and Barisal are done by IWT through D-C corridor and adjoining routes. Annual mean of departures from Chittagong to different destination is almost 18,000. Particularly, transporting petroleum oil and lubricant has to depend on this corridor. Apart from all these above, there has been a protocol since 1972 between Bangladesh and India on Inland Water Transit and Trade for the purpose of commercial transport between the countries using water ways, and providing transit facilities for two places in India. Also, the requirement of container traffic is increasing from time to time. About 70% of the total number of containers handled at Chittagong port are destined towards or originating from Dhaka and Narayanganj area. An inland container terminal has been constructed at Pangaon on the right bank of the Buriganga, four others in and around Dhaka and Narayanganj are being constructed. It is anticipated that in the revival of IWT container traffic and their development will play a significant role on economic development of the country. Again, both railway and road suffer capacity constraint, and also road is not fit for transporting trailers. In view of the above, maintenance of waterways is inevitable. Smooth and sustainable navigability in D-C corridor and adjoining routes under study can ensure revival of IWT. Maintenance of waterways will ensure sufficient water at all seasons and more water in rivers will ensure better eco system. *The proposed project activities may produce considerable environmental and social impact in the future. The project is to be financed by the World Bank and implemented by BIWTA, government of Bangladesh – both have environmental and social guidelines regarding impacts. This document is an Environmental and Social Impact Assessment for the* *preparation of the proposed World Bank Dhaka-Chittagong Ashuganj Regional IWT project and this ESIA document is a part of a larger Environmental and Social Assessment package of the proposed project. This ESIA mainly covers the activities under Component 1of the proposed World Bank project i.e. performance based navigation maintenance of IWT routes, ferry crossing and vessel shelters. The overall Environmental and Social Assessment (ESA) includes other stand-alone volumes under separate cover including: (a) ESA Executive Summary for the overall project, (b) EMF and RPF for activities under other components of the proposed project, including river terminals and landing stations as well as other minor works which may include building rehabilitation of BIWTA's training centre pilot activities on river training. The main object of this study as set out in the TOR (**Annex-B**) is to accomplish comprehensive EIA and SIA. Among others, this ESIA study has prepared Environmental Management Plan (EMP) and Resettlement Policy Framework (RPF) in carrying out maintenance dredging work, dredge material management along the routes, ferry crossings, and activities involving construction and maintenance of vessels shelters specifically for Component 1.*

1.1.1 Project Components

The Project will provide US$360 million in IDA funds to finance interventions aimed at improving IWT for cargo and passengers along the heavily-trafficked Chittagong-Dhaka-Ashuganj river routes, and in so doing, stimulating traffic growth on the waterways and away from the already heavily congested roads along these routes. These fall under the jurisdiction of the Bangladesh Inland Water Transport Authority, a Government authority mandated to oversee sector development. Main interventions include: navigation channel maintenance and improvement; navigation safety improvements; the construction, rehabilitation, and modernization of select river terminals; development of River Information Systems; institutional capacity development; and, funding for research and development to enable continuing sector improvement and sustainability. This includes work on sector policies and strategies needed to: improve revenue collection and management; incentivize public and private sector investments especially related to container transport; and, mitigate and improve IWT's impact on the social and physical environment. The Project consists of three components as follows:

Component 1: Improved Inland Waterway Navigation (US$235 million).

Component 2: Improved Services at Priority Inland Waterway Terminals and Landing Ghats/Stations (US$75 million).

Component 3: Institutional Capacity Development and Sustainability (US$50 million).

The map showing the project interventions is presented in Figure 1.1.

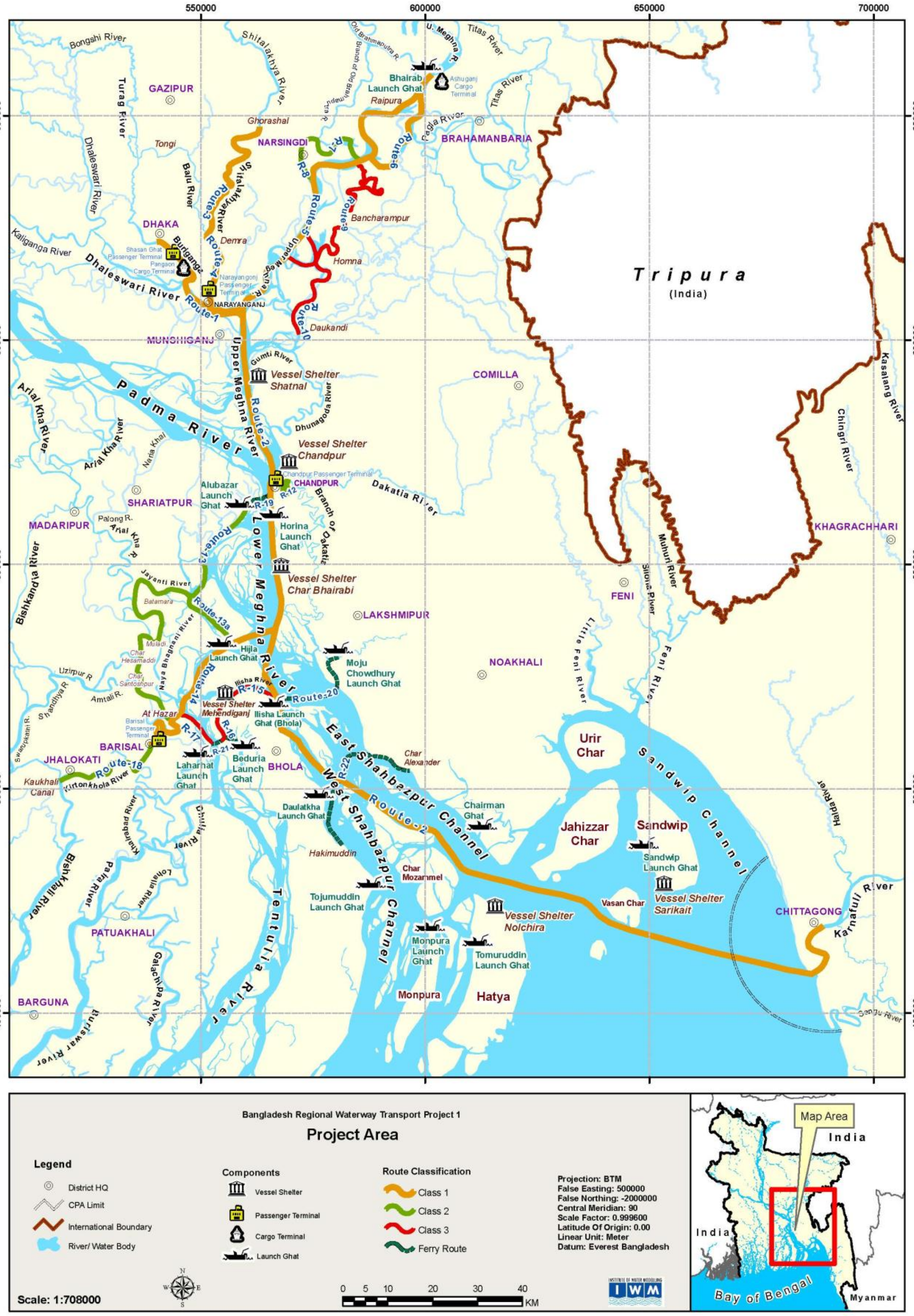


Figure 1.1: Map Showing the Project Area.

1.1.2 Brief descriptions of interventions

Dhaka-Chittagong river route is 280 km long in which the length from Dhaka to Munshiganj is 30 km and from Munshiganj to Chittagong is 250 km. According to BIWTA route classification, the entire route is classified as Class I. Ghorashal extension route is 57 km long that contains River Class I and III (Ghorashal-Demra section is of Class III that is, under this project, planned to be upgraded to Class I).Ashugang extension route is 244 km long that contains river routes of Class I, II, III (Narshindi loop and Bancharampur loop). Barisal extension is 222 km long which is under River Class I (approach to Aat Hazar via Illisha in the Meghnariver, and AatHazar to Jhalokathi in Bishkhali river), Class II (approach to AatHazar via Hijla), Class III (approach to AatHazar via Muladi). Not all the paths along the navigation route will undergo dredging works. Only river/channel sections that contain areas of shallow depths, obstacles by bars, constrictions etc. shall be taken into consideration for dredging.

Locations of Vessel Shelter

Six locations were selected by BIWTA for vessel shelters, and they are broadly at, in the sequence from upstream to downstream, Shatnol (Shatnol Nala), Chandpur (upsteam of Madrsaghat), around Hijla Bazar/Miar Char, Sarikait in Sandwip, Nolchira in Hatia. Vessel shelters would not necessarily be of the same type and size. Location specific need (planning and design – type, orientation, size, etc). Also where possible, multiple facilities are to be provisioned so that shelter could be used during idle time.

1.3 Environmental and Social Assessment

This section details the methods applied in the collection and analysis of the primary and secondary data used in this report. Primary and secondary information from government sources, non-government organizations (NGOs) and other Project-related stakeholders has been collected to support the preparation of this report. This section also describes the methods of impact assessment used along with methods for the development of recommended management and mitigation measures.

1.1.3 Purpose of ESIA

The Component 1 of Dhaka Chittagong Inland Water Transport Corridor Project intends to maintain the river routes between Dhaka -Chittagong and Dhaka – Ashuganj corridors and three ferry routes through annual maintenance dredging. (Prior to inception of the project, it is important to ensure that socio-economic impacts of the interventions are projected. The key purpose to the ESIA study therefore will be to identify any possible adverse impacts of the proposed project in advance and prepare a plan to avoid, minimize and mitigate these impacts to revive the stakeholder population and to improve or at least restore their pre project socio-economic condition.

1.1.4 Project influence area and study areas

Environmental Conservation Rules, 1997 (ECR) requirements, along with the newly-released industry guidelines (ERE Consulting Group, 2009), specify that the size of the overall study area should be determined on a case-by-case basis for individual projects, and that it should be based on an assessment of the likely zone-of-influence of the potential project impacts. As such, the broader Project study area was deemed to comprise entire river width of the proposed IWT route with a buffer of one kilometre on each side of the river bank.

1.1.5 Study Methodology

In order to conduct the required impact assessment for the ESIA report, it is necessary to collect relevant data from appropriate primary and secondary sources to fully establish existing baseline conditions for the relevant environmental (biophysical and socio-economic) aspects.

The ESIA study has conducted in-depth consultation meetings with stakeholders including socio-economic survey at 31 locations along the proposed IWT routes until December 2015. Respondents were selected from each of the launch/ferry terminals and dredging locations with a range from 15 to 25 while 30 respondents were interviewed from each of the storm vessel shelters. A team of experienced professionals and support staff has conducted surveys and consultation meetings after being briefed about the project in a day-long orientation session at the conference room of the Consultant office in Dhaka on the 15 September 2015. The orientation session was facilitated by social, environmental and technical team members. Techniques of data collection, sampling methods, methods of filling up questionnaire, potential locations of the survey, etc. were discussed in the orientation session using map of the study area. The sampled respondents representing HHs were 585 that consist of 2793 population with average HH size is 4.77. The respondents were selected by random sampling method from each of the locations and also by purposive sampling method in some locations. The questionnaire had modules on demography, socio-economic profile, income and livelihoods, Social infrastructure and river related issues. Each questionnaire was checked once in the field by supervisors and again in office, while processing data. Respondents' contact information was collected for further verification, if and when required. The consultation meeting participants were from project stakeholders on site and the FGD participants were selected from various homogeneous groups particularly occupational groups like farmers, fishermen, female passengers, sand traders, physically disabled transport users, etc. One consultation meeting was held in each location. The consultation meetings were conducted in participatory approach. The stakeholders were briefed about the project and their perception, concern and demands from the project were duly noted and presented in the ESIA. In addition, an additional national consultation workshop was carried out on the full draft ESIA study on March 31, 2016. Full details of consultation and disclosure meetings held as part of the study, including records of feedback provided, are provided in Chapter 13 and Annex I.

Environmental Data Collection and Analysis

In order to establish the baseline biophysical conditions within the study area, relevant secondary and primary data was collected and reviewed, a comprehensive field visit was undertaken, and a number of specialist studies were carried out. This process also included consultation with various relevant agencies including Government department, BIWTA, locally-active NGOs, and members of the local community.

The data generated allowed the Project team to better understand the complex interplay between the various biotic and abiotic factors within the study area and to establish the baseline conditions. Once this baseline was established it was used as a reference point to identify potential changes to the environment that may occur as a result of the proposed Project activities, as well as to allow development of measures to prevent, mitigate or manage these potential impacts.

Secondary Data Collection

A review was conducted of the biophysical, ecological and legal literature relevant to the Project. The review of secondary sources and informal initial field investigations were undertaken in order to prepare a preliminary assessment of the physical and social environment, biodiversity, and conservation significance of the identified study area. This preliminary literature review also assisted in identifying data gaps which would require collection of additional primary information through physical field survey. The following activities were included in this phase of the Project:

- Data and information was collected from various government departments – including DoE and Department of Public Health and Engineering (DPHE) – relating to site aspects including drainage networks, flooding characteristics, climate (weather), groundwater quality and soils; Secondary ecological data sources were collected and assessed;
- An appraisal was made of all legislation having direct and indirect relevance to environmental management within the Study Area including aspects such as biodiversity conservation, water quality, waste management, natural resource management and spill response;
- Previous environmental site studies, where available, were reviewed as well as relevant scientific journal articles; and

Thereafter, an information gap analysis was undertaken to identify the areas where further primary data collection would be required to complete the EIA.

Further detail regarding the titles of the relevant literature, policies, acts and other regulations and guidelines reviewed and applied during the course of this process can be found in legal section of this report.

Physical Environment Field Survey

To comprehensively evaluate the existing Project area baseline conditions, a field visit and data collection program incorporating a number of biophysical investigations was developed and implemented.

This survey aimed to identify important environmental components and environmental issues within the study area. It included investigation and observation of the local landforms, habitat types, drainage patterns, species abundance and distribution, soil types, water quality (surface water and groundwater), air quality, noise and hydromorphology.

The study area and surrounds were surveyed by foot and by vehicle. Important environmental features were identified and logged. Hand-held geographic positioning systems (GPS) were used to identify specific features for mapping and further analysis in the Project office.

Noise Monitoring and Assessment

Noise monitoring was undertaken to determine the ambient noise levels at six locations encompassing each of the sample sites were recorded using a calibrated SVAN 949 Sound

Level Meter set to A-weighting, fast response and statistical analysis settings. This monitoring provided a variety of noise descriptors, including LA10, LA90 and LAeq levels.

Soil and Water Sampling

For the water samples, a number of physical and chemical parameters were tested on-site including pH, temperature, conductivity and turbidity. Visual observations were also recorded including color and the presence/absence of detectable odors.

Ecological Field Survey

Two separate field surveys were undertaken to provide a primary assessment of the biodiversity values of the study area, as well as the potential presence/absence of protected species and ecologically-critical areas. Due to the specialist nature of this study, CARINAM was engaged by IWM to undertake the required work.

Initially, secondary data sources were analyzed in order to compile a potential presence/absence list of significant fauna and flora species. Thereafter two field teams – each comprised of a Wildlife Biologist, a Botanist and Aquatic Biologist – were deployed to undertake the required sampling and assessment. Sampling and survey was undertaken for both aquatic and terrestrial ecosystems, validation checks were made against the earlier-compiled species lists in order to establish a comprehensive baseline. Field surveys to establish the biological baseline were carried out in two phases to cover the monsoon (19 September – 07 October 2015) and dry (18 -25 December 2015) seasons. This assessment was also informed by the results of the mapping exercise described in the Physical Environment Survey above, particularly spatial information regarding vegetation patterns and water bodies.

The following activities were undertaken during the terrestrial and aquatic field surveys:

Direct Observation:

Direct observation on the occurrence and abundance of flora and fauna was made while travelling along creek banks and within water bodies, along road edges, across the agricultural fields and within village groves. As well as direct sightings, identification of animal presence was also based on identification of tracks, foot prints, feeding signs and animal/bird calls. Appropriate field guides and data proformas were used for this activity so that information was accurately recorded. Some plant species which could not be identified in the field were pressed and taken to the Dhaka herbarium for subsequent identification.

Interviews with Local Residents:

Many of the mammalian and reptilian species are cryptic and unlikely to be encountered using standard field sampling methods. As such, experience suggests that interviews with local people are a very useful method for collecting information on local biodiversity. This data is anecdotal and as such should not form the core of any assessment; however it does nonetheless provide useful supplementary information. During the field survey period, extensive interviews with local people were conducted to collect information on animal and plant presence, including occurrences, behavior, breeding, distribution and seasonal appearance.

Inspection of Fishermen's Catches and Fish Market Survey:

Whenever available, the catches of local fishermen were examined to assess species composition and abundances. The local fishermen were also interviewed to collect information on the occurrence and abundance of species, seasonality, etc. As with the terrestrial data collected during interviews with local residents, the data collected from these activities did not comprise the core information of the aquatic assessment, however nonetheless provided a useful supplement. The major fish markets, including the local fish landing centers, were also surveyed to record the local fish species caught as well as other aquatic animals which were collected along with the fish catch (e.g. insect larva collected in cast nets). Sources of the fish were ascertained prior to making any observations to verify that they were from within the local study area.

Geographical Information Systems

Geographical Information Systems (GIS) was used as a specialized analysis and presentation tool. Before commencing field investigations, spatial analysis of satellite imagery identified and present administrative areas and other boundaries/constraints to be considered for both the environmental and social assessments. For example, the sanctuaries, spawning grounds, infrastructures, vessel shelter locations, possible dredge materials disposal areas can be identified

Composition of Study Team

The environmental and social impact study (ESIA) has been carried out by Bangladesh Inland Water Transport Authority with the assistance of a multi-disciplinary team of national experts. In addition to the national team, Ministry of Shipping, Bangladesh engaged two (2) expatriate consultants namely Dr. Venkata Nukala (EIA advisor) and BKD Raja (SIA Advisor) to provide guidance and support to the national team to carry out this ESIA study in accordance with World Bank Guidelines.

Environmental study team: The EIA team comprised of Zahirul Haque Khan (Team Leader), Dr. Sheikh Muhammad Abdur Rashid (River Ecologist), Mohammed Anisuzzaman Khan (Terrestrial (plain/Char land) Ecologist), Md. Mehedi Hasan Emon (Environmental Engineer with expertise in pollution management), Rubayat Alam (River Hydrologist), Mohammad Abdus Salam Sikder (Coastal Hydrologist), Mohammad Ziaur Rahman (Modeller Sediment Dispersion), Md. Zahidul Islam (Agriculture Expert), Farhan Md. Zahir (Junior Water Resource Professional), Muhammad Ghulam Rasul (Junior Agriculture professional), Afroza Mahzabeen Anannya (Junior Environmental Expert/Terrestrial Ecologist), Md. Shamsuddin (Junior Environmental Expert/river ecologist), Md. Zahid Hasan Siddiquee (GIS Expert) and Syed Monowar Hussain (Survey specialist/Navigation Specialist) of IWM.

Social study team: The social team consisted of Khairul Matin (Sr. Socio-Development Specialist), Md. Rafiqul Islam (Media and Communications Specialist), G.M. Manzurul Mazid (Junior Socio- Development specialist), Sukhendra Narayon Chowdhury (Junior

Socio- Development specialist) Md. Mustafizur Rahman ((Junior Socio- Development specialist), and M.Hamidul Islam (English-Bangla report translator) of IWM.

1.1.6 Contents of the ESIA Report

The report is divided into twelve chapters that follow the activities stipulated in the TOR of the ESIA study.

Chapter 1- Introduction: This chapter describes the background of the study, project description, importance of the project and objectives of this ESIA study

Chapter 2- Legal and Regulatory Framework: It provides descriptions of Applicable Policies in Bangladesh and ESIA approval framework, international treaties and World Bank safeguard policies, overviews of Ops and guidelines, World Bank EHS guidelines.

Chapter 3- Project Description: This chapter contains project objectives, project components, proposed interventions and implementation methodology.

Chapter 4- Analysis of Alternatives: This chapter presents no project alternatives, alternatives to the project, IWT versus road and rail, alternative means of channel maintenance, alternative dredger types, and alternative to dredged materials management.

Chapter 5- Baseline Environment: Explains general climate, river hydrology and morphology, estuarine and coastal hydrology and morphology, flood plain hydrology, environmental quality on surface water, groundwater, riverbed sediment and air quality, riverine ecology, estuarine and coastal ecology, flood plain and char land ecology,

Chapter 6- Socioeconomic Baseline: Demography, livelihood sources, land use, public health, social infrastructure and cultural resources.

Chapter 7- Climate change and Adaptation: This chapter illustrates the new climate change scenarios i.e. Representative Concentration Pathways and projection on South Asia in accordance with the Assessment Report5 of IPCC. Trend analysis of sea level rise, change in temperature and precipitation in Bangladesh has also been presented. Projection of RCP 8.5 on the change in flow in the Brahmaputra, Ganges and Megna river for 2040-2069.

Chapter 8- Potential Significant Environmental Impacts: Methods of assessing significance of impacts, environmental, health and safety of impacts, social impacts and impact of vessel shelters and impacts of inland water transport are described in this chapter.

Chapter 9- Cumulative Impact Assessment: This chapter contains descriptions of Valued Environmental Components (VEC), likely impacts on VEC and cumulative impacts.

Chapter 10- Environmental Management Plan: The chapter focuses the impacts to be mitigated, and activities to implement the mitigation measures, including how, when, and where they will be implemented. The environmental monitoring plan describes the impacts to be monitored, and when and where monitoring activities will be carried out, and who will carry them out. In addition, EMP also provides the cost associated to each mitigation and monitoring measures. It also covers Institutional Arrangements.

Chapter 11- This chapter contains capacity development, existing institutional capacity of BIWTA and grievances.

Chapter 12- Consultation and Disclosure: Covers the process of various national, regional stakeholder consultations, FGDs and views, suggestions of the people from various cross sections attended in the consultations and FGDs

Chapter 13- Conclusion and Recommendation

2 LEGAL AND REGULATORY FRAMEWORK

2.1 Introduction

This Chapter presents a review of the national policy, legal and regulatory framework relevant to the environmental and social aspects of the present study. Also reviewed in the Chapter are the relevant international treaties of which Bangladesh is a signatory. The World Bank environmental and social safeguard policies are also highlighted.

2.1.1 Relevant National Legislations and Policies in Bangladesh

The implementation of the proposed interventions will be governed by the relevant Environmental Acts, Rules, Policies, and Regulations. Table 2.1 presents precise description of the applicable national laws, regulations and policies for the environmental social management of the project interventions.

Table 2.1: Review of Relevant Laws, Regulations and National Policies

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
National Environmental Policy, 1992	Bangladesh National Environmental Policy 1992 sets out the basic framework for environmental action, together with a set of broad sector action guidelines. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Marine environment is one of the key sectors covered in this policy. The main policy requirements related to the water sector are to ensure environmentally sound utilization of resources, so that developments do not create any significant adverse impacts on the environment; and that all water bodies and water resources are kept free from pollution. Key elements of the policy are: • Maintenance of the ecological balance and overall progress and development of the country through protection and improvement of the environment; • ensure that all steps are taken for flood control, including construction of embankments, dredging of rivers, digging of canals, etc., be environmentally sound at local, zonal and national levels;	According to this policy the proposed project needs full environmental assessment. The proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The ESIA studies are required to address the potential impacts and propose mitigation measures. In compliance to the

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	• keep the rivers, canals, ponds, lakes, haors, baors and all other water bodies and water resources free from pollution;; • Identification and regulation of all types of activities, which pollute and degrade the environment; • Ensuring sustainable utilization of all natural resources, and • Conduct environmental impact assessment before undertaking projects for water resources development and management.	policy detail ESIA is prepared.
Environment Conservation Act (ECA) 1995 and subsequent amendments (2000, 2002 and 2010)	ECA '95 is currently the main legislation related to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standard development and environment pollution control and abatement. The main strategies of the Act, that are relevant for this project, can be summarized as: • Declaration of ecologically critical areas and restriction on the operation and process, which can or cannot be carried/initiated in the ecologically critical areas; • Environmental clearance requirement for certain projects, which potentially create significant adverse environmental impacts; • Regulation of the industries and other development activities' discharge permit. • Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes. • Promulgation of standard limit for discharging and emitting waste and, • Formulation and declaration of environmental guidelines. This Act has established the Department of Environment (DoE), and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about environmental pollution. According to this act (Section 12), no industrial unit or project shall be	The ESIA study is prepared following guidelines of this Act. In accordance with the Act, the IWT project will need DoE's clearance prior to the commencement of the project. Also the Ecologically Critical Areas, defined by DoE under this act, will be considered while planning and designing of the project interventions. In connection with the project particularly construction of terminals on the bank of Buriganga at Sadarghat and Sasan ghat DoE,s opinion was solicited by the Consultant DoE informed that such development intervention can not be stopped even the river is considered as

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE. The amendment 2010 provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to affected person.	ECA. However, there shall be detail EMP in place for managing solid and liquid wastes at the terminals.
Environment Conservation Rules 1997 and Subsequent amendments (2002 and 2003)	The rule among others categorizes the industries and projects into four categories. As per ECR 1997, the project falls under Red Category needing detail EIA to obtain environmental clearances from DoE prior to commencement of any physical activities. Under the Rules, the following aspects, among others, are covered. • Declaration of ecologically critical areas • Procedures for issuing the Environmental Clearance Certificate (ECC) • Determination of environmental standards. The Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA 1995. It empowers the Government to declare an area 'ECA', if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall not be carried out or shall not be initiated in the ecologically critical area. The Rule 7 classifies industrial units and projects into four categories depending on environmental impact and location for the purpose of issuance of ECC. These categories are: Green, Orange A, Orange B, and Red. All existing industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under "Green" and shall	The EIA report is prepared in consideration of the procedure set in this rule.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	be granted Environmental Clearance. For proposed industrial units and projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of industries has been given in Schedule-1 of ECR'97. Apart from general requirement, for every Red category proposed industrial unit or project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) based on approved terms of reference (ToR) by DoE, Environmental Management Plan (EMP). As per ECR'97, water resources development projects fall under 'Red' category project. Therefore the project is 'Red' category project which requires IEE, EIA and EMP for environmental clearance from DoE. The rules however provide the Director General a discretionary authority to grant Environmental Clearance to an applicant exempting the requirement of site/location clearance, provided he considers it appropriate. [Section 7(4), 2nd Paragraph, Page 3105 of the Bangladesh Gazette of 27 August 1997].	
National Water Policy, 1999	The policy aims to provide guidance to the major players in water sector for ensuring optimal development and management of water. The policy emphasizes efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. It also addresses issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation and water need for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc. The policy has several clauses related to the project for ensuring environmental protection. Some of the relevant clauses are: Clause 4.9b:Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.	A number of clauses of this policy are applicable to the project as the dredging operation will affect water quality including change in aquatic habitats. The proposed interventions are designed and implemented with due consideration of the relevant clauses of the policy.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	Clause 4.12a: Give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan (NEMAP) and the National Water Management Plan (NWMP). Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time.	
National Water Act, 2013	The recently published Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. In general, if one takes a critical look at the Act, the new law has provided the right framework for better management of water resources in the country. As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. The private landowners will be able to use the surface water inside their property for all purposes in accordance with the Act. A worthwhile initiative is the requirement for permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks. However, the maximum amount of surface water or groundwater that can be withdrawn by individuals or organizations is not mentioned in the Act. Setting up a priority order for water usage in an area where the water resources is in critical condition is also a significant step.	The Act is considered relevant as the intervention involves improvement of navigability of the major water ways in the country. The ESIA study is conducted in consideration of relevant section of the Act.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
The National Environment Management Action Plan (NEMAP, 1995)	NEMAP, 1995 identifies the main national environmental issues, including those related to the water sector. The main water related national concerns include flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion; various specific regional concerns are also identified.	Relevant section of NEMAP is complied with in design and implementation of the project.
Bangladesh Environment Court Act, 2010	Bangladesh Environment Court Act, 2010 has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. This act allows government to take necessary legal action against any parties who creates environmental hazards/ damage to environmentally sensitive areas as well as human society.	According to this act, government can take legal actions if any environmental problem occurs due to project interventions.
The National Land Use Policy (NLUP), enacted in 2001	The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may be not possible through artificial land reclamation process, which is cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained.	The project intervention is designed adhering to the NLUP so that there is no and/or minimal change.
The National Water Management Plan (NWMP) 2001	The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions to establish an integrated development, management and use of water resources in Bangladesh over a period of 25 years. Water Resources Planning Organization (WARPO) has been assigned to monitor the national water management plan. The major programs in the Plan have been organized under eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs, and a total of 84 sub-sectoral programs have been identified and presented	The project ESIA study is conducted with due consideration of NWMP sub-sector clusters i), iii) and viii).

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	in the investment portfolio.	
Coastal Zone Policy, 2005	Coastal zone policy initiated as a harmonized policy that transcends beyond sectoral perspectives. The policy provides general guidance so that the coastal population can pursue their livelihoods under secured conditions in a sustainable manner without impairing the integrity of the natural environment. The policy framework underscores sustainable management of natural resources like inland fisheries & shrimp, marine fisheries, mangrove and other forests, land, livestock, salt, minerals, sources of renewable energy like tide, wind and solar energy. It also emphasizes conservation and enhancement of critical ecosystems.	In line with this policy the operation is conducted with minimal disturbance to the natural resources (benthic species, inland fisheries & shrimp, marine fisheries, mangrove forest, etc.) in the coastal area with fragile ecosystem. The ESIA has been prepared with due note of this policy.
Dredging and Dredged Material Management Policy, 2013	Government introduced the Policy 2013. Salient instructions, among others, relevant to dredging are: Project has to be formulated after identifying location of dredging and location for disposal of dredged materials. In dry season, dredged material shall not be disposed into flowing water. However, in south and southeast region, where tidal influence is very strong, material can be discharged into the river based upon recommendations from proper study. In rainy season, material may be disposed into river flow based on proper study of hydro-morphological considerations. 6.1.11 the following information will be required before the dredging program implementation related to the navigation: a) The goal of dredging works; b) River section by hydrographic / bathymetric survey; c) The location of dredging area; d) The amount of dredging works highlighting the river section by hydrographic / bathymetric survey;	The policy is relevant to the study in question. The ESIA study is conducted by considering salient contents of relevant sections particularly Sections 6.1.11, 7 and 8 of the policy. A meeting was held with DoE, BIWTA and Connsultants on February 3, 2016. Director Natural Resources Management and Research, chaired the meeting. In response to the queries of BIWTA Consultant regarding disposal

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	e) The distance between the dredging site and the dredged material disposal; f) The timing / period of conduct of dredging program; g) The information from the study of adverse effects on the environment or ecology due to dredging; h) The mitigation measure on the reduction of the adverse effects on the environment and the ecology. 8.0 Dredged material management: 8.1 Before starting dredging operation, proper planning, implementation technique and methodology are to be determined. 8.2 Provision for maintenance dredging is to be kept with its management. 8.3 For management of dredged materials following factors are to be considered: i. Objective of dredging; ii. Type and quality of river bed materials; iii. Size of river; iv). River bank and flood plain Characteristics; v). Demand for use of dredged material; vi) Quality of dredged material According to the policy dredged materials (soil, sand, sediment, etc.) from rivers can be disposed at specified locations for developing lands, urbanization, creating tourist areas, constructing dams and roads, exporting abroad to earn foreign currency, etc. 8.4 Conditions on temporary stockpiling: No agricultural land can be used for disposal of dredged spoils, dredged materials can be dumped in shallow places of river upon technical considerations and connections to link *khals* cannot be disrupted. 8.5 Conditions on permanent stockpiling: Best way of	of dredge materials, the director opined that in stream disposal to scour holes along the Lower Meghna is allowed subject to monitoring of impact on aquatic habitat and river morphology. He also emphasized that dumping of dredged materials shall avoid ponds, wetlands, etc, In case of on land disposal preference for beneficial use is to be given and nonarable khash land is to be used for piling dredge materials.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	management of dredged materials is to fill up low land following Conservation Act 2000, ensure use along with dredging, and arranging piling on government *khas* land.	
Inland Water Transport Policy (IWTP), 2009	The objective of the IWTP is to revive inland waterways traffic. This policy for IWT development has direct bearing on overall improvement of BIWT sector including dredging navigation routes, provision of inland port facilities and navigation aids, conducting hydrographic survey, vessel development, etc. The salient points of IWT Policy are: Inland Waterways Network: For this to be achieved, waterways shall be re-classified. In short term however, a core waterways network shall be identified to keep existing infrastructure and facilities running. Inland River Ports and Launch Landing Stations: More investments shall be made in ports and landing stations to make IWT more attractive and efficient. Proper passenger and cargo infrastructure and facilities shall be developed or augmented; accesses by roads shall be provided so that multi-modal traffic is ensured; waterways access shall be improved to reduce congestion at the berths; mechanical handlings shall be introduced to enhance efficiency and increase turn-round of vessels; and provide secured operational areas by security walls in order to improve passenger and cargo handlings. Network Maintenance: Funds shall be required to be committed by the Government only to maintain existing navigational asset. Hydrographic surveys shall be required to be carried out regularly to assess condition of waterways network and identify channels needing dredging works. Safety: Special focus is to be given on accident prevention, largely in the areas of inspection and	The proposed interventions are is in line with the project. Compliance to the policy is addressed properly in the EMP Section of the ESIA and proper monitoring arrangement by the project proponent is ensured in the study.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	enforcement. Design of vessels and construction shall be checked stringently. Institutional Issues: Considering transport sector as a whole, adequate government support in decision making and prioritization shall be given to IWT mode not only to maintain its present level of services but also to make improvements.	
Inland Shipping Ordinance 1976 and Inland Shipping (Amendment) Act 1990	Deals with the administration, registration, competency and pollution control, etc., of inland water transport. Primarily addresses pollution in the coastal and national waters and seaports of Bangladesh. The Act provides control for oil or pollutants discharged, spilled or dumped into Bangladesh water from ships, ship transfer to land, land, ports, exploration of the sea bed, pipelines and offshore installations.	The proposed intervention has close relationship with the ordinance and Act. EMP section of the ESIA has addressed relevant issues and BIWTA is committed to ensure proper compliance to these through proper monitoring arrangement.
Draft Rules for Inland Ship Safety 1994	The proposed Rules control impacts from all inland water transport, ports, ship-related facilities, and ship related activities for the protection of inland water in regard to air emissions, handling and storage of harmful materials, solid and liquid waste discharges, dredging, and disposal of dredged sediments.	The major activities of proposed interventions are in line with the rules and are addressed in the EMP.
Bangladesh Labour Act 2006	The Act provides the guidance of employer's extent of responsibility and workmen's extent of right to get compensation in case of injury by accident while working. Provides for safety of work force during construction period.	This act is relevant to the project intervention as there will be involvement of skilled and unskilled labour in operation and management of dredged spoils. The

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
		EMP is prepared to address relevant section of this Act.
Land Acquisition and Requisition Ordinance 1984	This Ordinance governs acquisition and requisition by the government of immovable property for any public purpose or in the public interest.	The project may require land acquisition and requisition for disposal of dredged materials, development of vessel shelters, etc. RAP will be prepared to deal these aspects.
The Bangladesh National Building Code (BNBC)	BNBC clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7, "In a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing."	The project will create facilities including construction of vessel shelters. These will involve construction of infrastructures. All civil construction works will be carried out following the BNBC Code.
National Agriculture Policy, 1999	This policy aims to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable and secure food system for all. The policy particularly stresses on research and development of improved varieties and technologies for cultivation in water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging and salinity and provide irrigation facilities for crop production.	The proposed project is expected to contribute to achieve the objectives of the agriculture policy by avoiding disposal of dredged materials on arable land and creating arable land by raising land level subject to quality of spoil material.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
National Fisheries Policy, 1998	The policy recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy suggests, among others, that biodiversity will be maintained in all natural water bodies and in marine environment and control measures will be taken against activities that have a negative impact on fisheries, resources and vice-versa. National Fisheries Policy focuses on aquaculture and marine fisheries development and includes the following mandates: (i) Maintaining biodiversity in all natural water bodies and in marine environment, (ii) Ensuring that chemicals harmful to the environment will not be used in fish shrimp farms; (iii) Using environment friendly fish shrimp culture technology; (iv) Expanding fisheries areas and integrating rice, fish and shrimp cultivation; (v) Undertaking control measures against activities that have a negative impact on fisheries resources and vice-versa; and (v) Formulating laws will to ban the disposal of any untreated industrial effluents into the water bodies.	This policy is relevant as the dredging activities involve major river system of the country, which are important fish feeding, breeding, spawning and migration routes. The proposed ESIA is conducted in compliance with the relevant directives including maintaining biodiversity in inland water ways.
Protection and Conservation of Fish Act, 1950 (Amended 1963, 1970, 1982, 1995, 2000)	This Act provides various measures for the protection and conservation of fish including specifying waters in which the catching of certain fish species is prohibited without a valid license, and specifying fish species of which the catching or sale in certain periods is prohibited; prohibiting the erection of fixed engines in rivers and canals; prohibiting the destruction of fish through the use of poison or explosives; and licensing and regulations with regard to frogs. In recognition that fish fry collection from nature may result in long term ecological destruction the government, in 2000, prohibited the collection of fry or post larvae of fish, shrimp and prawns of any kind, in any form and in any way, in estuary and coastal waters, diverting or blocking water flow that hinders fish movement/migration. The Rules contain a provision for conservation by empowering the government to declare any fish reserve in which fishing and any other detrimental activities can be prohibited.	Relevant as intervention area is located within Hilsha fish migratory route of the country. The project will be implemented with due care so that minimal/no damage occur to fishery for conservation of fishery resources. No intervention will be in place during Hilsha breeding periods.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
The Forest Act, 1927 and amendment1989	The Forest Act of 1927 as amended in 1989 grants the government several basic powers, largely for conservation and protection of government forests, and limited powers for private forests. The 1927 version of the act was amended in 1989 for extending authority over "any [Government-owned] land suitable for afforestation".	Relevant to the study in question. EMP is prepared in consideration of this Act.
Bangladesh Wildlife (Conservation & Security) Act, 2012 (previously known as Bangladesh Wildlife (Preservation) Order, 1973; amended as Bangladesh Wildlife (Preservation) Act 1974)	The previous Wildlife (Preservation) Order, 1973 & Wildlife (Preservation) (Amendment) Act, 1974 have been revamped to Wildlife (Conservation & Safety) Act of 2012. The Act has adopted new types of protected areas for conservation and protection of wildlife resources, created avenue for community conserved areas and also community based management of protected areas. This Act protects 1,307 species of plants and animals; and mandates imprisonment and fines for wildlife poaching, capturing, trapping, and trading. Bangladesh Wildlife (Preservation) Order (1973) and Act (1974) regulates the hunting, killing,capture, trade and export of wild life and wild life products. It designates a list of protected species and game animals.	Relevant as intervention may affect wildlife habitation, obstruct movement. The EMP is prepared to address this aspect.
Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009	The Government of Bangladesh has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009. The BCCSAP is built on six pillars: i. Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services, including health. ii. Comprehensive disaster management to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities. iii. Infrastructure to ensure that existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructures (cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate	Relevant as the country particularly the project area is vulnerable to climate change effect. Proposed interventions are designed to address climate induced effect.

Policies, Laws and Regulations	Description (Policies, Laws and Regulations)	IWT Compliance
	change. iv. Research and Knowledge management to predict that the likely scale and timing of climate change impacts on different sectors of economy and socioeconomic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change. v. Mitigation and low carbon development to evolve low carbon development options and implement these as the country's economy grows over the coming decades. vi. Capacity building and Institutional strengthening to enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change. RMIP will contribute towards achieving the objective of pillars such as (i), (ii), (iii), (iv), and (vi).	
The Embankment and Drainage Act, 1952	Consolidates the laws relating to Embankments and drainage providing provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.	Disposal of dredged spoil may create drainage obstruction. So adherence to relevant section of the Act is addressed in the ESIA.

2.1.2 Compliance with DOE EIA Guidelines

Department of Environment (DoE) under the Ministry of Environment and Forest (MoEF) is the sole entity to issue environmental clearance to any Governmental, Non-Governmental or private Organization intending to develop a project or set up an industry. Environmental Impact Assessments (EIA) should be conducted before projects are undertaken.

All existing industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed industrial units and projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of industries has been given in Schedule-1 of ECR'97. Apart from general requirement, for every Red category proposed industrial unit or project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) based on approved terms of reference (ToR) by DoE, Environmental Management Plan (EMP). As per ECR'97, water resources development projects fall under ‘Red’ category project. Therefore, the project is also categorized as ‘Red’ which requires IEE, EIA and EMP for environmental clearance from DoE.

The ECR'97 describes the procedures for obtaining Environmental Clearance Certificates (ECC) from the Department of Environment for different types of proposed units or projects. Any person or organization wishing to establish an industrial unit or project must obtain ECC from the Director General. The application for such certificate must be in the prescribed form together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Challan in favor of the Director General. The fees for clearance certificates have been revised in 2010. Rule 8 prescribes the duration of validity of such certificate (three years for green category and one year for other categories) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity.

The Department of Environment may take up to sixty days to approve the ESIA and thirty more days to issue the Environmental Clearance, provided everything complies with the requirements (Figure 2.1**).** This may be quite a lengthy process if DoE uses the full extent of the time limits.

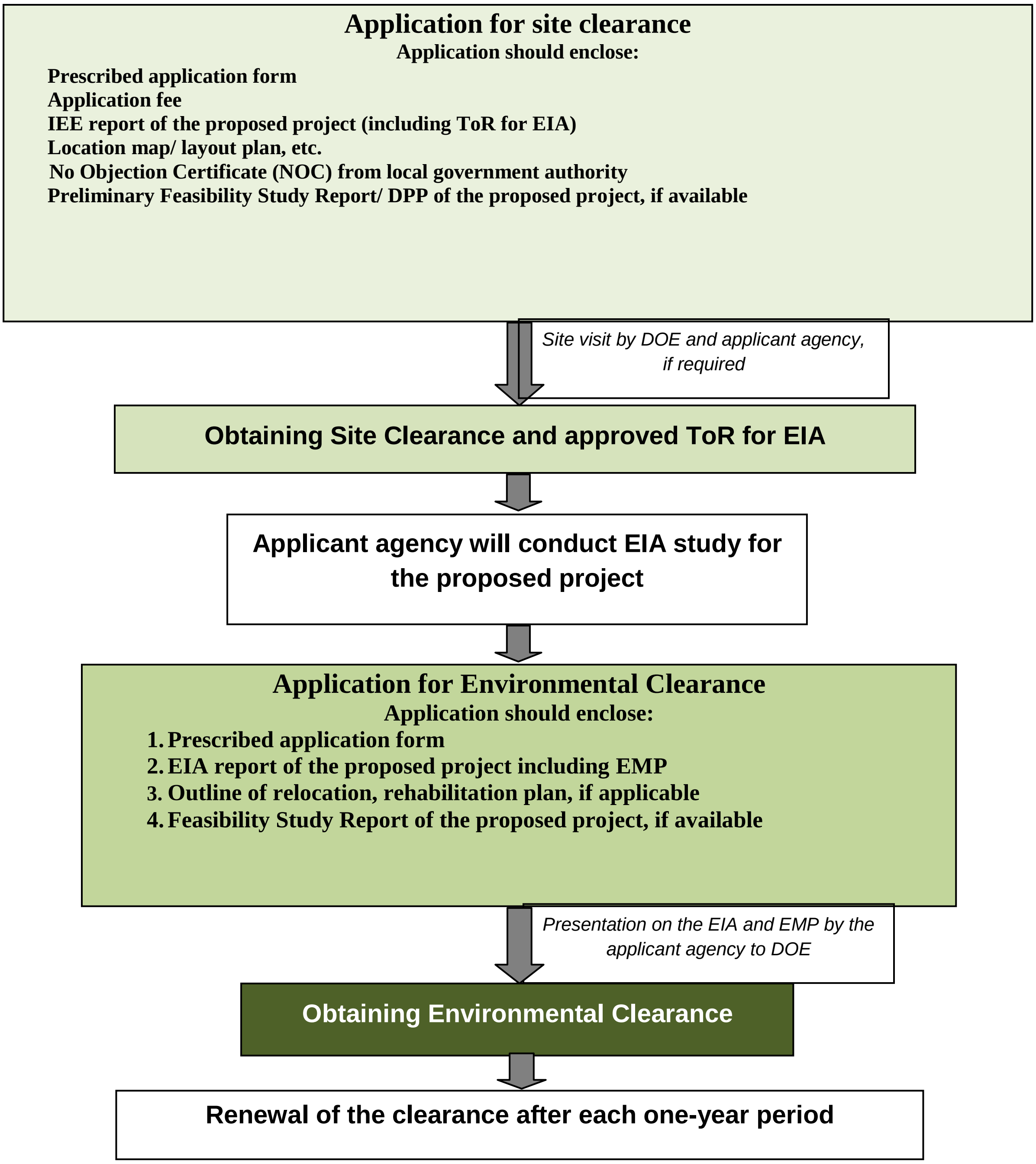


Figure 2.1: Process of Site and Environmental Clearance conform ECR 1997.

2.2 International Treaties

Bangladesh is signatory to several International conventions and treaties including MARPOL 73/78 (Prevention of Pollution from Ships), OPRC (Oil Pollution Preparedness Response and Cooperation) or the LC Convention 72 (dumping of ship wastes).The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) is subject to enforcement in Bangladesh marine and coastal waters. Therefore, ships in Bangladesh Ports are subject to inspection for the purpose of enforcing MARPOL 73/78. Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions is shown in Table 2.2.

Table 2.2: International Treaties, Conventions and Protocol

Treaty or Convention	Brief Description	IWT Compliance
London Convention	The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter1972, commonly called the "London Convention" or "LC '72" and also abbreviated as Marine Dumping, is an agreement to control pollution of the sea by dumping and to encourage regional agreements supplementary to the Convention. It covers the deliberate disposal at sea of wastes or other matter from vessels, aircraft, and platforms. It does not cover discharges from land-based sources such as pipes and outfalls, wastes generated incidental to normal operation of vessels, or placement of materials for purposes other than mere disposal, providing such disposal is not contrary to aims of the Convention. It entered into force in 1975. As of 2013, there were 87 Parties to the Convention. The London Convention consists of 22 Articles and three Annexes. The main objective of the London Convention is to prevent indiscriminate disposal at sea of wastes that could be liable for creating hazards to human health; harming living resources and marine life; damaging amenities; or interfering with other legitimate uses of the sea. The 1972 Convention extends its scope over "all marine waters other than the internal waters" of the States and prohibits the dumping of certain hazardous materials. It further requires a prior special permit for the dumping of a number of other identified materials and a prior general permit for other wastes or matter.	The Convention is indirectly relevant for the present ESIA as dredging operation is planned not only in the major river routes but also in the delicate coastal ecosystem of the country.

Treaty or Convention	Brief Description	IWT Compliance
	Since its entering into force in 1975, the convention has provided a framework for international control and prevention of marine pollution within which the contracting parties have achieved continuous progress in keeping the oceans clean. Among its milestones are the 1993 ban on ocean disposal of low-level radioactive wastes and the resolutions to end the dumping and incineration of industrial wastes. The efforts of the Parties are supported by a permanent secretariat hosted by the International Maritime Organization (IMO). On 17 November 1996, a special meeting of the Contracting Parties adopted the "1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972" which is to replace the 1972 Convention, subject to ratification. In line with UNCED's Agenda 21, the 1996 Protocol reflects the global trend towards precaution and prevention with the parties agreeing to move from controlled dispersal at sea of a variety of land-generated wastes towards integrated land-based solutions for most, and controlled sea disposal of few, remaining categories of wastes or other matter. Among the most important innovations brought by the 1996 protocol is the codification of the "precautionary approach" and the "polluter pays principle." Reflecting these principles, the protocol embodies a major structural revision of the convention the so-called "reverse list" approach. Now, instead of prohibiting the dumping of certain (listed) hazardous materials, the parties are obligated to prohibit the dumping of any waste or other matter that is not listed in Annex 1 ("the reverse list") of	

Treaty or Convention	Brief Description	IWT Compliance
	the 1996 protocol. Dumping of wastes or other matter on this reverse list requires a permit. Parties to the protocol are further obligated to adopt measures to ensure that the issuance of permits and permit conditions for the dumping of reverse list substances comply with Annex 2 (the Waste Assessment Annex) of the protocol. The substances on the reverse list include dredged material; sewage sludge; industrial fish processing waste; vessels and offshore platforms or other man-made structures at sea; inert, inorganic geological material; organic material of natural origin; and bulky items including iron, steel, concrete and similar materials for which the concern is physical impact, and limited to those circumstances where such wastes are generated at locations with no land-disposal alternatives. In addition, the 1996 protocol prohibits altogether the practice of incineration at sea, except for emergencies, and prohibits the exports of wastes or other matter to non-Parties for the purpose of dumping or incineration at sea. The 1996 protocol has effectively moved the scope of the original London convention landwards, relating it to the policy and management issues of land as well as sea wastes disposal.	
MARPOL Convention	The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in	The Convention is in line with the study in question. Most of the Annexes of MARPOL is required to be observed by the project proponent strictly as per EMP recommendation advocating strict observance to this and other relevant Conventions as Bangladesh is a signatory to this Convention.

Treaty or Convention	Brief Description	IWT Compliance
	response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes. Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983) Covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003. Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983) Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992).	

Treaty or Convention	Brief Description	IWT Compliance
	Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003) Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land. Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988) Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics. **Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005)** Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy	

Treaty or Convention	Brief Description	IWT Compliance
	efficiency measures aimed at reducing greenhouse gas emissions from ships.	
Ramsar Convention	Protection of wetlands. Broadly applicable for wetlands in and around the project influence area.	The operation may affect wetland habitat. Mitigation measures included in EMP to address potential impacts on wetlands and associated resources as well.
Protocol on Waterfowl Habitat	Amendment of Ramsar Convention to protect specific habitats for waterfowl.	Broadly applicable for wetlands in and around the project influence area. Mitigation measures included in EMP address potential impacts on wetlands and associated ecological resources as well.
CITES Convention (Washington)	Ban and restrictions on international trade in endangered species of wild fauna and flora.	Not directly relevant to the the project intervention since the project does not involve in any international trade of endangered species of wild fauna and flora. General restrictions have however been included in the Environmental Code of Practice.
Prevention and Control of Occupational hazards (Geneva)	Protect workers against occupational exposure to carcinogenic substances and agents.	Compliance to this is taken care of in the EMP of the ESIA report due to the fact that interventions involve occupational risks to some extent.
Occupational hazards due to air pollution, noise & vibration (Geneva)	Protect workers against occupational hazards in the working environment.	Relevant as there will be pollution due to gaseous emission from dredging equipment, vehicle movement as well as noise Appropriate mitigation and protective measures have been included in the EMP and vibration.
Occupational safety	Prevent accidents and injury to health by minimizing	Broadly applicable to the project activities under the

Treaty or Convention	Brief Description	IWT Compliance
and health in working environment (Geneva)	hazards in the working environment.	project. Compliance is attached in the ESIA to ensure health and safety to workers through prevention of accidental risks. Appropriate mitigation and protective measures have been included in the EMP.
Occupational Health Services (Geneva)	To promote a safe and healthy working environment.	Broadly applicable to the project activities under the project. Compliance to this will be adopted as there will be involvement of both skilled and unskilled manpower. Appropriate mitigation and protective measures have been included in the EMP.
Bonn Convention	Conservation of migratory species of wild animals.	Broadly applicable to the migratory birds in and around the project influence area. Project activities are not likely to have any significant impacts on these species; precautionary measures have nonetheless been included in EMP.
Civil liability on transport of dangerous goods (Geneva)	Safe methods for transport of dangerous goods by road, railway and inland vessels.	Broadly applicable to transportation of substances such as fuels during the project construction phase. Appropriate mitigation measures are included in the EMP.
UN framework convention on climate change (Rio de Janeiro)	Regulation of greenhouse gases emissions (GHGs).	The study will take due care of the convention as the intervention area is located within climate vulnerable zone. Appropriate mitigation and protective measures have been included in the EMP to minimize emissions of GHGs.
Convention on Biological Diversity (Rio de Janeiro)	Conservation of bio-diversity, sustainable use of its components and access to genetic Resources.	The ESIA will be prepared addressing conservation of biological species as these are subject to be affected by the project intervention. Appropriate mitigation and protective measures

Treaty or Convention	Brief Description	IWT Compliance
		have been included in the EMP for the conservation of biodiversity.
International Convention on Climate Changes (Kyoto Protocol)	International treaty on climate change and emission of greenhouse gases.	The ESIA is prepared with due note to the Kyoto Protocol as the project interventions are in the climate vulnerable area. Appropriate mitigation and protective measures have been included in the EMP to minimize emissions of GHGs.

2.3 World Bank Safeguard Policies

2.3.1 Overview of OPs and Guidelines

The main purposes of the Bank's safeguard policies are to (i) avoid harm to the environment and affected people and provide affected people an opportunity to participate in the development process; (ii) improve project design and performance; and (iii) protect the reputation of the Bank. The current set of safeguard policies cover a broad range of topics from environmental assessment to natural habitats, forests, resettlement, and Indigenous Peoples and others. The policies are the reflection of international conventions and internationally accepted principles of good practice in project preparation and implementation.

Table 2.3 precisely presents World Bank Safeguard Policies and their applicability to the Project.

Table 2.3: World Bank Safeguard Policies and their Applicability to the Project.

OP Number	Brief Description	IWT Compliance
OP 4.01 - Environmental Assessment	The World Bank requires an Environmental Assessment (EA) for all projects proposed for Bank financing to ensure that these projects are environmentally sound and sustainable. The proposed BIWTA project is classified Category A, because of the scope of the expected impacts from dredging operation, river training, vessel shelter construction and operation, the impacts of land acquisition, and the expected impacts on the natural environment.	Triggered. ESIA has been prepared considering A Category project as per OP 4.01.
OP 4.04 - Natural Habitats	There are no designated conservation areas or nature reserves in the project area. However OP 4.04 does apply since the intervention area covers major navigation routes including lower Meghan and part of estuary which consists of natural char lands in the active Meghan floodplain, with typical floodplain habitats and breeding grounds that might be affected by the project.	Triggered. The ESIA report is prepared in consideration of all ecological sensitive areas. In addition, a biodiversity management plan is prepared as part of ESIA.
OP 4.10 Indigenous People	For purposes of this Policy, the term 'Indigenous Peoples' is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in	Not triggered. The social impact assessment of the Project indicates that

OP Number	Brief Description	IWT Compliance
	varying degrees:[1] • self-identification as members of a distinct indigenous cultural group and recognition of this identity by others; • collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories; • customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and • an indigenous language, often different from the official language of the country or region. The OP defines the process to be followed if the project affects the indigenous people.	there are no indigenous communities residing in the project influence area and therefore, no impacts on them are expected under the project. This has been confirmed in the selected reach where operation will be carried out under the proposed project. Therefore, this OP is not triggered.
OP 4.11 Physical Cultural Resources	The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below. [2] • The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage. • The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of institutions	Triggered. As part of the environmental and social assessment studies for the project, a full baseline assessment has been carried out, including consultations, to identify any physical cultural resources (PCR) in the project influence area. Though there are no identified PCRs located in the subproject sites which would likely be directly affected or displaced by proposed works, there could be chance finds. 'Chance find' procedures will be included in the EMPs for all works activities.

[1] Excerpts from the OP 4.10.WB Operational Manual. July 2005.

[2] Excerpts from the OPN 11.03.WB Operational Manual. September 1986.

OP Number	Brief Description	IWT Compliance
	entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs. • Deviations from this policy may be justified only where expected project benefits are great, and the loss of or damage to cultural property is judged by competent authorities to be unavoidable, minor, or otherwise acceptable. Specific details of the justification should be discussed in project documents. • This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.	
OP 4.12 - Involuntary Resettlement	The project may require land acquisition for management of dredged material handling as well as construction of vessel shelter.	Triggered. Separate social studies are carried out and resettlement action plans (RAP) is being prepared. These aim to minimize resettlement while offering adequate compensation or settlement alternatives in conformity with World Bank policies and Bangladesh law.
OP 4.36 Forests	This Policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. The Bank believes that forests are very much essential for poverty reduction and sustainable development irrespective of their location in the world. The Bank assists borrowers with forest restoration activities that maintain or enhance biodiversity and ecosystem functionality. The Bank also assists borrowers with the establishment and sustainable	Triggered. This OP is triggered since the dredging operation will be over a long period located in different reaches including coastal area having mangrove vegetation and social forestry. The ESMP section of the

OP Number	Brief Description	IWT Compliance
	management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services. The Bank does not finance projects that, in its opinion, would involve significant conversion or degradation of critical forest areas or related critical natural habitats. Furthermore, the Bank does not finance projects that contravene applicable international environmental agreements.	ESIA has dealt these aspects in the light of this OP. However, dredging operation will avoid any such environmental hot spot. Also disposal of dredged materials will not be considered on mangrove vegetation nor in social forest area.
OP 4.09 Pest Management	Through this OP, the WB supports a strategy that promotes use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. Rural development and health sector projects have to avoid using harmful pesticides. Other pesticides can be used, but only as an element of an Integrated Pest Management Plan (IPMP) that emphasizes environmental and biological controls.	Not triggered
OP 4.37 Safety of Dams	The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB finances.	Not triggered. This OP is not relevant since the proposed Project does not involve construction of dams.
OP 7.50 Projects on International Waterways	Projects on international waterways may affect the relations between the World Bank and its borrowers, and between riparian states. Therefore, the Bank attaches great importance to the riparian making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard. A borrower must notify other riparian of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections.	Triggered. This Policy is triggered since the navigation route include international waterway. However, as Bangladesh is the most downstream country of the Major river system, the proposed project is not expected to adversely change the quality or quantity of water flow to the other riparian countries.
OP 7.60 Projects in Disputed Areas	Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a	Not triggered. This OP is not triggered since no part of the Project influence area is located in any disputed territory.

OP Number	Brief Description	IWT Compliance
	proposed project is located is dealt with at the earliest possible stage. The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [3]	
BP 17.50 - Public Disclosure of Information	According to the Bank Policy as well as ToR obligation the EA should be made available to the public by disclosure at public libraries or other places accessible to project affected groups, including a Summary EA in the local language.	The ESIA and RPF documents have been disclosed in BIWTA web site and through public consultations at Ashuganj and Barisal. The ESIA and RPF reports are also disclosed in World Bank website. The ESA Executive Summary has been translated into Bangla and disclosed in BIWTA website and made available to local community at local BIWTA offices. During ESIA preparations several consultations meetings were held in the project area including a national workshop in Dhaka

3 Excerpts from the OP 7.60.WB Operational Manual. November 1994.

2.4 World Bank EHS Guidelines

IFC Environmental, Health and Safety Guidelines of World Bank Group is presented in Table 2.4.

Table 2.4: World Bank Environmental, Health and Safety Guidelines.

EHS Guideline	Brief Description	IWT Compliance
Environmental Health and Safety Guidelines	The Environment, Health, and Safety (EHS) Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or project by existing technology at reasonable costs.	These Guidelines will be applicable to the Project particularly with respect to air emissions, ambient air and noise quality standards, waste water quality, hazardous material and waste management, and occupational and community health and safety management.
Environmental, Health, and Safety Guidelines PORTS, HARBORS, and TERMINALS	The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. The EHS Guidelines for Ports, Harbors, and Terminals are applicable to commercial ports, harbors, and terminals for cargo and passengers transfer. Shipping (including repair and maintenance of ships), fuel terminals, or railways are addressed in separate industry sector EHS Guidelines,	Relevant as the project includes provision of improved navigation routes and terminal facilities. ESMP section of the ESIA report has been dedicated to mitigate adverse impact due to the proposed intervention.

	specifically the EHS Guidelines for Shipping, Crude Oil and Petroleum Product Storage, Railways, respectively.	
The EHS Guidelines for Shipping	The EHS Guidelines for Shipping include information relevant to the operation and maintenance of ships used for the transport of bulk cargo, and goods. Cargo handling, vessel maintenance, and other in-port activities are covered under the EHS Guidelines for Ports and Harbors while issues specific to the transfer and storage of bulk fuels are covered in the EHS Guidelines for Crude Oil and Petroleum Product Terminals.	Broadly applicable as the project provides improved navigation routes and terminal facilities. The EMP is prepared to address mitigation measures due to proposed interventions.

3 PROJECT DESCRIPTION

3.1 Background

3.1.1 Details of Dhaka-Chittagong Corridor

D-C corridor and adjoining routes under study are considered artery of IWT network. It is estimated that these routes generate more than 70 percent of total IWT output. Most of major inland ports namely Dhaka, Narayanganj, Ashuganj-Bhairabbazar, Munshiganj-Mirkadim, Chandpur and Barisal are located along routes under the present study.

A total of 80 way side landing stations were developed by BIWTA along these routes. With all these infrastructures and facilities accessibility to rivers for the purpose of transport has enhanced dedicated jetties and ware houses. Larger industrial units, power plants established along the banks of rivers in these routes depend almost completely on IWT for transportation of bulk raw materials required for industrial units. About 300 passenger launches with average capacity of 250 passengers are departing daily from Dhaka, Narayanganj, Barisal and other stations. While almost 300 launches arrive daily at those stations. Besides, state owned BIWTC has its passenger service. With all these, it can be estimated that these routes provide transit of 200,000 passengers daily. Cargo and passenger throughput in the following table (Table 3.1) in major four inland ports namely Dhaka, Narayanganj, Chandpur and Barisal along these routes will further describe the importance:

Table 3.1: Passenger and Cargo Throughputs of River Ports

Port	2011-2012		2012-2013		2013-2014	
	Passenger (in million)	Cargo (in million tonne)	Pass (in million)	Cargo (in million tonne)	Pass (in million)	Cargo (in million tonne)
Dhaka	19.05	6.00	21.11	6.70	20.55	7.53
Narayanganj	23.13	10.53	22.72	12.76	24.17	13.61
Chandpur	2.10	0.42	2.27	0.47	2.28	0.50
Barisal	5.75	0.60	5.81	0.66	6.47	0.68

Source: BIWTA.

3.1.2 Inflow of maritime transport

D-C corridor and adjoining routes connect maritime ports in Bangladesh. Chittagong, being the main maritime port shares more than 90 percent of international sea borne trade. Intermodal distribution of goods handled at Chittagong largely depends on this corridor under study.

Coastal and inland vessels transport imported goods from Chittagong to different destinations inland. Average number of annual sailings from Chittagong to different destinations mainly Dhaka-Narayanganj area is almost 18,000. Annual volume of carriage of goods is 22.45 million tonnes. These are mainly: clinker, urea, wheat, raw sugar, soya seed, coal, salt, feldspar, ball clay, gypsum, lime stone, slag, yellow peas, rock phosphate, soda, HR coil, billet, TSP, MOP and maize. These are dry bulk and about 70 percent of imports are transported by river. One vessel can load 1,300 tonnes on average and takes a steaming time of 36 hours to reach Dhaka / Narayanganj. Transport of POL and liquid bulk largely depends on this corridor. About 220 oil tankers with average capacity of 1,500 each provide services for transport of POL and liquid bulk. About 6.7 million tons of POL and 1 million ton of soya bean oil are transported inland by this corridor annually.

3.1.3 Trans- boundary inland navigation

There exists a Protocol between Bangladesh and India on Inland Water Transit and Trade envisaging utilization of river resources of both the countries for commerce between the countries and for passage of goods between two Indian places through inland waterways of Bangladesh. Since its signing in 1972, working of this Protocol continues without any disruption. Protocol decided eight routes including two dormant routes of Rajshahi and Dhulian. In the remaining six routes D-C corridor and adjoining routes are common. It means that the corridor and adjoining routes contribute towards sub-regional transport cooperation. This Protocol has two aspects: carriage of inter-country trade cargo and carriage of transit cargo. During recent years, volume of inter country trade cargo is growing fast. These are mainly fly ash required by cement manufacturers and other commodities like food grain, gypsum, slag etc. These are mainly low price goods in bulk coming from Kolkata to mainly Narayanganj. This is an one way traffic since Bangladesh has nothing in bulk to export to India. Most interesting matter in this regard is that Bangladesh vessels share more than 90 percent of total tonnage despite a provision of sharing of cargo on equal tonnage basis. Table 3.2 illustrates the growth of inter country trade cargo:

Table 3.2: Cargo of Bilateral Trade (in ton)

Year	Indian Vessel	Bangladesh Vessel	Total
2006-2007	-	8,81,011	8,81,011
2007-2008	1,900	9,94,345	9,96,245
2008-2009	-	9,30,094	9,30,094
2009-2010	-	12,77,436	12,77,436
2010-2011	12,697	14,24,176	14,36,873
2011-2012	55,558	14,29,443	14,85,001
2012-2013	39,256	15,07,357	15,46,613
2013-2014	18,953	19,12,622	19,31,575

Source: *Traffic Department, BIWTA*

Unlike bilateral trade, volume of cargo of transit traffic is significantly declining. This has the two following reasons:

i) Development of transport infrastructure in the chicken-neck of India consisting of northern West Bengal and upper Assam.

ii) Problem of navigability in rivers of north-eastern Bangladesh, especially in the Kushiara. Table 3.3 will demonstrate current state of transit traffic:

Table 3.3: Volume of Transit Trade

Year	Volume (in tonnes)
2006-2007	12,557
2007-2008	8,230
2008-2009	14,628
2009-2010	4,474
2010-2011	590
2011-2012	2,695
2012-2013	18,685
2013-2014	2,373

Source: *Traffic Department, BIWTA*

3.1.4 Inland container traffic

Growth of international sea-borne trade depends mainly on intermodal distribution of goods handled at maritime ports. The main maritime port of Chittagong shares almost 90% of sea borne trade, is connected with Dhaka-Narayanganj area by these routes. Container traffic to and from Bangladesh is growing very fast. Of the total containers handled at Chittagong Port, 70% are destined for or originating from Dhaka-Narayanganj area. To meet the growing demand of container traffic, utilization of this corridor to full extent is inevitable. Railway suffers from capacity constraint and road does not have the bearing capacity to accommodate trailers. So, all the studies conducted recently recommended inland waterways to this end. An inland container terminal has already been developed at Pangaon, Dhaka by BIWTA. The most positive aspect in container traffic is that substantial interest of private sector has been manifested in development of infrastructure. At this moment, constructions of four river side container terminals in and around Dhaka-Narayanganj are nearing completion. As such, one of the main factors for revival of IWT in near future would be container traffic in this corridor. At the outset of sub-regional cooperation and understanding, these routes will also accommodate goods to and from the region beyond the border. To this end, construction of a multi-purpose inland container terminal under the Indian credit line is underway.

Projection of IWT container traffic by Pacific International, Japan

The Pacific International, Japan conducted Techno-Economic Feasibility for a Deep Sea Port in Bangladesh in 2009 wherein the following projection was included;

- 2020: 3.33 million TEU
- 2035: 8.52 million TEU
- 2055: 19.62 million TEU
- Modal split in IWT: 38%
- Vessel requirement: 55 in short term, 152 in mid term and 305 in long term.
- IICD requirement: 5 in short term, 10 mid term and 24 long term.

3.1.5 Need for maintenance dredging

Rivers in Bangladesh are deteriorating. Navigability is reducing and modal share of IWT in transport is declining. Road cannot meet growing transport demand resulting congestion, accidents and unmanageable maintenance of road. Even with rapid expansion, road will not be able to meet growing demand of trade and commerce.

Most of the recent studies on transport sector in Bangladesh recommended revival of IWT to meet growing demand. Bangladesh is proceeding gradually from lower middle income country to be an upper middle income country by 2021. To this end, facilitation of trade and commerce is. And for the growth and facilitation of trade an efficient multi-modal transport network is the main pre requisite. Only revival of IWT may ensure such efficient and cost effective network.

Being the main artery D-C corridor cannot demonstrate efficiency in terms of efficient navigation. Existing navigational quality does not ensure uninterrupted navigation. Vessels are to wait for high tide or to plan navigation adjusting time of high tide at different hot spots. In both cases, cost and time of transportation increase. Groundings of vessels and subsequent accident have become more frequent. Users lost confidence on IWT and looking for modal shift.

In view of the above, maintenance of waterways is inevitable. Smooth and sustainable navigability in D-C corridor and adjoining routes under study can ensure revival of IWT. Maintenance of fairways will ensure sufficient water at all seasons and more water in rivers will ensure better eco system.

3.2 Project Description

The Project will provide US$360 million in IDA funds to finance interventions aimed at improving IWT for cargo and passengers along the heavily-trafficked Chittagong-Dhaka-Ashuganj river routes, and in so doing, stimulating traffic growth on the waterways and away from the already heavily congested roads along these routes. These fall under the jurisdiction of the Bangladesh Inland Water Transport Authority, a Government authority mandated to oversee sector development. Main interventions include: navigation channel maintenance and improvement; navigation safety improvements; the construction, rehabilitation, and modernization of select river terminals; development of River Information Systems; institutional capacity development; and, funding for research and development to enable continuing sector improvement and sustainability. This includes work on sector policies and strategies needed to: improve revenue collection and management; incentivize public and private sector investments especially related to container transport; and, mitigate and improve IWT's impact on the social and physical environment. The Project consists of three components as follows:

Component 1: Improved Inland Waterway Navigation (IDA financing: US$235 million). This component shall include work to guarantee advertised depths and widths of navigation channels on select river routes. The work also includes provision of aids to navigation. The work is to be done on an Output- and Performance-based Contracting method designed to increase the efficiency and effectiveness of river asset management and maintenance. It is designed to ensure that the physical condition of the rivers under contract are adequate for the need of river users, over the entire period of the contract which is six to seven years. This type of contract significantly expands the role of the private sector, from the simple execution of works to the management and conservation of river assets. This is a departure from the traditional river maintenance contracts used in Bangladesh which have been less-than-optimal. Even where works have been carried out according to plan, the nature of the rivers has meant that advertised depths, aids to navigation and other river infrastructure do not last as long as they should because of deficiencies in the original design, aggravated by inadequate maintenance. The beneficiaries of the new concept are expected to be the river users. In a wider sense, future generations will be able to benefit from a better maintenance of past investments. River users will be able to know the Service Level they can expect in return for the payments they make for the use of the infrastructure (tolls, tariffs, user fees, taxes, etc.). The River Administration shall also benefit by obtaining better overall river conditions with reduced levels of expenditure.

Also included in Component 1 is work to provide safe harbors (storm shelters) whereby users can seek shelter from stress of weather in the Meghna Delta area during tropical cyclones. The Bay of Bengal is responsible for the formation of some of the strongest and most destructive tropical cyclones in the world. Adverse wave conditions, heavy rainfall and associated storm surges from these cyclones are a major cause of loss of life and infrastructure damage in the maritime delta area. With projected climate change, these effects are likely to intensify in coming decades. It is intended that the storm shelters shall be constructed under the same Output and Performance-based Contractor, using dredged material as a resource. Among others, this component will finance the following activities: (i) bathymetric and other surveys to determine the extent and types of dredging required, river training, environmental protection or other works; (ii) visual aids for day and night navigation such as light buoys, radar beacons, leading lines and other aids; (iii) limited and selected performance-based dredging to guarantee Least Advertised Depth; and (iv) development of six vessel shelters within cyclone prone areas along project routes equipped with mooring buoys to ensure safety for the vessels.

Component 2: Improved Services at Priority Inland Waterway Terminals and Landing Ghats/Stations (IDA financing: US$75 million). This component supports the development of two cargo terminals, four passenger terminals and 14 landing ghats/stations. The development of passenger and cargo terminals are within existing inland waterway port areas under the jurisdiction of BIWTA. It includes the modernization and extension of existing facilities to cater for increased demand. Terminals and landing stations are part of the network of about 448 river terminals, 374 landing stations, 23 coastal terminals and 25 pilot stations already provided by BIWTA. The passenger terminals and landing stations will specifically incorporate the needs of women users and less abled users, and all investments will address safety-related issues for all users. Specifically, this component will finance the following:

The cargo terminals include: (i) extension of the existing Pangaon Container Terminal with new general cargo vessel berths and land access infrastructure on the Buriganga river; and, (ii) rehabilitation and modernization of the existing general cargo terminal at Ashuganj including river bank erosion prevention, the replacement of pontoons, gangways and other dilapidated marine structures, the extension of berthing space

The passenger terminals include: (i) construction of a new passenger terminal at Shashanghat, downstream of the existing terminal at Sadarghat where landside congestion preclude the development of additional berths; (ii) rehabilitation works for the passenger terminal at Narayanganj; (iii) rehabilitation of works for the passenger terminal at Chandpur; and, (iv) extension of the existing passenger terminal at Barisal

Rehabilitation works or new construction of 14 landing stations or launch ghats under this Project are designed to provide access for rural communities, some of which in the lower Meghna delta have no alternative means of transport.

Component 3: Institutional Capacity Development and Sector Sustainability (IDA financing: US$50 million). A series of activities are proposed that will support BIWTA's overall enhancement of its management systems and human resources capacity for modern, efficient, and high quality management of the IWT sector in line with international standards, and to help BIWTA achieve long-term operational and financial sustainability. Activities to be supported include: (i) the development of River Information Systems to help BIWTA improve data collection for the planning, maintenance and development of IWT, as well as enhance climate resiliency of the IWT sector in Bangladesh by creating a more systematized baseline understanding of river hydrology and navigational implications, and provision of a Traffic Monitoring System for passengers and cargo; (ii) improvement of Human Resources capacity for better management of the IWT sector through upgrading and modernizing the IWT Deck and Engine Personnel Training Centre (DEPTC)) into a regional IWT Training Center with open access to all users in the Region and the world; (iii) a project preparation facility to finance feasibility, surveys, design and safeguards studies for continuous sector development; and, (iv) support for the Project Implementation Unit.

3.2.1 Project Development Objectives

The Dhaka-Chittagong river corridor and stemming-out route connecting Barisal is the country's prime IWT route that carries around 80% traffic. On the one hand realizing its importance in the role of mass transport of the country, on the other hand reducing the pressure on the Dhaka-Chittagong road and rail transport, the government has set a priority of enhance and improve this Class I route and also to upgrade associated routes from Class II and III to Class I.

The project development objective, therefore, is to increase the capacity, reliability and safety of inland water transport in the said routes. Besides, importantly, the activities are intended to attract more private sector investment in IWT sector, and country boats and vessels in inland transport. However, these huge works shall be accomplished in two phases. In the first phase the earlier four will be dealt with. As approach of maintenance work, the project aims to pilot a new approach and that is - it will employ a performance-based contracting modality to carry out the works, and hence the contractor shall be engaged on a relatively long term period (proposed 6 years) and they will be paid based on satisfactory performance to be determined by continual maintenance of specified river depths.

The proposed activities may produce considerable environmental and social impact in the future. The project is to be financed by the World Bank and implemented by BIWTA, government of Bangladesh – both have environmental and social guidelines regarding impacts. With this end in view for the project components taken in the first phase, this Environmental Impact Assessment and Social Impact Assessment study are being carried out under a set of terms of references. The main object of the study as set out in the TOR is to accomplish comprehensive EIA and SIA. Among others, this ESIA study shall prepare Environmental Management Plan (EMP) and Resettlement Policy Framework (RPF) in carrying out maintenance dredging work, spoil management along the routes, ferry crossings, and activities involving construction and maintenance of vessel shelters.

Expected output and outcome

Output of the project will be reflected a great increase of movement of passengers and goods in D-C corridor and adjoining routes under study. At the same time larger transport output in these routes will influence IWT output in other routes also.

As regard to passenger movement between Dhaka-Narayanganj area and the greater southern region, the Padma Bridge is considered to be the great threat. The Padma Bridge may not reduce the cost of transport by road to and from southern and other districts, but will certainly reduce transportation time substantially. And if, the state of navigation remains the same passenger movement in IWT will experience a sharp decline with the implementation of the Padma Bridge. But if the navigability improves with implementation of D-C corridor and other routes Project, IWT will remain competitive with road in terms of time and attractive in terms of cost. As such, IWT will contribute larger output in passenger-km. Unlike passenger movement, passenger movement in IWT has not any threats from competing modes of transport. Even with implementation of current projects road and rail will not be able to meet the growing demand of transport demand for freight movement. Rather, IWT has got considerable strengths and opportunities. Strengths are: natural advantage, linkage with India, choice of poor people in respect of cost, comparatively attractive for bulk and container traffic etc. While opportunities are: commitment of the Government to combat deteriorating rivers, environmental advantage in respect of carbon emission, dominating and growing private sector participation, development of river side container terminal, increased bilateral cooperation in respect of trans-boundary inland navigation.

As maritime ports have no other alternatives but to depend on inland waterways for growing demand of international sea-borne trade, IWT in Bangladesh will experience increased output in ton-km in coming years. When container traffic by inland waterways will be unlocked, modal share of IWT will rise comparatively. It is expected that modal share of container traffic to and from Dhaka-Narayanganj area by river may grow up to 45% in a period of five years.

Outcome of the project will be demonstrated in decreasing steaming time and decreasing time for turn around. These will enable vessels to increase capacity utilization and increase profitability. If current navigational problems remove and draft accommodation capacity of routes increases, transportation time will be reduced and higher economy of scale will be achieved.

3.2.2 Project Plan and Design : Project River Routes and Ferry Crossing

This project comprises with distinct physical components. These are i) Improvement of navigability of Dhaka-Munshiganj-Gazaria-Chandpur-Chittagong River route, ii) Three associated river routes: Munshiganj-Demra-Ghorashalriver route, Munshiganj-Ashuganjriver route, and connecting routes (emerged from Dhaka-Chittgong route) approaching to Barisal, iii) Three ferry crossing routes (Chandpur-Shariatpur, Lakhmipur-Bhola and Beduaria-Laharhat), and iv) Six vessel shelters on the threat of cyclones and norwesterly at proposed locations along the routes. As physical interventions, capital and maintenance dredging at selected locations for the said river routes for the earlier three components have been planned, and construction of vessel shelters for the last one.

Dhaka-Chittagong river route is 280 km long in which the length from Dhaka to Munshiganj is 30 km and from Munshiganj to Chittagong is 250 km. According to BIWTA route classification, the entire route is classified as Class I. Ghorashal extension route is 57 km long that contains River Class I and III (Ghorashal-Demra section is of Class III that is, under this project, planned to be upgraded to Class I). Ashugang extension route is 244 km long that contains river routes of Class I, II, III (Narshindi loop and Bancharampur loop). Barisal extension is 222 km long which is under River Class I (approach to Aat Hazar via Illisha in the Meghna River, and Aat Hazar to Jhalokathi in Bishkhali river), Class II (approach to Aat Hazar via Hijla), Class III (approach to Aat Hazar via Muladi). Bangladesh is crisscrossed by rivers which necessitate construction of bridges over the rivers to ensure uninterrupted transportation. Almost a dozen of bridges have been constructed over important rivers but still there are rivers flowing between road-heads and road vehicles have to depend on ferry vessels to cross the rivers. Three ferry crossing routes are taken under the project for obstacle-free movement. They are crossing between Harina (on the left bank of Meghna river under Chandpur) and Alu Bazar (under Shariatpur) across the Meghna River, between Maju Chowdhury's Hat (under Lakshmipur) and Illisha Launch Ghat (Bhola) across the Meghna River, and between Beduria (Bhola) and Lahar Hat Launch Ghat (Barisal) across the Tentulia River. BIWTA have been carrying out survey work for the purpose of this project. For all river routes and ferry crossings, therefore, locations of dredging in the river sections, its alignment, extent, depth of dredging, estimation of volume, and probable spoil management would be determined basing on the survey results. Dredging works along the main routes, three associated routes, across three crossings are broken into 18 work-items with two priorities – primary and secondary. Of them, the Dhaka-Chittagong main route, the Ghorashal-Demra route, the Demra-Munshiganj route, the Ashuganj-Munshiganj route, the approaching routes to AatHazar via Muladi, via Hijla. Via Illisha, and three ferry routes will get primary importance in survey and subsequent maintenance dredging. Initially BIWTA selected six locations generally with a view to developing safe vessel shelter facilities at Shatnol (under Matlab North Upazila), Amirabad (under Chandpur), Chandpur, Patarhat (under Mehendiganj upazila), Hatia, Sandwip. BIWTA is now actively considering the process of their development - their distribution along the main route, types of shelter, their detailed planning and design. The authority will get contributory input to this developing process towards finalization from the current ESIA study so that the benefits of the proposed shelters are optimized from safe sheltering point of view.

3.2.3 Proposed Interventions

Required Draft

Indicated draught for the Class I navigation route is 3.6 m (BIWTA Master plan, 1989). About 26 years has been elapsed after establishing the draught of 3.6m. Vessel with higher depth may have been introduced over this time. In view of this and to be in the safer side, required depth in the route could be maintained with 4.5 m.

Estimated Dredge Volume

Not all the paths along the navigation route will undergo dredging works. Only river/channel sections that contain areas of shallow depths, obstacles by bars, constrictions etc. shall be taken into consideration for dredging. However, actual location, extent, depth etc. will be determined after analyzing survey data. However, dredging length should not be more than 40 km. Last year (2014-2015) BIWTA performed maintenance dredging in the amount of 5 Mm^3 (see Table 3.5 below). Therefore, as maintenance dredging, annual volume as a whole should be around 6-8 million m^3.

Dredging intervention [as obtained from BIWTA]

Engineers responsible for navigation dredging in BIWTA were consulted for determining locations for dredging intervention in D-C corridor and adjoining routes under study. They do not have any updated survey nor any data for dredging interventions. However they shared and indicated some locations and indicative area of shoals. Such indications maybe seen in Table 3.4

Table 3.4: Locations of dredging intervention

Route /(River)	Number of shoal	Area of shoal
Laharhat-Bheduria (Tetulia)	3	1. Bheduria Ferry Ghat (1800mX35) 2. Sripur (700mX35m) 3. Laharhat channel (1500 m X 35 m)
Bhola-LAKHSMIPUR (Lower Meghna)	2	Ilisha Ferry Ghat _1500mX35m) 2.Moju Choudhurir Hat (2000X35)
Harina-Alubazar Ferry route (Meghna)	3	1. Alubazar Ferry Ghat (1000mX70m) 2. Lakhsmir Char (1000mX70m) 3.Confluence of Meghna and Lakhsmir Channel (1000mX70m)
Chandpur-Barisal (Meghna, Kalabadar)	10	1. Miarchar (1000mx70M) 2. Bhasanchar (1500mX70m) 3.Jalalpur (1500mX70m) 4.Char Bhairabi (700mX70m) 5. Tengramari (1200mX70m) 6. Charnainda (500mX70m) 7. Char Bogadia (500mX70m) 8. Bamnirchar (1500mX70m) 9. Pirerbari (500mX70m) 10.

		Sheora (600mx70M)
Barisal Port Area(Kirtan Kola)	1	Port basin (1000mX100m)
Hatia-Sandwip (Meghna estuary)	1	Char Nurul Islam (6000mX70m)

Source: BIWTA

Volume of dredging works performed by BIWTA in all routes may be taken into account to decide dredging interventions and volume. Table 3.5 illustrates total activities during last 10 years.

Table 3.5: Dredging Performed by BIWTA

Year	Maintenance (million m^3)	Development (million m^3)	Total (million m^3)
2005-06	2.23	4.249	6.479
2006-07	2.042	1.628	3.670
2007-08	1.407	1.718	3.125
2008-09	2.335	0.911	3.246
2009-10	3.492	0.504	3.996
2010-11	4.016	2.554	6.570
2011-12	4.361	2.447	6.808
2012-13	4.465	5.603	10.068
2013-14	5.790	4.702	10.492
2014-15	5.077	12.015	17.092

Source: BIWTA

For selection of locations for dredging interventions, dredging works performed by BIWTA at places in D-C corridor and adjoining routes in 2014-15 may be seen in Table 3.6

Table 3.6: Dredging locations and volume in D-C corridor 2014-15

Location	River	Target (million m^3)	Actual (million m^3)
Dhaka-Barisal route and Barisal Port area	Meghna, Arial Khan, Kirtankhola	0.350	0.279
Bhola-Lakhsmipur Ferry route	Meghna	0.300	_
Kanchpur Port area	Sitalakhma	0.200	0.004
Dhaka-Bhola route (Sripur, Bhederganj,Char Sivani)	Meghna, Tetulia	0.150	_

Mirkadim Port area and Gazaria under Munshiganj district	Dhaleswari	0.100	_
Laharhat-Bheduria Ferry route	Tetulia, Kalabadar	0.200	0.097
Chandpur-Barisal via Kaligangh	Meghna	0.150	_
Harina-Alubazar Ferry route	Meghna	_	0.368
Demra-Ghorashal-Polash	Sitalakhya	0.400	0/.117
Barisal Jhalkkathi-Barguna	Kirtankhola, Bishkhali	1.500	0.718
Dhaka-Chittagong	Buriganga, Meghna, Hatia channel	0.500	_

Source: BIWTA

The annual dredging volume over the years for maintaining the navigability of the navigation routes, ferry crossing of BIWTA. The dredging volume in the past, present and future for the navigation routes of BIWTA is presented in Table 3.7

Table 3.7: Past Present and Future dredging volume estimated by BIWTA

Programs	**Volume of Dredging (million m^3)**
Total Dredging (2014-15) in all the Navigation Routes	17
Yearly Maintenance Dredging	7-10
2015-16 Program	25

Source: BIWTA

The annual estimated dredging volume of the project routes is in the range of 6-7 million m^3. Analysis of bathymetric chart of 2015 shows there is a need of dredging in the navigation routes under this project. The dredging volume in the different rivers under the present project is presented in the Table 3.8

Table 3.8: Estimated dredging volume based on present bathymetric survey the navigation routes under the present D-C Corridor project

Route No.	Priority	Route Class	Channel width m (no slope)	Dredging depth m	Base Line Dredge Volume	Potential Annual Volume with 50% re-sediment rate	Potential Contractor Split (By Geographical Area)
1 & 2	**A**	1	76	-4.3	**37,500**	56,250.0	PBC-1
2 (South of Chandpur)	**A**	1	76	-4.3	**597,400**	896,100.0	**PBC-2**
3 & 4	**A**	1	76	-4.3	**22,600**	33,900.0	PBC-1
5	**A**	1	76	-4.3	**236,000**	354,000.0	PBC-1
6	**A**	1	76	-4.3	**-**	-	PBC-1
14	**A**	1	76	-4.3	**432,900**	649,350.0	**PBC-2**
18	**A**	2	76	-2.8	**1,000**	1,500.0	**PBC-2**
19	**A**	2	76	-2.8	**25,100**	37,650.0	PBC-1
20	**A**	2	76	-2.8	**387,000**	580,500.0	**PBC-2**
21	**A**	2	76	-2.8	**392,300**	588,450.0	**PBC-2**
22	**A**	2	76	-2.8	**396,500**	594,750.0	**PBC-2**
Sub-Total					***2,528,300***	**3,792,450.0**	
7&8	**B**	2	76	-2.8	**370,000**	555,000.0	PBC-1
12	**B**	2	76	-2.8	**152,800**	229,200.0	PBC-1
13	**B**	2	76	-2.8	**76,400**	114,600.0	**PBC-2**
13a	**B**	2	76	-2.8	**1,000**	1,500.0	**PBC-2**
Sub-Total					**600,200**	**900,300.0**	
9	**C**	3	30	-2.1	**126,800**	190,200	PBC-1
10	**C**	3	30	-2.1	**33,274**	49,911	PBC-1
15 & 16	**C**	3	30	-2.1	**607,500**	911,250	**PBC-2**
17	**C**	3	30	-2.1	**500**	750	**PBC-2**
Sub-Total					**768,074**	**1,152,111**	
TOTAL					**3,896,574.0**	**5,844,861.0**	

Note: Volume calculations estimated using BIWTA Multi Beam and Single Beam bathymetric data, Global Mapper software.

Locations of Vessel Shelters

Initially 6 locations were selected by BIWTA for vessel shelters, and they are broadly at, in the sequence from upstream to downstream, Shatnol, Amirabad, Chandpur, Mehendiganj, Sarikait in Sandwip, Nolchira in Hatia. The same selection but with a little variation is found on typical plan-layout of vessel shelter. They are Shatnol Nala (branch of the Meghna River), Amirabad Nala (the Meghna River), Dakatia River, Kaliganj, Hatia, Sandwip. Members of the study team (Syed Monowar Hossain and M. A. S. Sikder) held discussion meeting on distributing the shelters and selecting the location. The meeting decided to implement a shelter on Majer Char (opposite of Char Bhairobee in Haimchar Upazila) on the reason that Amirabad is close to Chandur, on the other hand, if at Amirabad, no sheltering provision do exist between Mehendiganj/Hijla and Chandpur where the section of the Meghna river is much stronger, wider, more exposed to cyclone, more significantly all passenger vessels from southern Bengal passes through this. The said members paid field visits with the company of BIWTA concerned officials at Shatnol, Chandpur, some places of river section between Shatnol and Chandpur, Barisal, Mehendiganj and river network around them for the purpose of selecting locations at Shatnol, Chandpur and Mehendiganj. BIWTA extended all out cooperation in every parts of the visits. During the visits they discussed with a number of Class I Masters of large passenger launch plying between Dhaka and Barisal, field personnel of Conservancy and Pilotage of BIWTA, local people, and held meetings with BIWTA officials of Chandpur and Barisal, also held meetings with some owners of passenger-vessels of Dhaka-Barisal navigation route and of other routes.

Shatnol as shelter location. Shatnol Nala (a branch of the Meghna River) can be deserved to be vessel shelter location. In comparison to choosing other point at Shatnol, the nala can be a better candidate since being a natural channel it can serve a natural harbouring, hence saving money and effort in its development as a safe vessel shelter. Shatnol as a location has many strategic importance. Firstly, it is hub for vessels coming down from Buriganga, Dhaleswari, Shitalakhya, Meghna and Gomti. Secondly, with respect time, many passenger vessels set for in the afternoon and reach Gazaria, Shatnol at late afternoon or at dusk. In norwesterly season there are chances of being caught by nor-westerly. In a short time the apprehending the potential danger can take shelter here at Shatnol vessel shelter. Thirdly, everyday huge number of passengers arrive here from Dhaka and other upstream locations by IWT and change their mode of transport by taking standard and non-standard road transport in reaching their destinations in Matlab, Chandpur, and adjoining area. They prefer such journey in saving their time.

Location of shelter at Chandpur. A bend area relatively shallow just upstream of the present ad-hoc Madrasa Ghat terminal on the left bank of the Meghna River could be selected/used as vessel shelter. There is an attempt by the government in developing and constructing a new port and terminal with sufficient facilities. Henceforth, the harbor can get the support of this port facilities. Again, Chandpur can enjoy additional facilities of existing new terminal on the right bank of the Dakatia River. This terminal appears to be in a good condition.

Note: Historically the river port for Chandpur was located inside the Dakatia River on the right bank near the railway station. This old port had fallen under severe attack and the most part of the facilities were engulfed by the river around 2002. Therefore, a new port was constructed afterwards a little upstream of the old terminal. Besides, at the same time another ad-hoc terminal was developed at Madrasa Ghat on the left bank of the Meghna River. The said new terminal on the Dakatia River was on usual operation except a few monsoon months (around July to September). During these monsoon months, until 2013, Madrasa Ghat terminal was used. However, the entire operation around the year was brought to the Madrasa Ghat terminal from 2014. Hence, existing terminal on the Dakatia River is no longer used. Again, however, it has very limited use by local small vessels. Also, this terminal is used by idle vessels to stay over and a kind of sheltering purposes.

Location around Hijla Bazar. In the attempt of selecting a point of location for safe vessel shelter between Majer Char and Barisal port, a point of location either adjacent to Hijla Bazar or between Hijla Bazar and northwest corner of Miar Char on the right channel of Miar Char (while going to Barisal) should be selected. Patarhat should not be the proper location since this is not the route of Majority of the vessels plying from southern Bengal towards Dhaka. Kaliganj should not deserve to be the candidate since it is out right on the Meghna River, entirely exposed to the Meghna River, channel remains very rough, bank has been retreating at an alarming rate. Mallikpur or nearby location should not be selected since it is nearby the Meghna River proper (so exposed to hazard). Moreover, importantly, vessels to-and-from Barisal/Bhola/Patuakhali/Barguna usually do not follow this path unless depth problem compels the driver to pass by Mallikpur. Vessels like to follow the river-path on the right side of the Miar Char (while going Barisal) past Dhulkhali Launch Ghat. Following Mallikpur route than Miar Char route do incur around half-an-hour time more in reaching Barisal. Miar Char channel needs to be dredged and can be given high priority among the dredging works in this project. Near Hijla Bazar is situated at a natural meeting point of four big channels, upazila is very nearby. There is an existing launch ghat. If Miar Char Channel is dredged, most vessels towards southern Bengal will pass by the Hijla Bazar. Therefore, as a location nearby Hijla Bazar should be the better option. This shelter can give multiple facilities i.e., by setting better landing facilities the place can be used as significant traffic transfer point. At the same time, the navigation people, passenger will get facilities of a upazila level location.

Location in Hatia. Nolchira is selected by BIWTA as a location for vessel shelter at Hatia. It is at the middle position of the north side of Hatia.

Location in Sandwip. Sarikait is selected by BIWTA as a location for vessel shelter at Sandwip. It is located on the south-west side of Sandwip.

The locations of required dredging along the routes are presented in the Figure 3.1 and the locations of vessel shelters are shown in the Figure 1.1

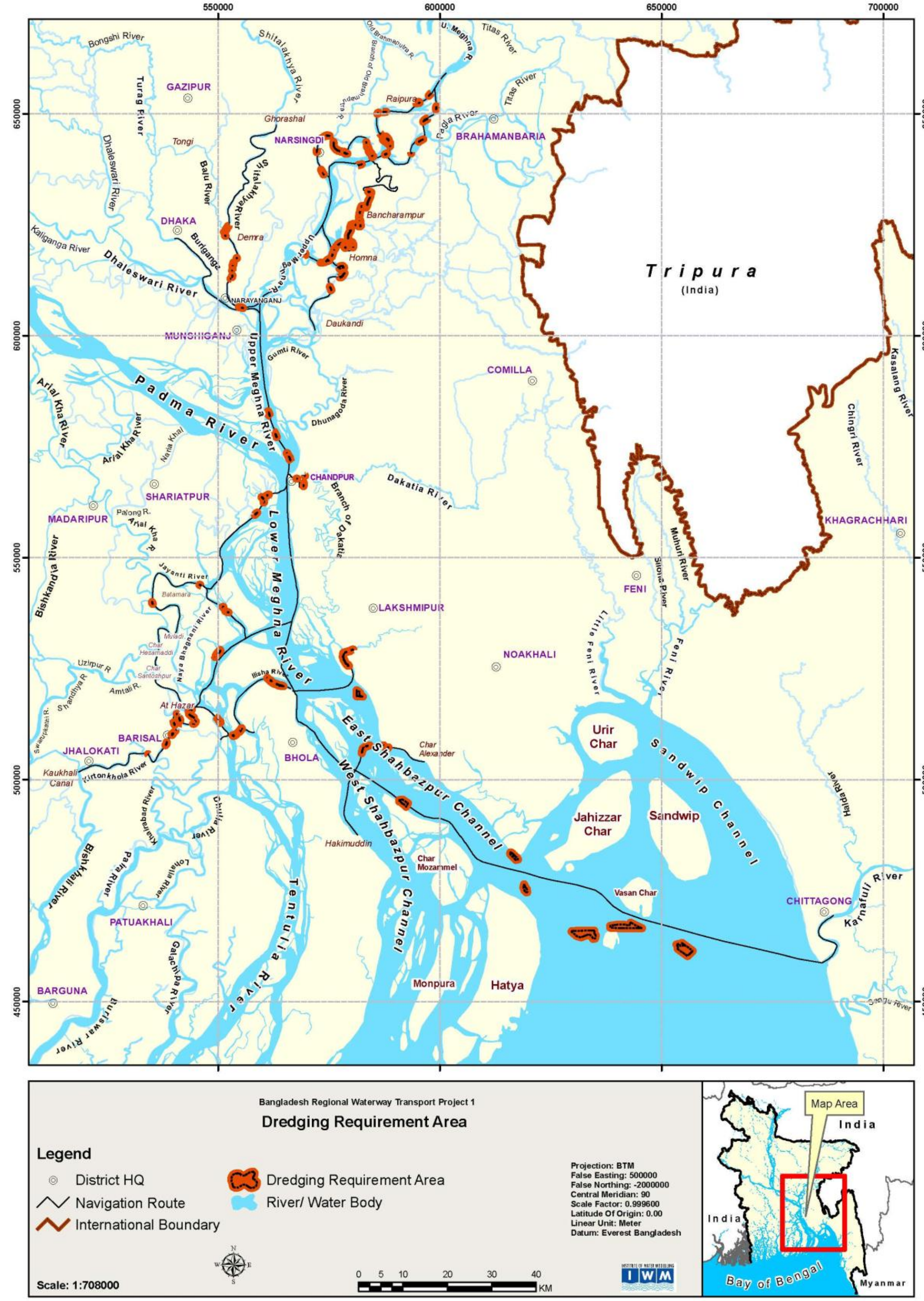


Figure 3.1: The locations of required dredging along the routes and vessel shelter.

Conceptual Design of Vessel Shelters

Under this project new vessel shelters will be established for the safety of vessel and passengers. In some sense it would, therefore, be interesting and challenging for BIWTA and concerned parties with respect to their development and construction. Towards objectives of real time risk mitigation and management for vessels plying through the routes under his project, a number of important issues/realities and considerations should be taken into account (but not limited to these only):

- The largest navigational route in terms of width, depth, current speed, involving coastal water, degree of exposure to southern wind, norwesterly, and cyclonic wind and surge
- Prime navigational route in terms of traffic volume, both passenger and freight, number of vessels, size of vessels, frequency of to-and-fro communications
- Design hazard/critical hazard: which one – nor-westerly or cyclone play role more in endangering the vessels. This should be the most important considerations, since observations on the past fatal disasters indicate that most major accidents occurred around Munshiganj, Gazaria, Shatnol, due to norwesterly.
- Direction and speed of wind
- Since question of saving of vessels, hence the traffic, as a type a kind of harbouring facilities must be there
- Inside harbour, point of across-berthing/anchoring or alongside berthing/anchoring. The final objective for an endangered vessel would be to stay along in an optimum alignment so that the vessel gets most stability and least wind thrust
- It is known that berthing/anchoring with a pantoon not actually safe since vessel may be destroyed, broken by repeated collision
- berthing/anchoring with a hardened bank by block-revetment or boulder work seems to be not safe at all, since vessel may be destroyed, damaged, broken by repeated collision
- Keeping safer distance apart from one vessel to another
- Most importantly, all 6 vessel shelters should not be in the form of same planning and design (type, size, components etc.), location specific criteria (orientation with river, chance of degree of danger, level of exposure, size of vessel) must be considered
- Open end or dead end. If designed newly a dead end harbouring facility can be designed depending on the physical orientation of the land and water situation around. However, any existing nala or branch of a river is selected where both ends be open. It is suggested to use natural channels/canals/branches wherever possible.
- Convenient approach channel to the vessel shelter, ample clearance in the rear-side for maneuvering so that other vessels already in the harbour do not get hampered, damaged

- Size of a shelter. As mentioned above, shelter might be variable in size. It has to be taken mind that as time passes bigger vessels are introduced than the previous ones. For example, Parabat 9 is now the longest passenger ship having length of around 95 m. Size should be such that at least 10 vessels of various sizes can take shelter at the time of danger.
- Fencing by thick tree planting. Encirclement of vessel shelter by planting such variety of trees that grow with thick bushes, firm roots, can also withstand against cyclone winds
- Road connection, where there is potential for transfer of passengers i.e., where possibility of multiple use
- In case of shelter at Chandpur, natural water-body near the left bank immediately upstream of present Madrasa ghat BIWTA terminal can be used as shelter, so constructing a separate additional harbour may not be necessary. But the area needs to be so improved that impart sufficient safe harbouring/ sheltering facilities.
- Multiple facilities. More facilities, where possible, apart from sheltering can be planned and designed so that the facilities of sheltering can be utilized during normal time. Such as, where there is traffic potential, a reasonable pontoon and other facilities can be developed so multiple benefits can be obtained.

Typical Plan for Shelter by BIWTA

A layout vessel shelter titled 'Typical plan for shelter at different station' is available with BIWTA having trapezoidal dimensions in which the length of parallel sides are 170m (landside) and 230 m respectively, and the length of two other lateral sides are 300m with two pontoons facilities, each with size of 30m*10m (Figure 3.2). A breakwater system is planned of 75m long in the middle of the entry of the sheltering water-area, with two opening of 77.5 m on either side of the rubber float/breakwater. Pontoon is planned with the objective of multiple/additional use of the facilities during normal time. As planned, the requirements are (as seen in the layout plan): land acquisition, excavation/dredging for navigation and basin, slope/bank protection, berthing facilities (spud, ram, gangway, pontoon), mooring facilities, breakwater system, approach road, attendant room, external and internal electric supply, water supply, water forecasting

It is to be noted that a couple of obvious weaknesses are:

- a unique design must not serve the purpose of all location
- orientation for a vessel with respect to shelter of entering, turning, staying, exiting etc. not clear
- a kind of traffic control/SOS facility is missing that appears to be essential, since still most of the vessels lack of such modern communication facilities.

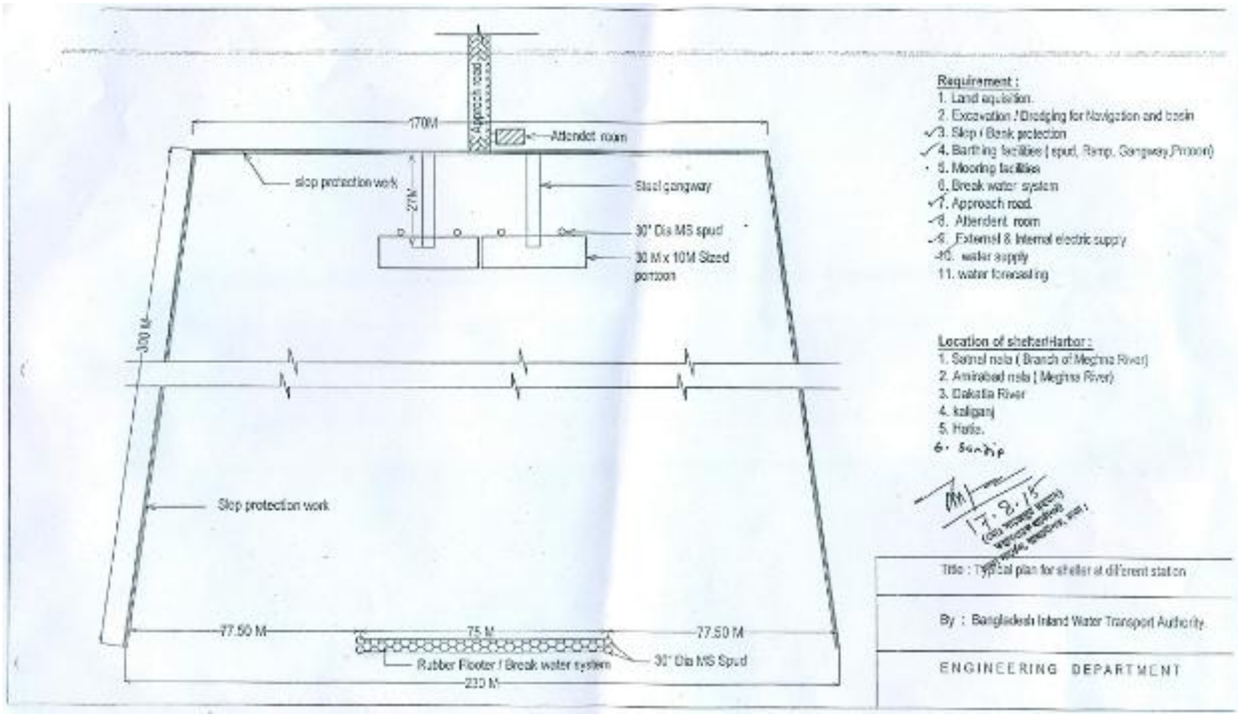


Figure 3.2: Typical layout-plan for shelter at different station by BIWTA

3.3 Implementation Methodology

3.3.1 Contracting Modality, Sequence of Construction

Contracting Modality

Basic Considerations on Modality of Contract for Maintenance Dredging

Performance-based contract. In contrast to traditional 'waterfall' approach, the contract mode should be performance-based, because it is a result-achieving contracting means that procurement organization definitely seeks in order to improve performance and lower the project cost.

Experience and resourcefulness of a contractor. In the effort of enlisting of dredging contractor attention and importance must be given to, among others, two principal qualities – experience and resourcefulness. Apart from enlistment of contractor, these criteria must be sought in preparation of bidding documents so that fit ones are screened in.

Experience with large alluvial rivers and coastal areas. In examining past dredging experience of a contractor, experience with large alluvial rivers where the river reach is very dynamic and sediment load and dynamics are huge and random.

Tenure of initial contract. Obviously, a huge endeavour and investment for a dredging company/contractor are involved in mobilization of resources and actual operations, as such tenure must be sufficient enough so that it should attract experienced and resourceful contractor. In the D-C corridor project, initial contract for the performance-based dredging it is suggestive that the tenure be of 5 (five) years.

Possibility of extension. If performed well with desired standard and BIWTA does require more services, the contract can be extended or revised on a yearly basis meaning from a year to another.

Multiple fitness criteria in bidding process. The bidding system must include two separate bids – 'Technical Bid' and 'Financial Bid'. Selection system should be such that a contractor has to pass through both of them. However, due weight must be given to technical resourcefulness in terms of qualified and experienced personnel, modern machineries and equipments, and sharp management.

Reach-wise/ route-wise contract. Not as a whole, contract and bidding can be made river reach-wise/ route-wise so as to create a competitive environment in participating dredging contract and practical dredging operations.

Mentioning appropriate time and duration of dredging work. Appropriate time of dredging work should involve such time in a year when rivers and estuaries lie on a considerably low stage.

Sequence of Activities involved in maintenance of navigation channel

- Since all the routes-along the river will not be dredged nor will a whole wide cross-section undergo as part of maintenance dredging, in the first instance, therefore, current and potential navigation channels/routes should carefully be indentified giving necessary wit. A morphologist can play a role.
- Then, depending on the routes draft requirements should be considered, identified.
- Then, when water recedes considerably, at the start of dry season or during dry season, for the purpose of coarse estimation of horizontal extent of dredging need, all sorts of obstacles – constrictions, inadequacy of navigation width, shoals, semi-submerged, submerged bars and islands should be identified. Concerned personnel in Conservancy and Pilotage Department (CPD) of BIWTA can play an important role here. They can provide suggestions-input into Hydrographic and Dredging Department of BIWTA. Also, when dredging is done by external agency (by outside consultants, and contractor), they can advise that agency with their regular experiences. Some types of identification marker can be put to demonstrate this 'coarse extent of dredging need'.
- Then, during a suitable time (dry period, avoiding monsoon and high stage, it is a matter of practical judgement), detailed survey work can be carried out over river reaches in which extent of dredging need already identified. Survey endeavour also be carried out over some shallow river reaches where there may be potential problems.

- Then, a survey data have to be analysed and results shall be made available.
- Then, hence final dredging locations, extent, depth, volume of dredging shall be quantified. Accordingly, a clear and practically useful dredging map shall be made available. This map shall guide the dredging work in the field.
- In parallel, along the routes, spoil management – whether rainbowing into the flowing water or transporting onto bank. When decision is made such that spoil should be placed on the land over bank, then a dumping and distribution plan have to be clearly chalked out. Also, a further use of spoil a plan can be made. This spoil management plan can go with the dredging map. Hence, both can work together. In this D-C corridor, it is suggestive that spoil should be dumped overbank instead of rainbowing into water.

Some important issues for effective dredging as follows:

In order to make the dredging endeavour practically effective, dredging operations shall be carried out in dry season when river-water stage is considerably low.

- Until next season of dredging is arrived, some form of monitoring and feedback can be sought from concerned CPD personnel at BIWTA and the practical users – masters, owners of vessels in the corridor and adjoining routes.
- Then, these feedback shall be brought into the considerations in order for preparing dredging-plan and activities. Again, steps as mentioned above should be followed.
- Selection of types of dredger which will be suitable for the D-C corridor project shall depend on, among others, the location of dredging, efficiency of dredger, spoil management plan etc., **Section 3.3.2** can be referred to.

Introduction of Performance Based Contract for Maintenance

In traditional contracting approach and methods, contracting focuses more on aspects of mile stone reporting, how works are done, completion of work steps in order to get certificate of completion and get payments from the procurement/contracting organization. The main disadvantage of this method of contract is that the target of the contractor is to completion of work and not achieving the real goals and objectives of the project for which the contractor was called for. In contrast to the traditional contracting method, contracting body should rather prefer performance based contract that is a practical action oriented contracting method which aims at quantity of outputs and quality that tie at least contractor's payment, contract extension, renewal etc. to the achievements of set objectives through measureable standard of performance. The check words in distinguishing the performance based contract modality from traditional ones are '*what work/output is to be achieved*' not '*how it is to be completed*'.

In developing a performance based contract it is necessary to develop a set of specifications. There are two tools to develop such specifications which are then used in performance checking. They are Performance Work Statement (PWS) and Statement of Objectives (SOO). Performance Work Statement should include the following:

- Description of works in terms of targeted results, not the way it is to be done or mentioning working hours. For example, in D-C corridor project it is to achieve assured targeted navigation depth 4.5 m.
- Setting measureable standard for performance which will enable to assess the actual work.
- Sticking to the set standard of performance and financial incentives so that can create a congenial and competitive environment for the contractors. As a result, contractors will get encouraged to develop innovative and cost-effective ways.

Such contract mode should have the following aspects: developing measure of performance, identifying incentives and disincentives, choosing the right contractor, managing performance. In developing standards of measureable performance, the following should be remembered:

- the standard shall be set on quantitative output, quality, timeliness
- care must be taken so that un-necessary overburden is created
- looking at an optimality of cost – not so high that creates burden on the government/contracting organisaton, not so low that hinders quality of work and becomes disincentives to the contractor.

Selecting a right contractor is very important element in the entire contracting process. Without getting an experienced and resourceful contractor quality work cannot surely be expected. Therefore, selection should be on qualifications and experiences and the process should be such congenial and fair so that good ones can come forward and compete. Also point of due diligence – qualified bidders might be invited for a period of due diligence. Arrangements can be made for site visits, meetings, supplying required data and information so that they can be competitive in tailoring client’s need.

Managing performance is another important aspect of the contract and work process. There should be a guide that helps both parties in progressing and managing the work load and performance of work. Usually, mainly management of contract performance is guided by the terms and conditions set out in the contract and, importantly, the relationship between the contractor and the contracting authority.

In a word, in order to improve performance to ultimately get the desired results and lower the cost of the project, a performance based maintenance contract should have such features as: describing the required results, setting the measurable performance standards, quality assurance plan for evaluating contractor's performance, and use of incentives – both positive and negative. It is suggestive that this D-C corridor project shall consider these aspects of performance based contract for maintenance dredging.

3.3.2 Dredging

Dredging Technologies and Potential types of dredger

Dredging is the process of dislodging, raising, handling and transporting mainly soil underwater from layers of the earth in order to create/maintain artificial depths. The dredging process when applied to construction of harbours and trenches for foundations/pipelines is called `Capital Dredging'. However when applied for removal of siltation in existing harbours, rivers and clearance of siltation in lakes etc. is termed as `Maintenance Dredging'. The dredging process can be split up into the following four sub systems:-

- Pre-treatment
- Excavation
- Transportation and
- Disposal

The pre-treatment consists of treating the ground surface before the excavation process. This is mainly required for dredging of rock and similar hard materials in order to fragment/loosen the same either mechanically or by use of explosives.

The excavation process is a combination of two operations, namely, disintegration and movement of soil. The disintegration of soil can be performed either mechanically or hydraulically.

The transportation process involves the movement of the dredged material from dredging site to disposal site. For transportation four systems are normally adopted, namely, self contained hopper, self-propelled barge and pipelines. In case of self-contained hopper, self-propelled and dumb barges, the material is released from the hopper into water either by bottom opening doors, valves or sliding doors. In some dredgers, pumps are used for employing the material from the hopper through a separate pipeline. The selection of method of transportation depends upon the distance between the dredging and disposal site. The dredgers are classified into the following categories:

- Mechanical dredgers
- Hydraulic dredgers
- Pneumatic dredgers
- Special dredging equipments

The types of the dredgers mentioned above mainly differ in method of dislodging the soil.

Mechanical Dredger

The mechanical dredgers use mechanical means for dislodging the soil, the examples of this type of dredger are grab dredgers, dipper dredger, bucket dredger, rock breaker and back hoe dredger. The salient features of these types of dredgers are as under:

Grab Dredger

These are the most common types of dredger. This type of dredger consists of a slewing type of crane fitted with grab and mounted on a pontoon or self propelled hopper barge. Upto 4 grab cranes can be conveniently installed on a dredger. This type of dredger can be used with almost all types of soil and is ideally suited for working in confined areas such as docks, alongside berths etc. The capacity of grab type of dredger is normally rated by their bucket capacities which vary from 1 cum to 35 cum and the output depends upon the number of cycles that could be achieved and varies from 300 to 400 cum per hour. The limits of operation of grab type pontoon/hopper type dredgers are as under:

	Grab Pontoon Dredger	Grab Hopper Dredger
Minimum water depth to operate	1m	3m
Maximum water depth to operate	50m (Extendable)	45m (extendable)
Wave height	2 m	2 m
Maximum cross current	1.5 knots	1.5 knots
Minimum Turning circle	--	75 m
Maximum Shear strength(clays)	300 KPa	100 Kpa
Maximum Compressive strength	1 MPa	--

Dipper Dredger

The dipper dredger is basically a power shovel operating from a pontoon/barge. The bucket is attached to the extremity of a hinged right arm and a forward leading hoist wire supplies the digging power. Since large horizontal forces have to be applied to the ground by the bucket, it is necessary for pontoon to have positioning spuds to prevent transfer of force to anchor wires. Dipper dredgers are ideal for dredging of hard material such as blasted rock, weak rocks, stiff clays, boulder clays etc. The output of dipper dredgers is about 200 cum per hour. The limiting operational conditions for this type of dredger are as under:

Minimum water depth to operate	=	3.5 m
Maximum water depth to operate	=	20 m
Maximum width of cut	=	30 m
Minimum width of cut	=	Bucket width
Maximum wave height	=	1.5 m
Maximum swell height	=	1.0 m
Maximum cross current	=	2.5 knots
Maximum Compressive strength (intact rock)	=	12 Mpa

Bucket Dredgers

In this type of dredger, the dredging action is achieved by a continuous chain of buckets which scoop material from the seabed and raise it above water. The buckets are inverted as they pass over the top tumbler and discharge under gravity onto chutes which convey the dredged material to barge alongside. The heavy bucket chain is supported by a fabricated steel ladder and driven electrically or hydraulically via the top tumbler. The ladder is mounted on the centerline of a pontoon, which is positioned and moved by a pattern of five or six winches. The bucket capacities of the dredger varies from 150 to 1200 litres and bucket speeds upto 30 m/min. and output varies from 250 to 1000 cum/hr. The advantage of this type of dredger is continuous dredging process without significant dilution of the dredged material which facilitate high load factors in the barges without excessive over spilling and uniform dredged level with good control of depths.

The main disadvantage of this type of dredger are low efficiency when required to remove only a small depth of material and the sticky cohesive material, higher noise level etc. The limiting operational conditions for the bucket dredger are as under:

Minimum water depth to operate	=	5.0 m
Maximum water depth to operate	=	35 m
Maximum cut width (single pass)	=	150 m
Maximum Wave height	=	1.5 m
Maximum Swell	=	1.0 m
Maximum cross current	=	2.0 knots
Maximum particle size	=	1500 mm
Maximum compressive strength (intact rock)	=	10 Mpa

Back-hoe Dredger

This dredger is basically a backhoe excavating machine mounted on the pontoon. Back hoes are powered by line pull or direct hydraulic linkage. The outer arm of the backhoe has cutting edges and the teeth are fitted to increase the point pressure on the material to be dug. This type of dredger is ideal for dredging of stiff clays, weak rocks, blasted rocks etc. The back hoe dredgers are normally rated according to the maximum size of digging bucket that machine can handle. The capacities of the bucket range from 1 to 20 cum. The output of this type of dredger varies from 100 to 400 cum/hour. The limiting operational conditions for this type of dredger are as under:

Minimum depth of water to operate	=	2 m
Maximum depth of water to operate	=	24 m
Maximum width of cut	=	25 m
Minimum width of cut	=	Bucket width
Maximum wave height	=	1.5 m
Maximum swell height	=	1.0 m
Maximum cross current	=	2.0 knots
Maximum compressive strength (intack rocks)	=	10 Mpa

Rock Breaker

The rock breaker consists of a heavy pointed chisel (upto 30 t) having cast steel point mounted on a pontoon. The chisel can be hoisted and dropped vertically on the rock to be broken. Modern rock breakers have pneumatic or hydraulic hammers, which break rock with a frequency of 1.2 to 2 blows per second. The average output of a 15 t chisel is 8 to 12 cum/hr.

HYDRAULIC DREDGERS

The hydraulic dredgers employ hydraulic techniques such as suction, jetting etc. for dislodging the soil particles and then drawing up by a centrifugal pump. The various types of hydraulic dredgers being used worldwide are as under:

- Plain Suction Dredger
- Cutter Suction Dredger
- Trailer Suction Dredger
- Water Injection Dredger

The salient features of the above mentioned dredgers are given in following paragraphs.

Plain Suction Dredger

These types of dredgers are equipped with a centrifugal pump for raising the mixture of water and soil to deliver material into the transport system. This type of dredger is suitable for loose type of material. The output of such type of dredgers is limited. To improve the output of these types of dredgers special types of suction head or cutter or jets are mounted and advanced type of dredgers such as trailer suction dredgers, cutter suction dredgers have been developed.

Trailing Hopper Suction Dredgers

The trailing hopper suction dredger is essentially a self propelled, self loading and self-discharging sea going vessel with one or more flexible suction pipes equipped with special suction heads i.e. this type of dredgers have ability to dislodge the material to be dredged, suck in and discharge into the hopper contained in its body while moving ahead. Most trailing suction dredgers have twin screw propulsion and a powerful bow thruster, which provide a degree of manoeuvrability. Unloading is normally by means of a bottom-discharge arrangement or by pump discharge. The main advantages and disadvantages of the trailing suction dredger are as under:

Advantages

- Relative immunity to weather and sea conditions
- Independent operation
- Minimal effect on other shipping
- Ability to transport dredge material over long distances
- Relatively high rate of production
- Simple and hence inexpensive, mobilisation procedure

Disadvantages

- Inability to dredge strong materials
- Inability to work in very restricted areas
- Sensitivity to concentration of debris
- Dilution of dredged materials during the loading process

The trailer dredgers are normally rated according to its maximum hopper capacity which is typically 750 to 10000 cum, but exceptionally may be larger.

The maximum depth to which dredging is possible is limited by the vacuum head generated by the dredge pump. If the dredge pump is mounted within the hull the maximum economical dredging depth of a medium size trailer dredger is about 30 m, although for some larger dredgers, dredging depths of upto 80 m may be possible with reduced dredging rates.

The hopper is loaded by pumping soil water mixture and using the hopper as sand trap allowing the suspended solid to settle and water to flow through over arrangements provided in the dredger. The loading time for hopper dredger depends upon the characteristic of the soil dredged. In case of fine grained soil such as very fine sands, silts and soft clays due to their low rate of settlement, it is unlikely that there will be any significant increase in the hopper load achieved by continued pumping beyond the time that hopper overflow commences. However in case of coarse grained soil such as sand loading upto 80% may be achieved. Modern dredgers have Automatic Light Mixture Overboard (ALMOB), to minimise the turbulence in the hopper and improve the loading of the hopper.

When the hopper is loaded, the suction pipes are returned and dredger sails for dumping. The dumping of dredged spoil is accomplished by one of the following methods depending upon the soil type and sea conditions:-

Type	Application
Bottom door : hinged	Clean silt, sand and soft clays in calm water
Sliding	Clean silt, sands and soft clays in shallow water or rough seas
Bottom valves	Clean silts, sands and soft clays in rough seas
Split hull	Any material including those containing boulders or debris for disposal in shallow water and moderate seas
Pump	Silts, sands where disposal is to on shore area for land reclamation
Scraper	Shore discharge of dredged aggregates
Grab	Shore discharge of dredged aggregates

Cutter Suction Dredger

These types of dredgers have a powerful cutter for dislodging the soil particles in addition to the hydraulic suction and transportation arrangements. The main advantages and disadvantages of the cutter suction dredger are as under:

Advantages

- The ability to dredge a very wide range of material by pumping with water directly to the disposal or reclamation area.
- The ability to operate in shallow water and to produce a uniform level bottom with high rates of production.
- The ability, in case of modern dredgers to dredge to a pre-defined profile e.g. in channels.

Disadvantages

- Sensitivity to sea condition
- Limited distance through which dredge material can be economically conveyed
- Dilution of dredged material
- Limited depth of dredging
- High mobilisation costs

The cutter suction dredger is usually rated according to either diameter of the discharge pipe, which may range from 150 mm to 1100 mm or by the power driving the cutter head, which may range from 15 KW to 4500 KW. Most of the cutter suction dredging fleet available have installed power from 2000 to 10000 HP; though the cutter suction dredgers with higher installed power also exist which are used for dredging of hard soil, soft rock etc. The limiting operational conditions for cutter suction dredgers are as under:

Minimum depth of water to operate	=	0.75 m
Maximum depth of water to dredge	=	35 m
Maximum cut width (single pass)	=	175 m
Maximum Wave height	=	2.0 m
Maximum Swell	=	1.0 m
Maximum cross current	=	2.0 knots
Maximum particle size	=	500 mm
Maximum compressive strength (rock)	=	50 Mpa

In addition to the above pneumatic dredgers, amphibious dredgers, scrapper dredgers and other miscellaneous types of dredgers are available which are suitable for specific types of works, such as pneumatic dredgers are suitable for dredging of very soft cohesive soils and Amphibious type of dredgers are suitable for dredging in shallow water e.g. inter-tidal zone, etc.

SELECTION OF DREDGERS

The following factors govern the selection of a dredger for a particular work:

- Site characteristics and conditions
- Nature of soil/rock to be excavated
- The nature of dredged material to be transported
- Environmental factors

The implication of each of the above mentioned factors on the selection of the plant and equipment for dredging has been discussed in the following paragraphs:

The selection of the dredging plant largely depends upon the characteristics of the site such as accessibility, minimum and maximum depth of water, location and accessibility of disposal site, dimensions of the dredging area, proximity to the structures, accuracy of dredging required etc. and the meteorological and oceanographic conditions, traffic etc. and the dredging plants and equipment for a particular site is selected based on site specific information. In case of dredging in shallow areas and inter-tidal zone either dredgers requiring only draft available are selected or dredgers which are able to dredge ahead of their hull such as cutter suction, grab and bucket dredgers are selected so that they can dredge from deep water moving towards shallower depths making room for their movement, or a combination of two types of dredgers are deployed. The small dredging may be used to create a basin of adequate for the bigger dredger, which may subsequently operate from the basin pumping the dredged spoil to the reclamation area.

Similarly wind wave and swells are the main meteorological and oceanographic conditions which affect the working of the dredger. The high wind may make anchoring of dredger and loading on to the barge operation difficult. The dredgers which are located by means of spuds are susceptible to waves which may lead to the damage of the spuds, spud carriages and guides. Anchored vessels are less susceptible to the waves except in the case of dredgers with rigid connections to the excavation face such as cutter suction and bucket dredgers which may get damaged when their ladder strikes bottom. In general most of the dredgers suffer a reduction of efficiency due to lack of control of excavation process and intermittent loss of contact of cutting edge with the sea bed and/or the relative motion between barge and the dredger if barge is used for dumping of the dredged spoil. The limitations on the dredging equipment by wave and swell reported in the literature are given below:

Dredging Plant	**Wave height (m), (Period 6 to 8 seconds)**	
	Limited heights For efficient Operations	Heights above which operations are dangerous and/or very insufficient
Drilling Pontoon (floating)	1.0	1.5
Drilling Pontoon (spudded) working	2.0	3.5
Drilling Pontoon (spudded) moving	1.0	2.0
Dipper dredger	0.3	0.6
Back hoe dredger	0.4	0.8
Bucket dredger	0.4	1.0
Grab dredger (self propelled)	2.0	3.0
Grab dredger (dumb)	0.4	1.0
Cutter suction dredger (small)	0.2	0.5

Cutter suction dredger (large)	1.0	2.0
Trailing suction hopper dredger (small)	1.5	2.5
Trailing suction hopper dredger (large)	3.0	4.0

Currents mainly affect the manoeuvrability of the dredger and are important when dredging in confined areas. Dipper, backhoe and bucket dredgers given sufficient anchorage can work in current upto 3 knots. In strong current the positioning of grab in case of grab dredgers becomes difficult. In strong currents the production of bucket and grab dredgers also reduces drastically. The cutter suction dredgers suffer from current in two respects; lateral; pressure on the dredger and the floating pipeline. The large cutter suction dredgers can work in the current upto 2 knots.

In order to arrive at the rate of dredging in various types of soil using the available types of dredgers the reputed contractors world-wide should be contacted.

Potential types of dredgers and their functions

Dredging technologies and different types of dredgers have been described in details in the earlier section. A little further description is now provided below on two types of hydraulic dredgers since they are mostly used in alluvial environment.

Hydraulic type dredgers mainly of two types: *trailing suction hopper dredger* and *cutter suction dredger*. The trailing suction hopper dredger is practically a ship that by the use of dredging equipment can dredge desired location and discharge into the ship's container and can sail it in order for releasing the dredge elsewhere. This type of dredger can be used in deepening river bed in maintaining navigable waterways, to construct/raise new land or dredge can be dumped into the sea when spoil management becomes a problem either in-stream or on the land. The hopper suction dredger has self-loading and unloading capacity, if required a pressurized discharging aid can be equipped. As an operation procedure, one or two suction pipes having trailing suction head connected to the end descend onto the river bed (desired dredging location). There are nozzles in the head that are connected to a high pressure installation that are capable of loosening the bed material (sand). Since vacuum is created inside the pipe, the dredge is sucked and conveyed into the holding vessel said earlier. As a discharging method, usually dumping is done somewhere else, usually into the sea. However, by pressing method – liquefying the dredge inside the hopper by high pressure water and discharge can be made possible over a long distance. But this will surely add much extra cost.

Cutter suction dredger consists of a centrifugal pump and the suction tube that has cutting mechanism (rotary blade) at the end. Loosening the sand and cutting are done simultaneously, and the dredged material is sucked by the dredging pump and transported through a pipeline. Usually the distance of transportation pipe line by design could be 2-3 km. However, by adding booster pump to the pipeline the dredge-spoil can be transported/dumped to a further distance.

In this project the dredging operation involves a number of rivers of hundreds of kilometers and most locations of dredging will be well inside the coastline. Therefore, cutter suction type dredger would be the feasible option from both technical and financial point of view. However, while dredging locations are the coastal area, for example downstream of Bhola, Lakshmipur hopper suction type dredger might be considered provided if costing favours in choosing such type. The photograph of a cutter section dredger is presented in Figure 3.3

Figure 3.3: The photograph of Cutter Section Dredger

As known from BIWTA, at present it mostly uses cutter suction dredgers of the sizes 18 and 20 inches for the purpose of their inland dredging. In this project, the contractor will chose the dredger type based on his own assessment.

Dredging frequency and schedule

Though it is debate whether in-stream disposal or over-bank dumping, the schedule should largely depend on this decision. Rivers lose their speed of current from November, during high dry period January to April flow is nearly stagnant except thalweg. Therefore, dredging during such time may result in deposition in nearby places. If in-stream dredging that should be done during high-discharge and high-current speed condition so that dredge can go away much further downstream. But feasible dredging time for convenient and efficient dredging surely would be the dry season provided if the dredge-spoil is managed on the nearby bank.

In scheduling actual dredging operations fish-breeding time must be given due importance. Usually such breeding time, particularly for the hilsa fish, twice a year – around mid-September to mid-October and March-April.

3.3.3 Management of dredged material

Dredging is a key aspect in keeping the river route navigable. Managing dredged materials will be a key challenge to achieve the project goals, as dumping the dredged materials without a legitimate plan will result in negative impacts like soil contamination and environmental degradation, reduction of yield rate and ultimately transfer the dredged material back to the river. Acquiring community recommendations through consultative process about dredged material management has been an important issue of the proposed study. The dredged materials are expected to have two features; contaminated and no-contaminated. The non-contaminated materials will have also two dimensions i.e. usable for sand filling and another for civil construction. These both categories of materials can be sold to willing buyers/traders or can be used in rural road development, dyke construction or some other purposes. In fact, as means of keeping the materials from the river bank, the first choice of the stakeholders is to sell them to willing buyers/traders or to deposit in a suitable location from where people/community can take away for development purposes. In some sites, the stakeholders advised to use the dredged materials for maintenance and increasing heights of the river bank/polders. Some of them suggested using the sediments for increasing heights of the yards of community properties like school grounds, Eidgah, Madrasah, etc. The contaminated spoils should be managed in scientific way so that there will have no environmental hazards. During consultation meetings with the local people, sand traders, local government representatives and Upazila administration, some effective suggestions have come out. According to their opinion the dredged materials may be used in various sectors effectively that may promote development of the community and local economy. It was also opined that dredged materials may be sold to the local traders and willing buyers or deposited in a suitable location so that community people may use it for their needs. In some areas the dredged materials may be thrown in to the deeper channel of the river especially at Chandpur and lower Meghna. Various suggestions from the stakeholders about dredged material management are hereby listed in Table 3.9 below. Nonetheless, these community preferences need to be balanced with considerations about negative social impacts, costs, administrative challenges (given low institutional capacity of BIWTA on social management), and environmental factors associated with land acquisition or lease and on-land disposal. Therefore, it has been determined by BIWTA that the first choice for dredged material disposal shall be in the river, whenever suitable in-river locations are available, as per environmental criteria and technical considerations. Only when in-river disposal is not a viable option shall on-land disposal be carried out, in accordance with provisions of the EMP and RPF, both of which require consideration of local community needs and interests as well as minimizing negative impacts. This is further discussed and elaborated in the impact assessment and EMP chapters of this report.

Table 3.9: Participants advice on dredged spoils management;

Sl.	Venue of the Meeting	Dredging Requirement	Dredged Spoil Management: Community Opinions
1.	**Venue :** Sadar Ghat, Ward No. 7 **Thana:** Kotwali **District:** Dhaka	Urgently needed	1. It can be used for sand filling in low lying areas using scientific methods. 2. It should be taken far away from people as the sediment is highly contaminated.
2.	**Venue :** Aganagar Ghat **Thana:** Keraniganj **District:** Dhaka	Urgently needed	1. It should be taken away from residential area as the river bed is highly contaminated.
3.	**Venue:** Jinjira Bottola **Thana**: Keraniganj **District:** Dhaka	Urgently needed	1.It is contaminated, so it should be taken far away from residential areas to keep the environment people-friendly
4.	**Venue:** Munshiganj Launch Ghat **Thana:** Munshiganj Sadar **District:** Munshiganj	Dredging is required	1. Some sand businessmen want to buy dredged materials. 2. Stake yard of the businessmen may be used to dump dredged materials.
5.	**Venue:** Munshiganj Ferry Ghat **Thana:** Munshiganj Sadar **District:** Munshiganj	People didn't mention navigation problem	1.They don't feel dredging requirement
6.	**Venue:** Naranpur **Thana:** Titas **District:** **Co**milla	People didn't mention navigation problem	1.They don't feel necessity of dredging
7.	**Venue:** Batakandi Bazar **Thana:** Titas **District:** Comilla	People didn't mention navigation problem	1. They don't feel necessity of dredging
8.	**Venue:** Bhairab Bazaar Launch Ghat **Thana:** Bhairab **District**: Kishorganj	Dredging is required	1.It can be used in river bank's improvement 2. It can be used for filling low residential areas and yard of community properties
9	**Venue: R J Tower & resort,** **Thana: Ashuganj** **District: Brahmanbaria**	Urgently required	1.Some people want to buy the sand 2. It may be used for rural road development and river bank improvement
10.	**Venue: R J Tower & Resort** **Thana: Ashuganj** **District: Brahmanbaria**	Urgently required	1. There are two locations beside the river to deposit dredged materials at the moment: i) near the cargo terminal (150 decimal) and ii) near Ashuganj gas plant (180 decimal) 2. Some locations are already being used as stake yards for sand and the traders may cooperate with the project to take more sands;

Sl.	Venue of the Meeting	Dredging Requirement	Dredged Spoil Management: Community Opinions
			 3. the participants at the regional workshop advised the project to use the dredged material for construction of a 6 km connecting road with Ashuganj and Nabinagar; 4. This connecting road will develop business and transportation opportunities of Ashuganj;
11.	**Venue: Shatnal launch ghat** **Thana: Matlab** **District: Comilla**	People didn't mention navigation problem	1. Dredged materials can be used in road construction 2. Launch ghat should be upgraded with more facilities including connecting road
12.	**Venue: Harina Ferry Ghat (Common people including passenger)** **Thana: Chandpur Sadar** **District: Chandpur**	People didn't mention navigation problem	1.It can be used for sand filling and plinth of the house 2. It may also be used for development of yard of community properties, play ground and rural roads.
13.	**Venue: Harina Ferry Ghat (businessmen & Fishermen)** **Thana: Chandpur Sadar** **District: Chandpur**	People didn't mention navigation problem	1. Non-contaminated sand may be used for household work 2. Can be stored in a particular location so that people can take away for their use 3. Can be sold to traders and willing buyers
14.	**Venue: Chandpur launch Ghat** **Thana: Chandpur Sadar** **District: Chandpur**	People didn't mention navigation problem	1.It may be used in construction work 2. Can be sold to traders and willing buyers, 3. Can be thrown in to the deeper channel of the river nearer to Chandpur
15.	**Venue: Boro Station Mul Head** **(Dakatiya Mohona)** **Thana : Chandpur Sadar** **District: Chandpur**	People didn't mention navigation problem	It may be used for sand filling and plinth of the house Can be stored in a particular location so that people can take away for their use
16.	**Venue: Boro Station Mul Hea (Camp Office)** **Thana: Chandpur Sadar** **District: Chandpur**	People didn't mention navigation problem	1.It may be used for sand filling or construction works of the roads and buildings 2. Can be sold to sand traders and willing buyers

Sl.	Venue of the Meeting	Dredging Requirement	Dredged Spoil Management: Community Opinions
17.	**Venue: Char Bhairab** **Thana : Haim Char** **District: Chandpur**	Dredging is required	1. The dredged materials may be used in construction works 2. Can be sold to traders or deposited in a suitable location so that community can use it for their necessity
18.	**Venue: Moju Chowdhury Ghat** **Thana: Laksmipur Sadar** **District: Laksmipur**	Dredging is required	1.It may be used in riverbank construction 2. Can be filled in low lying areas including play ground and yard of community properties, rural roads
19.	**Venue: Boyar Char, Chairman Ghat (Fishermen Community)** **Thana: Hatiya** **District: Noakhali**	Urgently needed	1.It may be used in ghat construction and rural road development 2. May be sold to willing buyers 3. May be deposited in a suitable location for further use of the community people
20.	**Venue: Chairman Ghat (Owner Association)** **Thana: Hatiya** **District: Noakhali**	Most Urgently needed	1. It may be used for plinth of house, road and river bank construction, and for increasing height of polders 2. Can be sold to willing buyers/ traders.
21.	**Venue: Doulat khan launch ghat** **Thana: Doulat khan** **District: Bhola.**	People didn't mention about navigation problem	1.It may be used as the road construction material 2. Development of yard/play ground may also be done by the dredged materials
22.	**Venue: Tajumuddin launch Ghat** **Thana: Tajumuddin** **District: Bhola.**	Dredging is required	1.It may be used as the road construction material 2. May also be used for development of play ground and river bank as there is erosion threat here
23.	**Venue: Bheduriya ferry Ghat** **Thana: Bhola sadar** **District: Bhola**	Dredging is required	1. It may be used for sand filling in low lying areas/play ground, etc. 2. May also be used for Ghat development and river bank improvement
24.	**Venue: Lahar hat (vatikana)** **Thana: Bandar Thana** **District: Barisal**	Urgently needed	1.It may be used for sand filling in low lying areas 2. People also opined to sell the materials to willing buyers and traders; 3. The area is erosion prone; the participants opined to use the dredged materials for bank protection work;
25.	**Venue : Kaliganj Launch Ghat** **Thana : Mehendiganj** **District: Barisal**	Dredging is required	1.It may be used for sand filling in low lying areas

Sl.	Venue of the Meeting	Dredging Requirement	Dredged Spoil Management: Community Opinions
26.	**Venue : Sreenagar** **Thana : Raipura** **District: Narsingdi**	Dredging is required	There is a large wet land (20-30 acres) under private ownership. There are plenty of fellow land in Sreenagar Mouza (Baghaikandi, Gozariakandi, Gopinathpur village) where a huge quantity of sand may be deposited; Local Chairman (Sreenagar UP) confirmed availability of space for dredged materials deposition. The owners are willing to increase height of their low lying land by dredged materials. at it will increase value of their land; There are also sand businessmen, who are willing to purchase dredged material during implementation;
27.	**Venue : Karimpur** **Thana : Narsingdi Sadar** **District: Narsingdi**	Dredging is required	The locals welcomed the project; But all the fellow land are under private ownership, within the range of 10-20 decimals, which is small compared to volume of dredged materials; People opined to keep dredged materials in a suitable location beside the river so that local people may take it for their/community needs

Source: Stakeholder Consultation Meeting outcomes

Based on community consultation, location of dredging analysing hydrological and morphological conditions of the navigation routes, and environmental and social considerations, locations of dredged material placement have been identified.

In the Meghna Estuary two locations have been identified for dredge material placement. One is along the northern shoreline of Hatiya Island and another one is the eastern shoreline of Bhola Island. Hatiya Island has been experiencing severe erosion over the years at its northern shoreline due to deep scour hole along this shoreline and high current speed. Figure 3.9 shows the location of deep scour hole along the northern shoreline of Hatiya Island

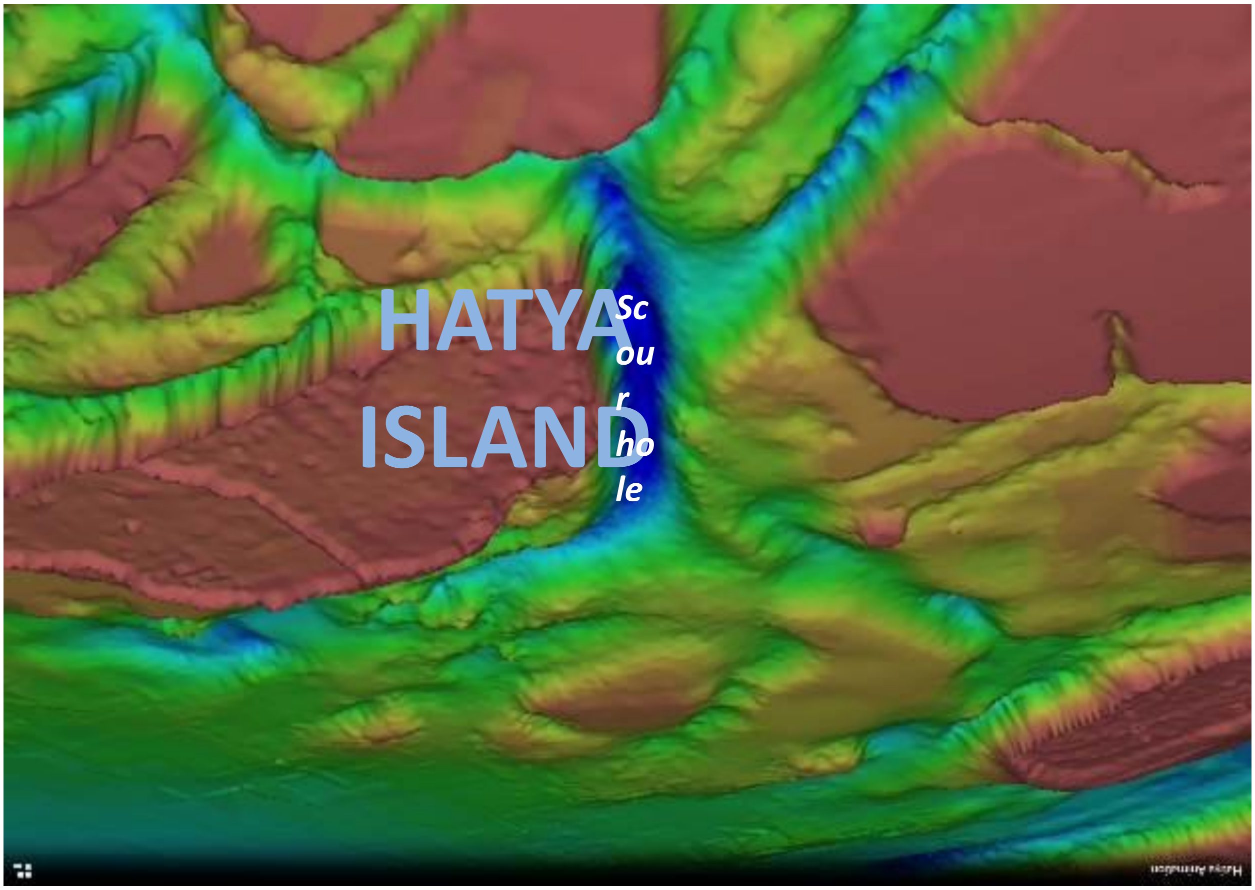


Figure 3.4: Three Dimensional Model of Scour hole at the North East corner of Hatya Island using Mike 21 modelling software

If dredged material is placed at this location then it will reduce the erosion rate. Morphological model study shows that, this dredged material is distributed naturally with high and low tides. This mechanism is considered as shoreline nourishment with dredged material. Figure 10.1 shows location of dredged material placements.

4 ANALYSIS OF ALTERNATIVES

4.1 No project Alternatives

4.1.1 Current problems with inland navigation

Current problems of inland navigation in the Dhaka-Chittagong corridor and adjoining routes under study can be described according to following:

Dry season navigability

Condition of dry season navigability in the rotes under study and elsewhere in IWT network is the core problem of inland navigation caused by deteriorating condition of rivers. Due to recession of water in the rivers vessels have to wait for high tide, run in half-load or under load condition to avoid groundings. take a detour that increase transportation time and cost and turn around time of vessels as well. All these aspects make IWT mode unattractive and create lack of confidence among the users.

Lack of aids to navigation

Inappropriate aids to navigation along the routes create problem combined with dry season navigability. Equipments of aids to navigation installed by BIWTA are considered by navigators not sufficient according to requirement.

Inappropriate loading-unloading facilities

Inland ports in Bangladesh are characterized with marginal facilities that do not provide safe embarkation and disembarkation of passengers and goods. Due to lack of mechanization, head-load still remains the main means of loading / unloading of cargo. This makes inland ports inefficient.

Safety

IWT is safer compared to road transport in Bangladesh. But recent accidents in inland waterways which claimed substantial lives and properties reveal that there exist lack of safety management in IWT.

4.1.2 Consequences of non-maintenance of navigation channels

If the present state of navigational conditions continues or in other words if the channels under study not maintained for smooth navigation, the following conditions will be evident immediately:

- Transportation cost and time will be increased.
- Turn around time of vessel will further increase to such extent that IWT will not remain cost-effective.

- Hinterland connection of maritime ports will be disrupted and will leave ports as inefficient.
- Congestions in roads and maritime ports will further increase.
- Inland container transport by rivers will not be sailed.
- Private investment in IWT sub-sector will be discouraged.
- International sea-borne trade will not be able to meet transport demand.
- Facilitation of trade and commerce will be restricted resulting unemployment.
- Poor people will lose opportunity of cheaper transport.

4.1.3 Marine accidents and safety

Revival of Inland Water Transport: Options and Strategies, 2007 by the World Bank estimated that *the ratio of fatalities of per billion of passenger-km is 158 for roads and 41 for IWT*. So, IWT looks safer compared to road statistically. But the nature of marine accidents so gruesome that attract the attention of millions. Even these marine accidents are not frequent like those on roads but pictures of perished copes published in the media create a state of fear and no confidence in the minds of users. Media reports reveal poor governance in safety management.

Accidents and fatalities on roads in Bangladesh is one of the highest in the world. The World Health Organization (WHO) in its recent report estimated that road accidents in Bangladesh claimed 21,316 lives annually. While Headquarters of Bangladesh Police claimed that a total of 2,067 persons were killed and 1,535 injured due to 2,027 road accidents in 2014. This figure was calculated on the basis of FIR lodged in the concerned Police Stations. On the contrary, number of marine accidents and fatalities during last 15 years may be seen in the Table 4.1

Table 4.1: Statistics of marine accidents

Year	Number of accidents	Number of fatalities
2000	09	353
2001	17	33
2002	17	297
2003	31	464
2004	41	127
2005	28	248
2006	23	51
2007	11	02
2008	22	120
2009	34	260
2000	29	118
2011	22	74
2012	15	162
2013	10	22
2014	16	124
Total	**325**	**2455**

Source: Department of Shipping & BIWTA

These are official figures calculated on the basis of FIR lodged in local thana and cases filed in the marine court. It is evident that number of fatalities derived from number of dead bodies recovered after the accidents. Number of missing persons was not considered.

One example may be mentioned to determine the quality of above figures. In July, 2003 a passenger launch named MV Nasrin capsized in the confluence of the Meghna and Dakatia near Chandpur with about one thousand passengers on board including the owner of the launch. The depth of the river at that spot was about 50 m. The capsized launch could not be located or recovered even with combined salvage operation of Navy, Fire Service and BIWTA for continuous 15 days. The investigation Committee constituted by the Ministry of Shipping estimated that a total of 645 persons were killed in the accident. Committee estimated this number on the basis of dead bodies recovered and registered number of missing persons. According to BIWTA's record 911 persons were killed in 7 accidents in the year 2003. While the above table claims only 464 fatalities in the same year.

However, if we consider the above table this will be found that the rate of fatalities per year is 167 and rate of accident per year is almost 22. Through random analysis of investigation reports of marine accidents, the following causes were found:

- **Dangerous or improper overloading.**
- **Collision,**
- **Poor condition of vessel.**
- **Storm / Cyclone / Tornado**
- **Inefficient operation**
- **Combination of two or more causes.**
- **Breakdown.**
- **Grounding.**

4.1.4 Need for storm shelter

Storm, tornado, cyclones and other natural calamities have become more frequent in Bangladesh. Vessels while in operations have to encounter this challenge. In such contingencies vessels have to take a refuge that is safe and have capacity to provide assistance to vessels in distressed. Not only foul weather, breakdown of marine engine or the propeller may leave the vessel in distressed.

Physical characteristics of rivers in Bangladesh are such that at most of the places vessel in distressed find no natural advantage to take refuge. So, planned creation of storm shelters along the accident prone routes and stretches may enable the vessel to avoid threat of capsize and save lives of hundreds.

4.2 Alternatives to the Project

4.2.1 IWT versus road and rail

A sustainable development strategy for transport network must consider costs and benefits inclusive of every element. Costs of a transport mode include development and maintenance of a network, ownership of vehicles and its operation and maintenance costs. These are referred to internal costs or sometimes termed as direct costs. The costs, which could be fixed or variable, have been the primary determinant of the costs of haulage in Bangladesh or elsewhere in the South Asia. There is, however a growing realization that every mode of transport carries what are known as external costs, hidden costs that burden not only users of the mode but also the society at large. The most prominent externalities that impose such costs in a particular mode are accidents, pollution, climate change, congestion and land side infrastructure development.

There has been an alarming rise in road accidents in Bangladesh over the past few years. According to a Study conducted by Accidents Research Center (ARC) Of Bangladesh University of Engineering and Technology (BUET), road accidents claim on average 12,000 lives and lead to 35,000 injuries. According to the World Bank statistics annual fatality rate from road accidents in Bangladesh was found to be 85.6 per 10,000 vehicles.

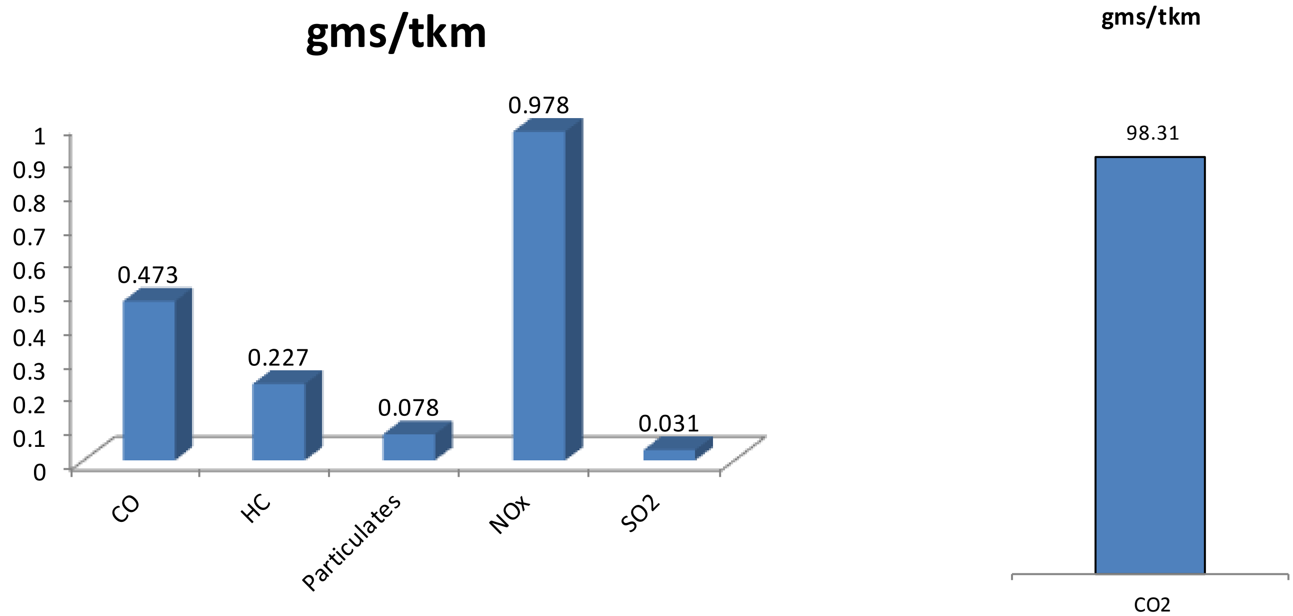
Similarly cost of road congestion particularly in the Dhaka city was estimated by the Metropolitan Chamber of Commerce and Industries, Dhaka through a Study conducted by two engineers of RHD and one transport economist of MCCI according to Table below:

Table 4.2: Cost of Traffic Congestion in Dhaka city

Factor	**Cost** (Bn BDT)
Loss of business hours	118
Environment	22
Transport industry	20
Additional fuel	5.75
Accident	0.50
Total	195.55

Source: *MCCI Study in 2010*

Road vehicles pollute the air with carbon monoxide, hydrocarbon, particulates and NOx leading to a host of respiratory diseases including asthma, bronchitis and setting the stage for growing incidence of cardiovascular disease. Emission of carbon dioxide from road vehicles cause global warming.

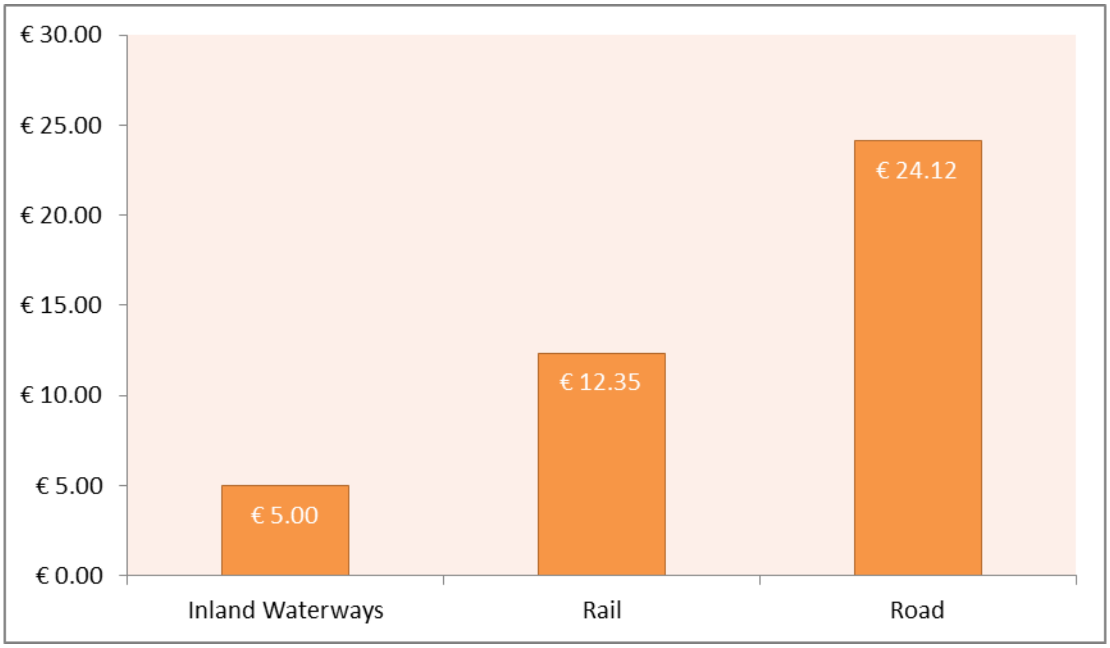


Source: *EU Progress Report on Short Sea Shipping, 1999*

Figure 4.1: Road Transport Emissions

The European Union in 2002 determined that for every 1,000 ton-km of cargo hauled, road transport carries a total hidden external cost of Euro 24.12 as against Euro 12.35 in rail and only Euro 5 for IWT.

Reliable estimates of such external costs in the context of Bangladesh or elsewhere in the South Asia are not available. But given the general conditions of our roads and trucks, it would be eminently reasonable to assume that external costs in Bangladesh of road transport exceed those of IWT by a factor that is decidedly higher than in the EU.



Source: *Transportation cost and benefit, TDM Encyclopedia*

Figure 4.2: External Costs of Transport Modes

Modal option for development strategy of transport sector, environment must be a determinant factor. IWT always remain on the top in terms of carbon saving. One liter of fuel in the river produces 100-200 ton-km of transport output as against 25 ton-km in road, four to eight times lower. The World Bank in its Report on Revival of Inland Water Transport: Options and Strategies, 2007 revealed that with an estimated 1.95 billion ton-km performed by IWT in 2005 excluding country boats, about 58.5 million liter of fuel were saved by using IWT instead of road. Using the Integrated Pollution Prevention and Control (IPPC) conversion factors, this represents 155,000 tons of carbon dioxide.

4.2.2 Alternative routes for Dhaka-Chittagong corridor

Modal option for future development strategy should also be based on social issues. IWT contributes directly to social benefits nationwide by providing a cheaper mode of transport and employment opportunities. According to the World Bank (Revival of Inland Water Transport: Options and Strategies, 2007) total employment in IWT sub-sector is more than 4.64 million. A substantial portion of rural population has no access to any mode of transport other than river.

In view of the country's economy, public investment for future development of IWT is significant and reasonable. The World Bank estimated an amount of savings at BDT 7.5 billion in transport costs of cargo resulting from the use of IWT instead of road (Revival of IWT, 2007).The cost of dredging was estimated at 0.6 billion BDT take at BDT 100 per cum. In other words, benefit of BDT 7.5 billion at the cost of BDT 0.6 billion which is economically justified. The minimum traffic necessary to justify the cost of dredging was obtained by dividing the total costs of dredging by the average benefit from dredging per kilometer. The average cost of dredging per km was obtained by dividing the total cost of dredging by the length of navigable IWT network. The average benefit from dredging per kilometer was obtained by dividing the difference between IWT and road cost by the number of ton-kilometer for IWT output. This was derived from the volume of cargo traffic transported by inland waterways by the formal sector vessels only. The output of the informal sector was not included as those can play in all condition. The following Table will illustrate the comparative per ton-km costs of each mode:

Table 4.3: Comparison of Cargo Tariff by Modes

Mode	**Dhaka-Chittagong (BDT ton-km)**	**Distance (km)**
Road	4.50	243
Rail	2.74	260
IWT	0.99	306

Source: *Revival of IWT by the World Bank, 2007*

It should be noted that freight of IWT and rail increased very slightly less than 10% while that of road increased to about 40 percent since 2007.

The Study of the World Bank also revealed that in terms of productivity per kilometer of network of different modes railway is the best followed by IWT and road at the bottom. IWT has more than twice the productivity of road for the carriage of cargo as illustrated in Table 4.4

Table 4.4: Productivity of Different Modes

Comparison	**Road**	**Rail**	**IWT**
Network	274,000	2800	24,000
Productivity Passenger-km	359,000	1,500,000	369,000
Productivity Ton-km	57,000	293,000	127,000

Source: *The World Bank in National Workshop on IWT, 2005*

It is mentionable that for calculation of productivity existing networks of road and rail were considered. While for IWT, total geographical not navigable network was considered. If navigable network of 6,000 km was considered, productivity in terms of passenger and goods would increase by 400 percent.

4.3 Alternative Means of Channel Maintenance

There may be ways and means to maintain rivers and stream channels to keep them functioning. However, means of maintaining should largely depend on a number of criteria such as types, size, surrounding hydrological environment, social and economic purpose of the river. There may be potential ways that are usually used in maintaining river channels, such as dredging, river training, bank protection works etc.

Dredging

Whatever be its ultimate purpose and location, in fact, dredging is an excavation activity either done by manually or by using machines and at a part of dredging has to be carried out underwater. Here is the difference between an excavation of a burrow pit in case of constructing a road and excavation of bottom sediment of a middle or point bar of a river. Rivers not only are carrying mass of water but also carrying sediments of varying sizes. Due to varying physique and inputs to river, particularly excessive sediments input create bars and chars constrictions in the river. In order to maintain desired navigational channel and required depth dredging is a necessity.

River Training

River training activities are ways and means that are applied in a river reach so as the reach is expected to show a desired behavior. Training measures that are usually employed are breakwater (groynes, spurs etc.), hardening river bank. Breakwater means are employed in order to deflect water course away from the bank so that the concerned bank that were under attack becomes safe. Each groyne/spur has some area of influence where it could reduce the flow speed and produce a calmer environment so that gradual sedimentation can happen. In this way the channel course become shifted away and a deeper course may develop further away from the bank. However, hardening is a defensive measure that makes a safeguard for the endangered bank or for the bank that has potential danger to be fallen under attack. This type of measure is desirable where important installations, public dwelling of massive scale, towns and cities are under attack or may undergo under attack. Even a dredging activity can be regarded as river training work when it is planned, designed and implemented with the goal of achieving a desired behavior of a river i.e., river is able to provide safe navigation, the river is not eroding its banks etc.

As to bank protection works, as its name implies they are a kind of measures whose principal purpose is to protect bank. Obviously, bank protection works are included within the broad class of river training.

Flow path can be deflect away from the bank towards somewhere in the middle by constructing river training structures such as groynes (permeable, solid), bamboo bundles etc. This can be done in the affected side of the bank or even on the both bank. In this way channel augmentation is possible by deepening the river bed. This method might be considered desirable where only bank erosion and protection is concerned. However, where the river is not much wide to accommodate sufficient number of two-way traffic of varying sizes, particularly where large vessels involves this sort of constriction by placing such measures of river training clearly make obstacles to traffic. Hence, they appear not a feasible alternative measure. Again, deepening in this way may not bring sufficiently required depth for navigation purposes. Here, in this D-C corridor project huge number of two-way traffic of varying sizes is expected and that will be increasing over time with the pace of socio-economic development. Again for rivers like Buriganga, Shitalakhya where river width shrinks much with huge lowering of river stage during dry period. But navigation requirement is perennial.

A comparative discussion on the measures of dredging, river training as alternative means of channel maintenance:

As pointed out above, though as means river training measures, bank protection works help channel maintenance, that surely should be not be sufficient for maintaining required channel depth for navigation purposes. It is particularly true in case of very large river where river flows in different channels with many shoals, bars and chars. This is the case for D-C corridor project where the most navigation route involves mighty Padma and Meghna River with width of even many kilometers. Also these rivers are highly sediment laden. It is a project which seeks sufficient navigation depths along the entire river navigation routes and ferry crossings, so the need for dredging is inevitable.

Though in this project some rivers – the Buriganga, the Shitalakya, the Dhaleswari are meandering type not showing middle chars like the Padma and the Meghna. In channel maintenance a kind of river training, bank protection bring some benefit. However, this may not be sufficient for the whole route and in order to achieve required navigation depth particularly when the aim is to improve IWT to allow more passenger and cargo traffic and improve river ports and terminals. Again, river training and bank protection works should not be feasible for river routes of hundreds of kilometer. For example, a river training work was accomplished while constructing Hardinge Bridge to guide the flow and expect that the flow would not have chance to make harm to the bridge abutment. The work has still been performing well. However, that kind of guide bund cannot be built either along the whole river or in many locations in view of cost and other considerations. Therefore, if proper dredging is done with proper spoil management and spoil resuse fjor beneficial purposes, dredging means can bring useful channel maintenance.

Cost in some Past Projects

Obviously, the cost of river training/bank protection works depends on the type, size, design of structure. Also, it depends on the material to be used and the market rate that changes over time. Bangladesh Water Development Board is the main responsible government organization in implementing river training, bank protection works. A good indication of costing can be obtained from some past projects or projects being taken by BWDB. Here are some examples given in the following:

- Bank revetment works to be implemented by placing CC block at Paranpur, Sengati and Sailadah on the Madhumati River involving Polder 36/1. Estimated cost: Tk. 300,000 per meter (USD 2750 per meter).
- Bank revetment works being implemented by placing CC block near Godagari upazila under Rajshahi district on the Ganges River. Estimated cost: Tk. 500,000 per meter (USD 6250 per meter).
- Bank revetment works to be implemented by placing CC block near Mawa on the left bank of the Padma River. Estimated cost: Tk. 446,000 per meter (USD 5575 per meter).
- Proposed bank revetment works to be implemented by placing CC block under Kalni Kushiara River Management Project in the north-east region of Bangladesh. Estimated cost at DPP stage (ie, not design cost): Tk. 252,000 per meter (USD 3150 per meter).
- Bank revetment works suggested for implementation by placing CC block in places along left of the Meghna River under Kamalnagar and Ramgati upazila in Lakshmipur district. Estimated cost: Tk. 289,000 per meter (USD 3612 per meter).

Note: As observed, BWDB presently as a measure of bank protection prefers bank revetment by placing CC blocks to constructing spurs. Cost per meter for a spur on the Jamuna and Ganges river implemented by BWDB were USD 1550 and USD 1019 respectively in 1990s.

4.4 Alternative Dredgers Types (Equipments/Techniques)

Potential types of dredgers and their functions

According to engineering design basically there are 3 kinds of dredgers; they are mechanical, pneumatic and hydraulic dredger. As known, though there are some mechanical dredgers are in use by BWDB, BIWTA (those are being used they are very old), being inefficient this type is not the preferred one.

Hydraulic type dredgers mainly of two types: *trailing suction hopper dredger* and *cutter suction dredger*.

Cutter Suction

Cutter suction dredger consists of a centrifugal pump and the suction tube that has cutting mechanism (rotary blade) at the end. The main technique is applied in dredging is that loosening the sand and cutting are done simultaneously, and the dredged material is sucked by the dredging pump and transported through a pipeline. Though can be used in sandy, clayey soil, due to the capacity of cutting it has preferred use in case of dredging on bedrock or very hard soil or gravel deposits. Usually, the distance of transportation pipe line by design could be 2-3 km. However, by adding booster pump to the pipeline the dredge-spoil can be transported/dumped to a further distance.

Trailing Suction Hopper Dredger

The *trailing suction hopper dredger* is practically a ship that by the use of dredging equipment can dredge desired location and discharge into the ship's container and can sail it in order for releasing the dredge elsewhere. A description of its functionality and uses are also given in **Section 3.3.2**.

In principle, its dragging technique is basically similar to a vacuum cleaner. That means sail-and-drag, sucking by creating vacuum and hence loading, then sailing to unload elsewhere. The hopper suction dredger has self-loading and unloading capacity. As an operation procedure, one or two suction pipes having trailing suction head connected to the end descend onto the river bed (desired dredging location). There are nozzles in the head that are connected to a high pressure installation that are capable of loosening the bed material (sand). With respect to limitation of its uses, since it prepare and collect dredge by loosening sediments and dragging and and also steel teeth are not so big, so it is capable of working on relatively loose and soft substance.

As to the components of equipments, apart from the ship with engine, it has rearward extending one or more suction pipes, one or more dredging pumps in order to create suction (under pressure) to extract dredged sediment inside the pipe, transportation pipes in order to send dredge into the hopper, an overflow device to get rid of the redundant water overboard, kind of degassing devices to remove any gas from the substance.

A comparative consideration

Where pumping is possible, hydraulic dredgers are much more efficient than mechanical dredgers. However, any situation that limits the uses of hydraulic dredging other types can be used. For example, due to hard rock, debris or narrow channel with a lot of passing traffic, which does not allow the floating pipeline. In such circumstances, grab dredgers can be used. Again, in such situation hopper barges would be required to convey the dredged spoil to the desired dumping sites. On the whole, choosing an appropriate dredger type is a matter of optimization between the issues - dredging project, constraints and dredging equipments. A good guidance on the suitability of types of dredging equipments depending on the soil condition can be seen in Table 4.5

Table 4.5: Suitable types of dredging equipments on the soil criteria

TYPE OF EQUIPMENT	SOIL				SITE		
	SILT	CLAY	GRAVEL	ROCK	OFF SHORE	IN SHORE	
						TRAFFIC	NO TRAFFIC
BUCKET DREDGER	G/R	R/G	R/G	R/G	NA/R	NA	G
PLAIN SUCTION DREDGER	R	NA	G	NA	R/G	NA	G
CUTTER SUCTION DREDGER	GOOD	G	G	R	R	NA	G
TRAILING SUCTION HOPPER DREDGER	GOOD	R	G	NA/R	G	G	G
GRAB DREDGER	R/G	R	G	NA	NA	NA/R	G
BACK HOE	R	G	G	R	R	R	G
BED LEVELLER	GOOD	NA/R	R	NA	NA	G	G

= GOOD R = RESTRICTED NA = NO APPLICATION

[Courtesy: H van Muijen, IHC]

Feasibility under this project

In this project the dredging operation involves a number of rivers of hundreds of kilometers and they are well-wide, and most locations of dredging will be well inside the coastline. From efficiency consideration with respect to all aspects – technical, capacity, cost, the mechanical dredgers would not be feasible. Their use is diminishing day by day, when other robust and efficient devices are available. Using of hydraulic-type would be feasible due to the size of the river (long, wide), type of sediments (no bed rock, all navigation paths and routes pass through flood plains and estuaries, all are late holocene sediments, no debris etc). Therefore, cutter suction type dredger would be the feasible option from both technical and financial point of view. However, while dredging locations are the coastal area, for example downstream of Bhola, Lakshmipur hopper suction type dredger might be considered provided if costing favours in choosing such type. In no way hopper suction would be a viable option for inland rivers, since the sailing distance will surely be very long, the capacity, therefore, be low and hence the cost for each unit volume of sediment would be quite high. As known so far known from BIWTA, it will be using for dredging inside inland rivers 18-inch cutter suction dredger. And in the estuary area either hopper suction or 26-inch cutter suction dredger will be used. Nonetheless, ultimately it is up to the contractor to select the dredging methodology. Therefore, it is possible that the contractor will pick different methodologies as per their own analysis of relative benefits and costs of each method in specific project areas.

4.5 Alternatives to Dredged Materials Management

Dredging is necessary to move water vessels easily throughout the project routes. The most environmentally friendly disposal method in most cases will be in-river disposal, as long as precautions are taken to avoid sensitive aquatic habitats and to minimize sediment suspension in the materials placement process. On the other hand, based on demand of the communities, some dredged material could be kept on the low land nearby the dredging locations. As a result, the people of the project area would be benefited by using materials in case of rural road maintenance, yard of community properties such as Eidgah, Mosque, Madrasah, and play ground of School/college, etc. However, this has to be weighed against potential negative social impacts associated with required land acquisition or lease, and possible displacement of households or livelihood activities. In addition, on-land disposal requires proper environmental management, which entails higher costs than in-river disposal. It may also be deposited along the river within compartment/stake yard of the traders/willing buyers. In case of big rivers the dredged materials may be deposited in the deeper channel of the river. By introducing/adopting latest technology the dredged materials may also be pushed to the sea. In case of contaminated sediment, DOE has instructed that all disposal shall be in the river, at least in the Shitalakhya and Buriganga rivers, which are the only rivers within the project area where contamination was found in baseline sampling surveys. Only in the highly unlikely case that in-river locations are not available for contaminated sediment, shall such sediments be brought on shore. In that case, proper isolation and treatment will be required to reuse to avoid/mitigate environmental hazards.

5 BASELINE ENVIRONMENT

5.1 Physical Environment

5.1.1 Climate

Temperature

The climate of the study area is sub-tropical with three seasons; namely summer from March to May, monsoon from June to October, and winter season from November to February. The annual maximum temperature at Dhaka varies from 31.0°C to 42.3°C and in Sandwip from 30.6°C to 39.3°C. Maximum temperature occurs in the month of April to June and minimum temperature in January. Monthly minimum temperature varies from 6.4°C to 11.7° at Dhaka and in Sandwip 7.4°C to 13.0° during the period of December to March. These values of temperature are derived from the time series temperature data from 1967 to 2008 of Bangladesh Meteorological Department. Figure shows the variation of maximum, mean and minimum temperature at Dhaka and Sandwip.

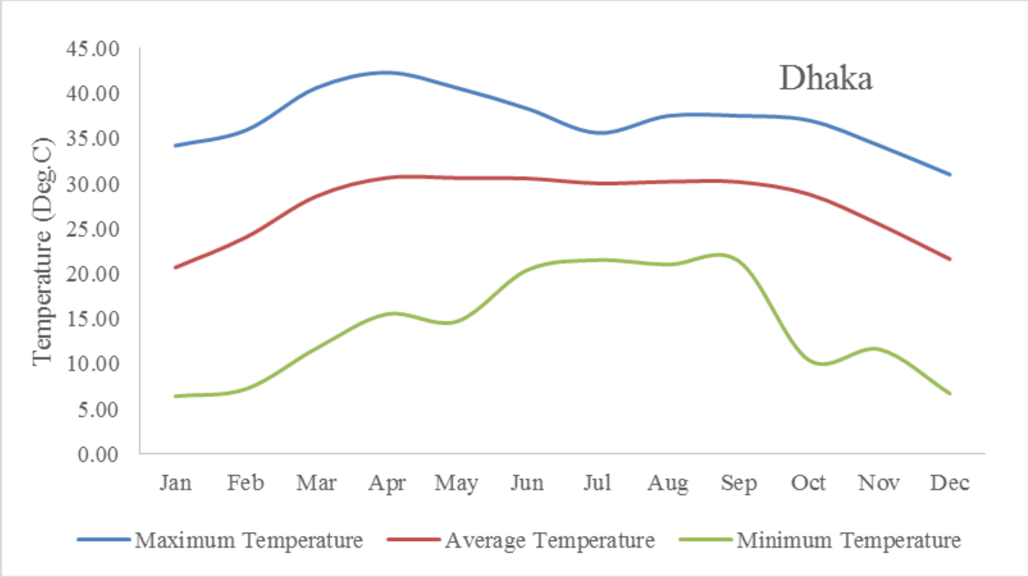


Figure 5.1: Variation of Monthly Maximum, Average and Minimum of Maximum Surface air temperature at Dhaka

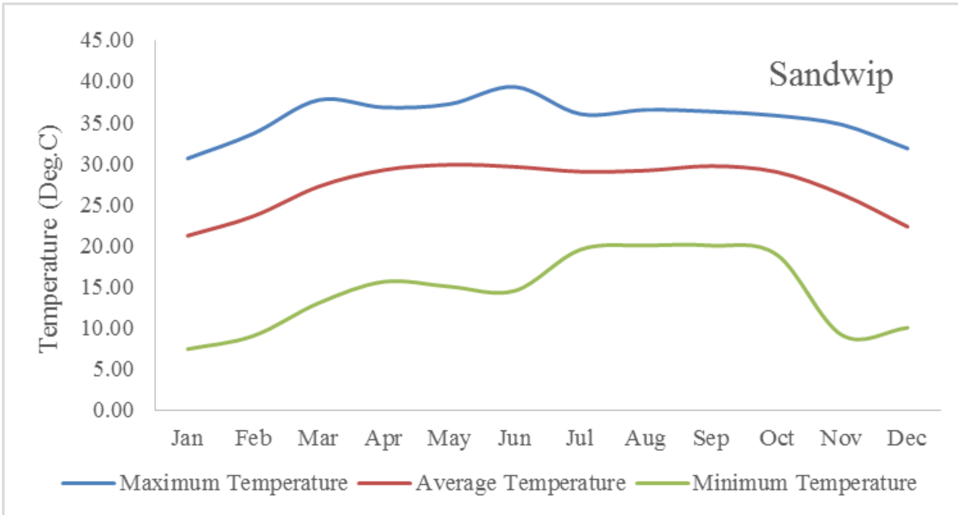


Figure 5.2: Variation of Monthly Maximum, Average and Minimum of Maximum Surface air temperature at Sandwip

Precipitation

Mean annual rainfall in this region is about 2100mm at Dhaka and 3480mm at Sandwip over a period of 40 years. About 75 to 80 percent of annual rainfall occurs during June to September. The maximum monthly rainfall during June to September varies from 450mm to 850mm in the study area. Monthly accumulated rainfall at Dhaka and Sandwip are presented in the Figure 5.3-Figure 5.4

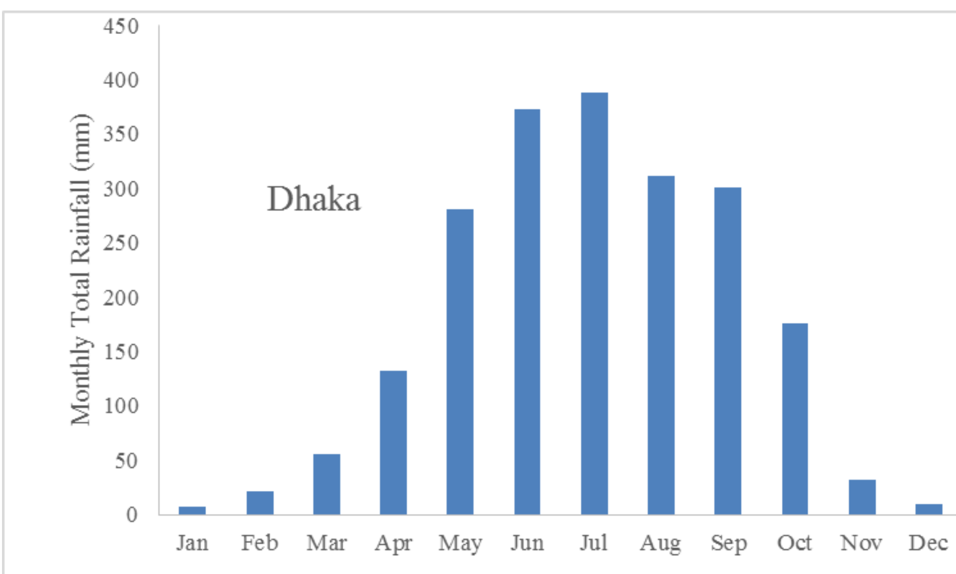


Figure 5.3: Monthly accumulated rainfall at Dhaka

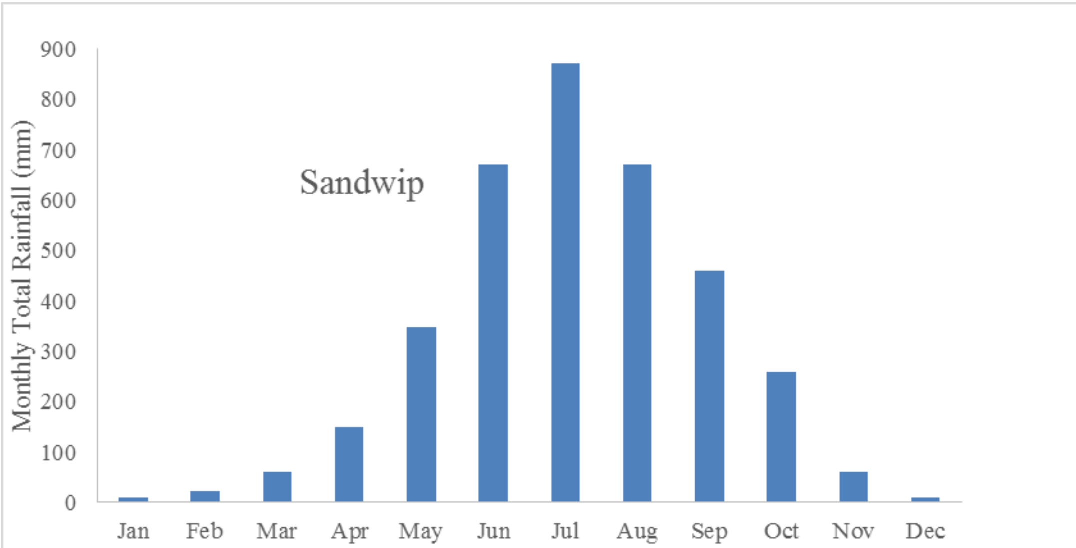


Figure 5.4: Monthly accumulated rainfall at Sandwip

Wind

The wind regime in the study area shows seasonal variation between the dry season (November to May) and the monsoon season (June to October). During the dry season the prevailing winds are calm. In the monsoon season the prevailing winds are from South-Southeast direction with an average speed of about 3-7.6 knot in the Meghna estuary based on data analysis of Bangladesh Meteorological Department for the period of 1966 to 2009. The maximum wind speed can be in the range of 32-99 knot. Table 5.1 shows the seasonal maximum and average wind speed in Lower Meghna estuary.

Table 5.1: Seasonal maximum and average wind speed in Lower Meghna estuary.

Seasonal maximum and average Wind speed (knot)								
Station	Pre-monsoon (March-May)		Monsoon June –September		Post-monsoon October- November		Winter December - February	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Chandpur	35	1.95	32	1.64	52	1.02	40	0.94
Barisal	65	4.47	99	4.23	80	2.86	50	2.87
Bhola	91	3.30	92	3.09	51	1.84	46	1.93
Hatiya	99	4.40	50	4.80	60	1.87	80	2.14
Sandwip	91	3.76	85	4.20	60	1.43	44	1.47
Chittagong	90	6.59	71	7.76	82	2.65	50	2.72

5.1.2 River Hydrology and Morphology

General

Bangladesh is a land of rivers. There are hundreds of rivers in Bangladesh with a large network of navigation routes. Transportation through waterways has always been a natural, environment friendly and relatively cheap mode of transport. Over the decades the navigability during dry season in many rivers of the country has been deteriorating because of morphological processes and for withdrawal of water from the rivers beyond the border and within the country. The navigability has been further aggravated by poor or no maintenance of inland waterways. Navigability of inland waterways is strongly influenced by river hydrology and morphology. River systems in Bangladesh exhibits high seasonality over a year i.e. abundant of water during monsoon and scarcity of water during dry season from December to May. Navigability becomes very critical during dry season in many river routes and ferry crossing because of siltation and inadequate water flow. It is very essential to know the hydrological and morphological characteristics along with biological environment of the river systems under the present study before implementing any navigation improvement measures. The present project includes the following major rivers for navigation improvement. Table 5.2 presents the major river systems of Dhaka-Chittagong corridor route.

Table 5.2: List of river systems under Dhaka-Chittagong Corridor with extension to Narayanganj, Ashuganj and Barisal

<table>
<tr><th>River(s)</th><th>From</th><th>To</th><th>Length (km)</th><th>Existing (BIWTA) River Class</th></tr>
<tr><td colspan="5">Main Dhaka-Chittagong Corridor Route</td></tr>
<tr><td>Buriganga, Dhaleshwari and Upper Mehhna</td><td>Dhaka (Zinzira River Ghat)</td><td>Munshiganj</td><td>30</td><td>1</td></tr>
<tr><td>Upper Meghna</td><td>Munshiganj</td><td>Chandpur</td><td>39</td><td>1</td></tr>
<tr><td>Lower Meghna and Meghna Estuary</td><td>Chandpur</td><td>Chittagong</td><td>211</td><td>1</td></tr>
<tr><td colspan="5">Narayanganj Extension</td></tr>
<tr><td>Shitalakhya</td><td>Gorashal</td><td>Demra</td><td>35</td><td>3</td></tr>
<tr><td>Shitalakshya and Upper Meghna</td><td>Demra</td><td>Munshiganj</td><td>22</td><td>1</td></tr>
<tr><td colspan="5">Ashuganj Extension</td></tr>
<tr><td>Upper Meghna</td><td>Ashuganj</td><td>Munshiganj</td><td>83</td><td>1</td></tr>
<tr><td colspan="5">Barisal Extension</td></tr>
<tr><td rowspan="5">Lower Meghna
Meghna Estuary
Arial Khan
NayaBhagnani
Tentulia
Maskata
Kirtonkhola</td><td colspan="2">Approach from Alubazar North of Batamara up-to At Hazar</td><td>83</td><td>2</td></tr>
<tr><td colspan="2">Approach via Muladiupto At Hazar</td><td>40</td><td>3</td></tr>
<tr><td colspan="2">Appoach via Hijlaupto At Hazar</td><td>32</td><td>2</td></tr>
<tr><td colspan="2">Approach via Ilishaupto At Hazar</td><td>37</td><td>1</td></tr>
<tr><td>At Hazar</td><td>Jhalokati</td><td>30</td><td>1</td></tr>
<tr><td colspan="5">Ferry Crossing Routes</td></tr>
<tr><td>Lower Meghna</td><td>Chandpur</td><td>Shariatpur</td><td></td><td></td></tr>
<tr><td>Lower Meghna</td><td>Lakshmipur</td><td>Bhola</td><td></td><td></td></tr>
<tr><td>Tentulia</td><td>Beduria</td><td>Laharhat</td><td></td><td></td></tr>
</table>

Project Influence area

The project influenced area is defined based on navigation routes, vessel shelters, ferry crossing, locations of dredge materials disposal, which covers the rivers, estuary and flood plain within 1km to 7km vicinity on both bank of the rivers. The project influenced area is marked in orrenge in the Figure 5.5. Annex-D represents measured data (Discharge and Water Level) within the project influence area during the study period.

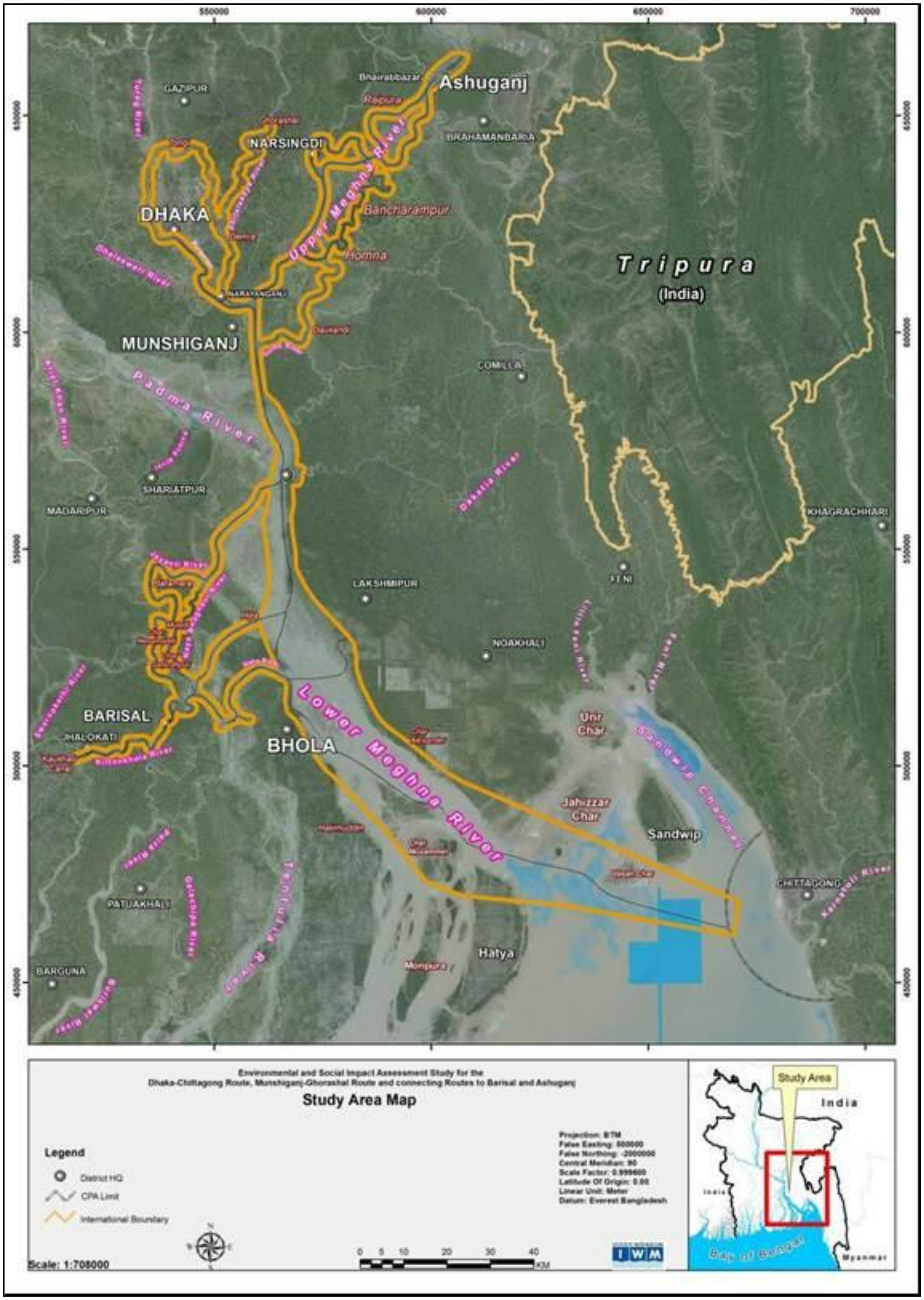


Figure 5.5: Project influenced area

Buriganga River

The Dhaka Metropolitan City is surrounded by the Buriganga-Turag, Balu, Lakhya and Tongi khal, which make a system of a circular water route and preserves the natural environment of the city. These rivers are gradually silted up including its off-take from the main source of the Brahmaputra/Jamuna river over the years. Currently, the flow of these rivers during dry season becomes very insignificant, which triggers the river water pollution as a serious problem. Such declined condition of river flows with morphological changes reduces the navigation and water-way communication system. Huge sedimentation at the off-take and river reaches is the major problem in achieving sustainable navigability and other economic development.

The rivers surrounding the Dhaka city receives water mainly from the Jamuna/Brahmaputra river including its floodplain flow during monsoon and during dry period, the off-take is fully cut-off due to huge sedimentation and the tidal water from the Meghna River enters into the river systems. In the dry period (from November to May) all the peripheral rivers are completely tidal and reversal of flow occurs in these rivers.

The Buriganga river, having a length of only 17km, is one of the most important rivers in Bangladesh. This river is economically very important to Dhaka. Launches and country boats provide connection to other parts of Bangladesh. It provides important services to the residents, including water supply, navigation, recreation, sanitation and flood control. This vital river however has become extremely polluted and is close to biological death for several reasons. The tremendous increase in population over the last three decades has created enormous environmental problems, including among others the disposal of solid waste, sewage and drainage problems. River depth is decreasing due to sludge deposition hence affecting the navigation. Proper dredging of the existing river and removing non degradable matters from the river bed are essential for restoring the river for its multi-purpose services.

The headwaters of the Buriganga river have been gradually reducing during the past few decades due to siltation and channel shifting. This has resulted currently to a situation where the flow is bare minimum in the dry season making the Buriganga less suitable for navigation and also the deteriorating the quality of the river water. A typical water level hydrograph at the Millbarak on the Buriganga River, which has little tidal influence, is shown in the Figure 5.6. The high seasonal variation is seen in the hydrograph.

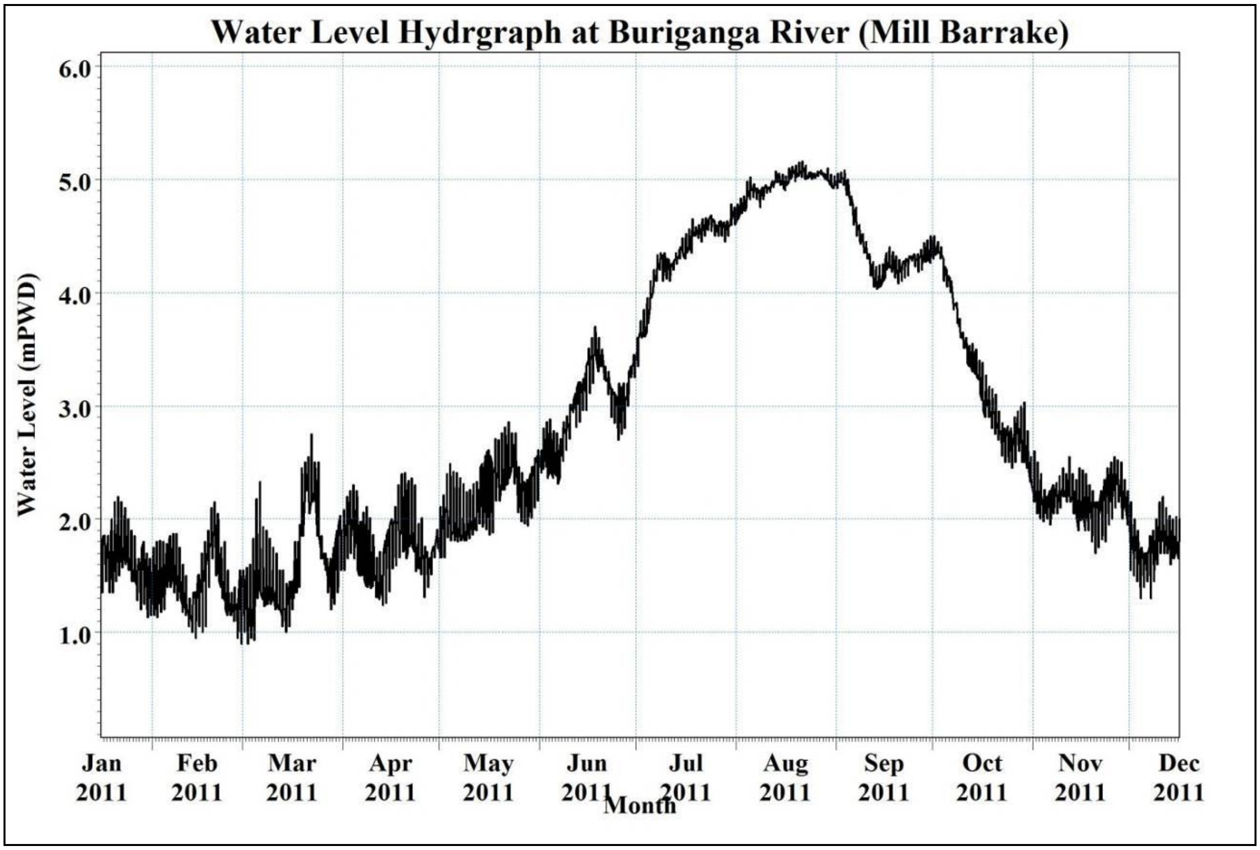


Figure 5.6: Observed water level hydrograph at Mill Barrake on the Buriganga river

The monthly statistics of daily water level is illustrated in the Table 5.3. Over the period of 1996 to 2012, it is seen that the minimum water level can fall to 0.52 mPWD and water level can rise to 7.2 mPWD.

Table 5.3: Monthly water level statistics of Buriganga river at Mill Barrake

Historical WL at Mill Barrake (Dhaka) on Buriganga River (1996-2012)			
Month	Maximum WL (mPWD)	Average WL (mPWD)	Minimum WL (mPWD)
January	2.2	1.39	0.65
February	2.64	1.24	0.52
March	2.75	1.37	0.6
April	3.17	1.79	0.77
May	3.95	2.38	1.14
June	4.87	3.47	2.04
July	6.68	4.67	2.9
August	6.70	4.95	3.43
September	7.24	4.76	3.32
October	5.41	3.75	1.92
November	3.83	2.42	1.12
December	2.65	1.75	0.9

The minimum daily water level from December to April is below 1 mPWD. However, average monthly water level varies from 1.24 mPWD to 1.79 mPWD for the same period indicating higher navigation depth for a considerable period even in the dry season.

The maximum flow occurs during monsoon, which is 2630 m^3/s. The minimum flow over the period of 1996 to 2012 is 110 m^3/s. The river exhibits high seasonality of water flow triggering a critical condition for navigability during dry season. Figure 5.7 shows the monthly variation of water flow/discharge of Buriganga river at Mill Barrake.

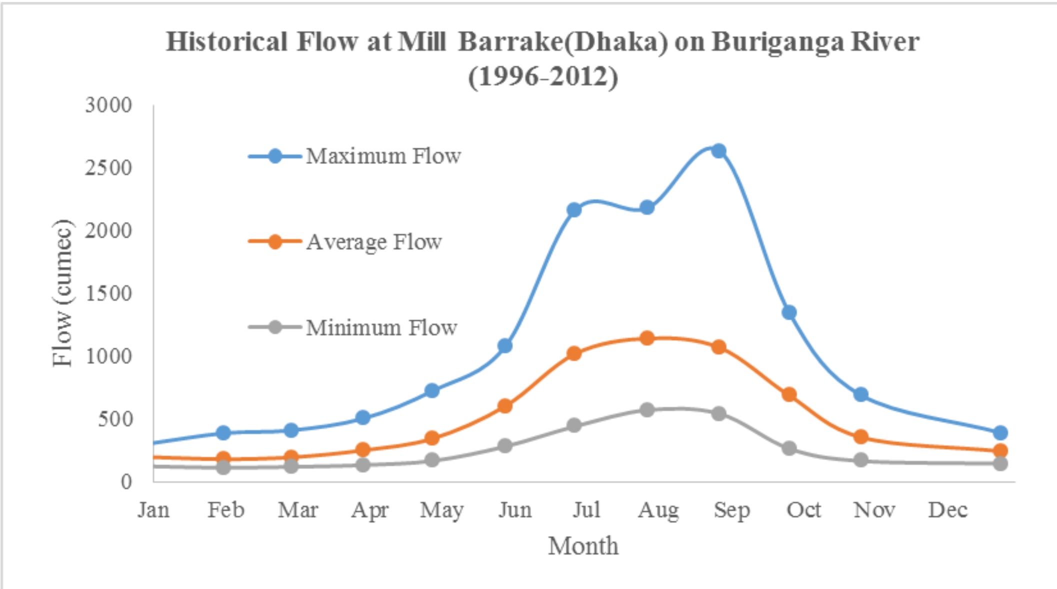


Figure 5.7: Monthly minimum, maximum and average discharge hydrograph of Buriganga river at Mill Barrake

Shitalakhya River

The river Shitalakhya flows along the eastern side of Dhaka and Narayanganj districts and falls into the river Dhaleswari near Madanganj of Narayanganj. The river is 110 km long and 250 m wide, having 375 hectare water area. The river flows through Gazipur. The Shitalakhya river was once an important center for the industry. Even today, there are centres of artistic weaving on its banks. There also are a number of industrial units on its banks, including the thermal power plants. Industrial affluent dumped into the river resulting in high levels of pollution is a cause for concern. There is a river port in Narayanganj, numerous launches move out along the river to different parts of Bangladesh. The government has approved construction of a container terminal on the river Shitalakhya with foreign investment.To understand the seasonal variation, a typical hydrograph at Demra on the Sitalakhya River is shown in Figure 5.8. The water level variation over the years is very high and during dry season the river is influenced by tide as seen in the water level hydrograph.

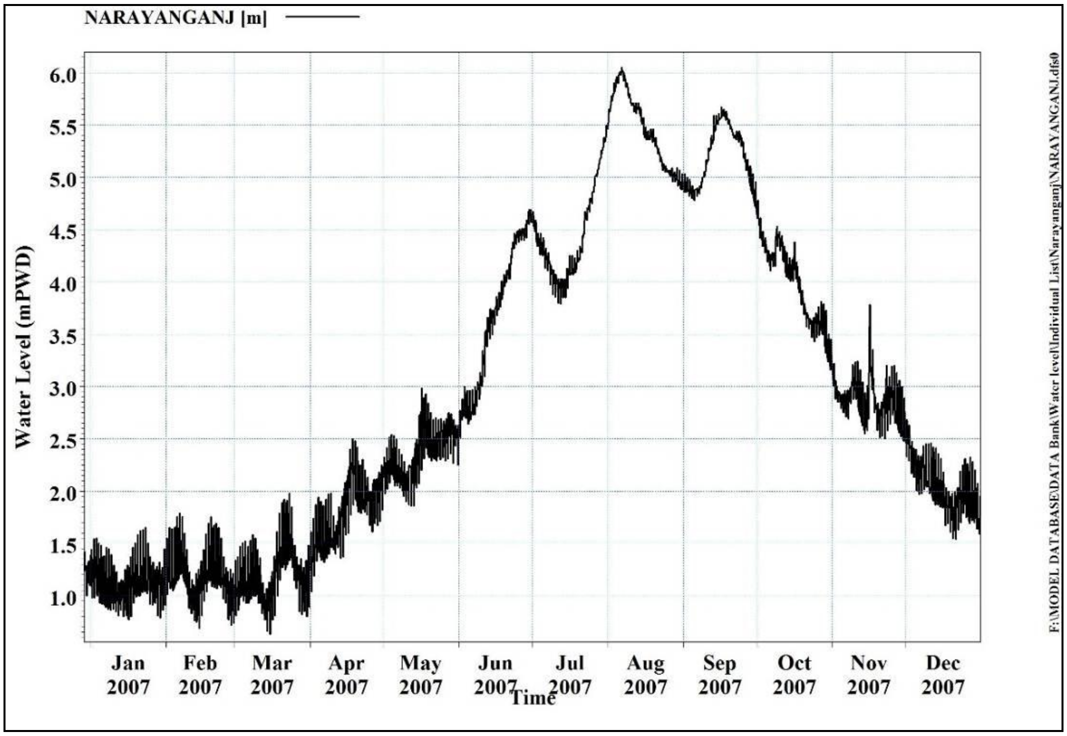


Figure 5.8: Observed water level hydrograph on Shitalakhya river at Demra

Daily water level variation is from 0.72 mPWD to 6.92 mPWD, which implies huge seasonal variation of available navigation depth. Water level starts to rise from the month of April and reach at peak in the month of August as seen in the Table 5.4. Water level remains at higher level from April to November providing good navigation depth in this period of the year.

Table 5.4: Monthly water level statistics of Shitalakhya river at Demra

Water Level Variation in Shitalakhya River at Demra (1990-2012)			
Month	Maximum WL	Average WL	Minimum WL
January	2.57	1.60	0.72
February	2.28	1.49	0.81
March	3.09	1.63	0.74
April	3.41	2.08	1.07
May	4.10	2.71	1.37
June	5.27	3.75	2.33
July	6.70	4.95	3.15
August	6.92	5.25	3.84
September	6.70	5.01	3.85
October	5.57	4.06	2.27
November	3.87	2.65	1.43
December	2.81	1.97	1.15

The water flow varies from $40m^3/s$ to $540m^3/s$ over a year. During dry season the water flow/discharge is very low. The monthly average flow varies from $65m^3/s$ to $75\ m^3/s$ during the period from January to March causing low river water level that results in inadequate navigation depth. The monthly maximum, minimum and average flows are presented in the Figure 5.9.

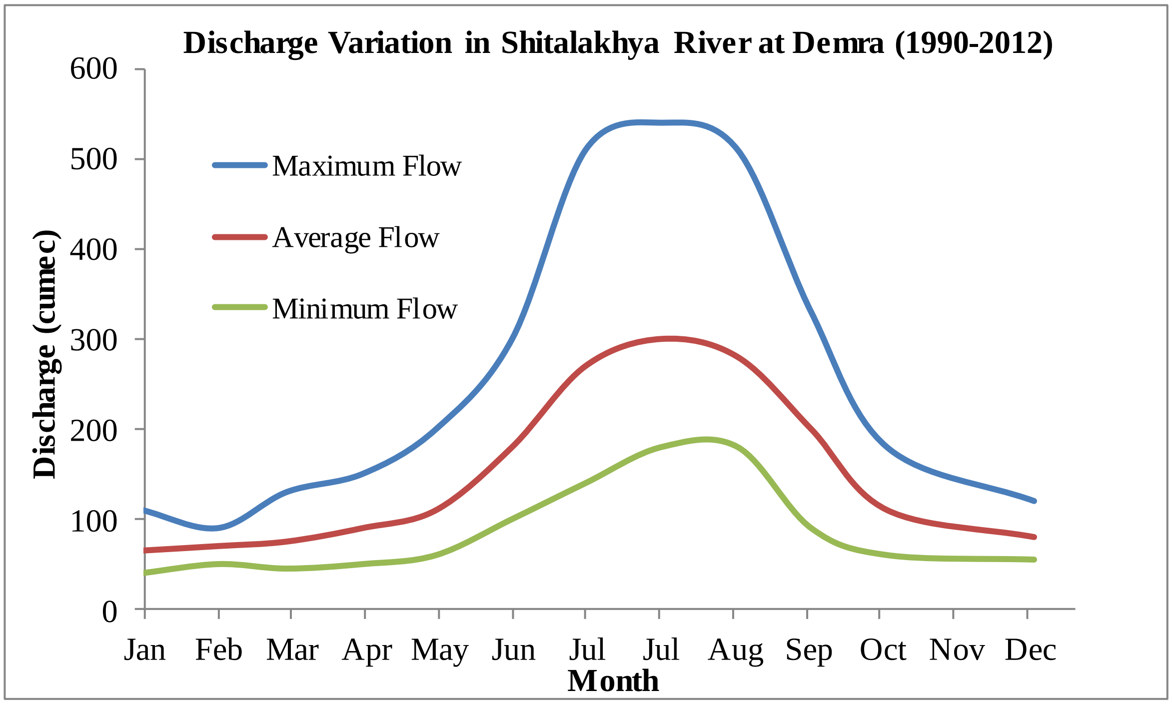


Figure 5.9: The monthly maximum, minimum and average flow hydrographs of Shitalakhya river at Demra

The Lakhya system is a stable meandering rivers. The reduction of the sinuosity of the Lakya near its downstream part indicates that the water and sediment charges are in balance with the channels capacity.

Dhaleswari River

The Dhaleswari River is the main left-bank distributary of the Jamuna/Brahmaputra river and is the main channel of a complex river system. The maximum flow in the river is around 1400 m^3/s. Off-take morphology of this river from the Brahmaputra/Jamuna comprises a system of watercourses subject to continuous morphological changes thereby influencing the flow entrance as well as location at which it takes place. During the construction period of Jamuna Bridge in 1995, the off-take of Old Dhaleswari became completely closed by construction of closure. However, as an immediate response of the Jamuna, there was a further widening of the already existing small spill channel around 2km downstream of the present Jamuna Bridge location along the left side and got connected to the old course of Old Dhaleswari river. Previously, the pungli was a distributary from the Old Dhaleswari River. Now, the Old Dhaleswari becomes the inland river and the Pungli is directly feeding from the BrahmaputraJamuna. The maximum flow in the Pungli is around 600 m^3/s. The off-taking river, Dhaleswari is flowing full/partly in the monsoon starting from June to October and other months remain dry in a year (Figure 5.10). The downstream part (near Rekabibazar) of the Dhaleswari River has little bit tidal influence with a fluctuation of around 0.5m. The percentage historical changes of annual flow volume of the Dhaleswari River with respect to the Bramaputra/ Jamuna flow.The flow through the Dhaleswari River was nearly 7% of the Jamuna flowing 1960's and rapidly declined to 3.5% of its parent river in 1970. This flow continued till the early 1990's. Probably, after closing the north off-take of the Dhaleswari River in connection with the Jamuna Bridge, the flow of the river further reduced to 1% of the Jamuna River and thus various planform parameters of the river adjusted themselves by reducing flow of the river (IWM, 2004). The flow at the offtake of the Dhaleswari river has been analysed to find the minimum, average and maximum flow. Figure 5.10 and Table 5.5**Error! Reference source not found.** show the monthly flow statistics over the year. It is seen that the upstream flow is almost zero during dry season, which implies that the offtake needs to be dredged for restoring the dry season flow.

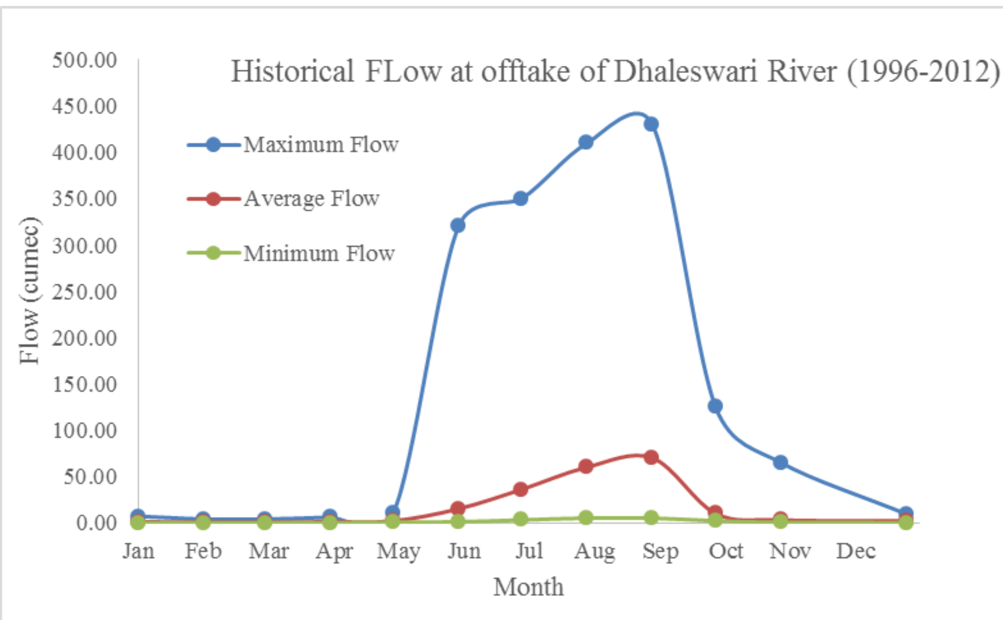


Figure 5.10: Monthly water flow hydrographs of Daleswari river at Off-take

During monsoon maximum flow is quite significan and can be 430 m^3/s as seen in the Table 5.5.

Table 5.5: Monthly flow statistics of the Dhaleswari river at the Off-take (1996- 2012)

Historical Flow at offtake of Dhaleswari River (1996-2012)			
Month	Maximum Flow (cumec)	Average Flow (cumec)	Minimum Flow (cumec)
January	7.00	1.00	0.00
February	4.00	0.60	0.00
March	4.01	0.70	0.00
April	6.00	1.00	0.03
May	10.00	2.00	0.50
June	320.00	15.00	1.00
July	350.00	36.00	3.00
August	410.00	60.00	5.00
September	430.00	70.00	5.00
October	125.00	10.00	2.00
November	65.00	3.00	0.50
December	9.00	2.00	0.04

Upper Meghna River

The upper Meghna River flows in the north-eastern part of Bangladesh .The Upper Meghna carries the combined flow of the Surma and the Kusiyara Rivers which originate in the Indian hills northeast of Bangladesh. The Surma River flows through the Sylhet area which is rapidly sinking away. A number of tributaries of the Surma originate from the Sisang hills in India and from piedmont areas. They bring quite some sediment (boulders, gravel, sand), that most probably settles in the Sylhet area.

Going in downstream direction, the Upper Meghna River is joined by the Old Brahmaputra at Bhairab Bazar. The Dhaleswari is another tributary (and another distributary from the Jamuna system) and it joins the Upper Meghna River at Munshiganj on the right bank. Some tributaries that originate from the Tripura hills join the Upper Meghna at the left bank. Although having some reaches with a system of various channels, the Upper Meghna River can be characterized as a river mainly meandering within a well-defined high water bed and having flood discharges up to some 16000 m^3/s.

1) Water Level

Time series daily water level of Upper Meghna river at Bhairab Bazar was analysed to find the statistics of water level in characterising the variation of water level over a year. Figure 5.11 presents the monthly variation of water level and Figure 5.12 shows observed water level at Bhairab Bazar. The daily water levels at Bhairab Bazar vary between 0.74 m and 7.78 m (see Table 5.6). Figure 5.11 demonstrates water level statistics. The water level along the Upper Meghna are subjected to tidal influence. During low flows in the UpperMeghna River the tidal range near the confluence with the Padma River is about 1m and under those conditions still a vertical variation in tide of some 0.2 m is noticeable in Bhairab Bazar.

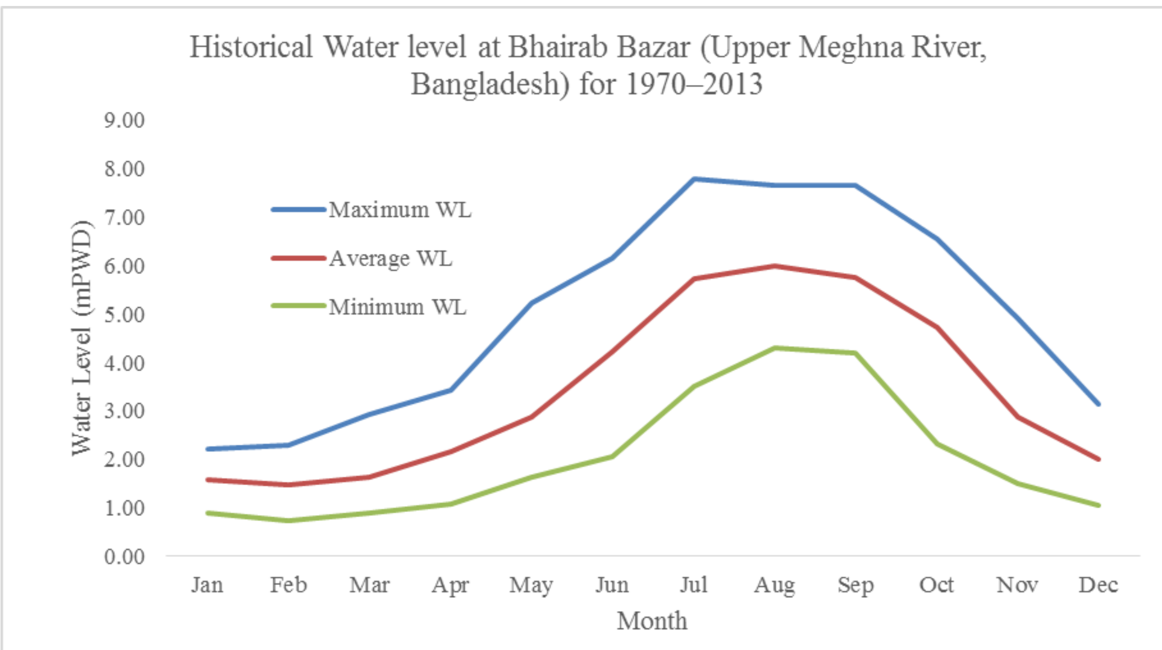


Figure 5.11: Monthly variation of minimum, average and maximum water level of Upper Meghna river at Bhairab Bazar

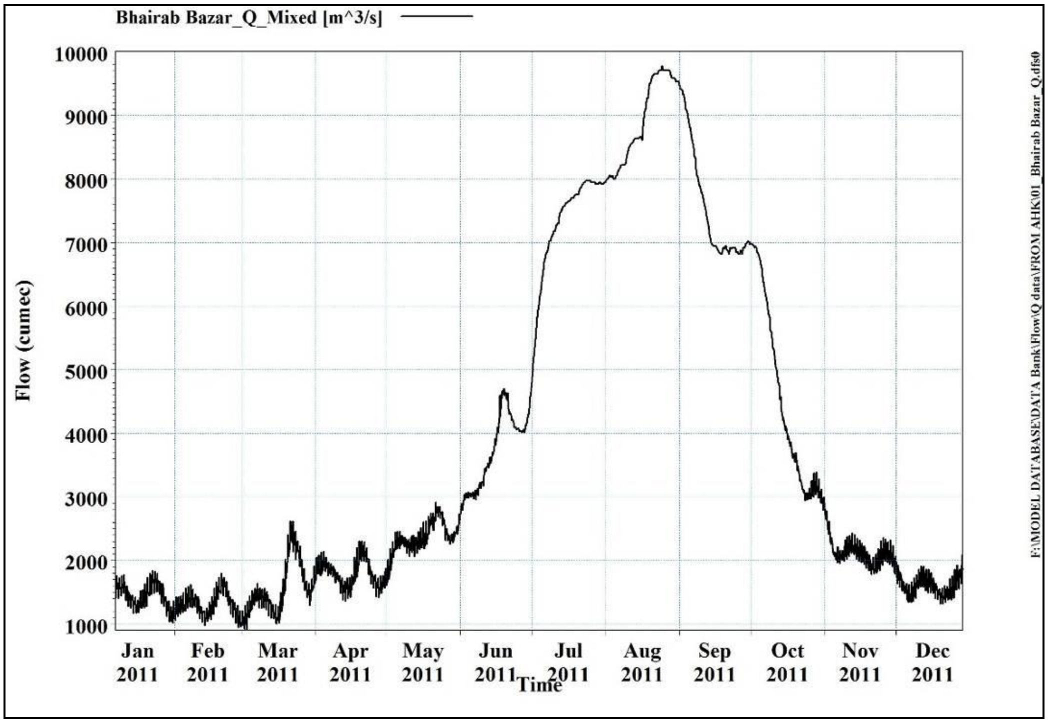


Figure 5.12: Observed water level hydrograph of the Upper Meghna River at Bhairab bazar

The minimum water level can fall below 1m from January to March as seen in the monthly statistics of water level and there is every likely to experience inadequate navigation depth in this Class 1 route during this period. Table 5.6 presents the water level statistics. The seasonal variation is quite significant and seasonality index i.e. ratio between maximum and minimum water level over a year is about 9 which implies higher navigation depth from June to October.

Table 5.6: Water level statistics of Upper Meghna River at Bhairab Bazar

Historical water level at Bhairab Bazar (Upper Meghna River, Bangladesh) for 1970–2013			
Month	Maximum WL (mPWD)	Average WL (mPWD)	Minimum WL (mPWD)
Jan	2.22	1.59	0.89
Feb	2.29	1.48	0.74
Mar	2.94	1.64	0.90
Apr	3.43	2.16	1.09
May	5.23	2.89	1.63
Jun	6.14	4.21	2.06
Jul	7.78	5.73	3.51
Aug	7.65	6.00	4.29
Sep	7.66	5.74	4.19
Oct	6.55	4.71	2.31
Nov	4.91	2.89	1.51
Dec	3.14	2.01	1.06

2) Discharges

The major contributors to the river upstream of Bhairab Bazar are from the Baulai, the Surma and the Kushiyara rivers, covering an area of 62,960 km^2. The river stretch Meghna River from Bhairab Bazar to Chandpur is about 125 km in length and known as Upper Meghna river. Width of the river varies from 1 km to more than 10 km. The river channel is more or less well defined upstream of its confluence to the Padma. The river bed and banks consists mainly of clayey-silt which is often loosely packed and is susceptible to liquefaction at some places. Of the three major rivers, the Upper Meghna carries relatively less sediment The range of variation of other characteristic sizes along the Upper Meghna River for single value of D_{50} is 0.130mm. Figure 5.13 shows the minimum, maximum and monthly mean discharge of the river at Bhairab Bazar.

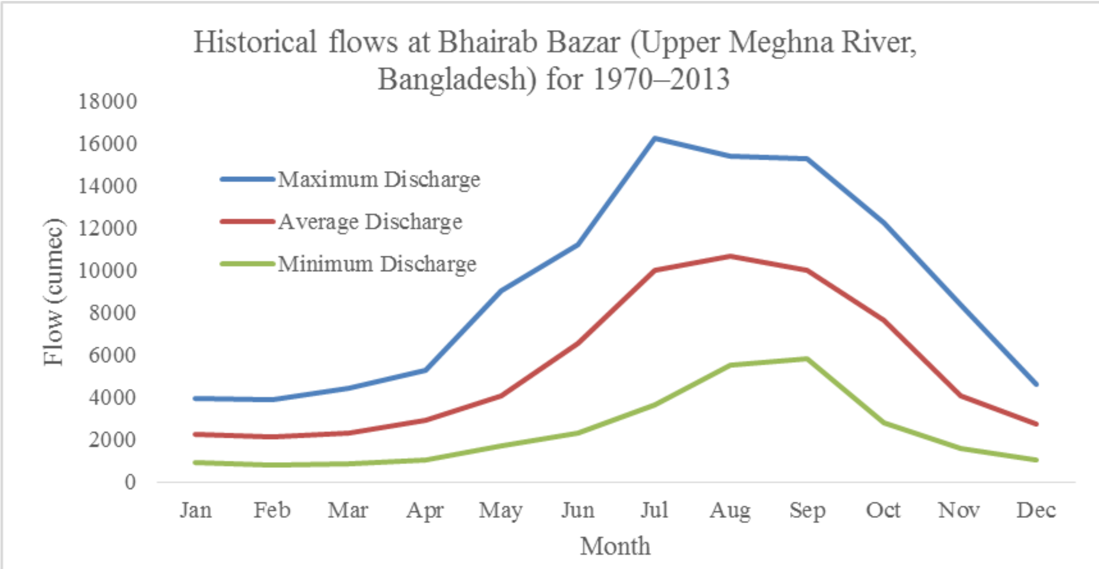


Figure 5.13: Monthly flow hydrograph of the Upper Meghna riverat Bhairab Bazar

The maximum flow is about 16203m^3/s and occurs during July to August. The river discharge falls significantly during dry season and becomes about 800m^3/s resulting in very low water level as well as navigation depth.

Water flow in the river governs the navigation depth along the river length. There is a high seasonal variability of water Flow in the Upper-Meghna river (Table 5.7). The average daily water flow at Bhairab Bazar varies between 0.74m and 7.78 m over a year. The lowest figure demonstrates the small slope along the river during lowest discharges.

Table 5.7: Water flow statistics at Bhairab Bazar of Upper-Meghna river (1970-2013)

Month	Maximum Discharge (cumec)	Average Discharge (cumec)	Minimum Discharge (cumec)
Jan	3920	2250	940
Feb	3880	2130	800
Mar	4460	2310	840
Apr	5250	2930	1060
May	9060	4050	1680
Jun	11200	6560	2340
Jul	16200	9990	3620
Aug	15360	10660	5530
Sep	15240	10000	5830
Oct	12230	7630	2800
Nov	8360	4080	1620
Dec	4600	2760	1060

5.1.3 Estuarine and Coastal Hydrology

Tide

The Meghna Estuary is a very dynamic estuarine and coastal system. Here, at the northern end of the Bay of Bengal, the combined flow of two of world's largest rivers, Ganges and Brahmaputra (Jamuna), finds its way through the Lower Meghna River to the sea. Erosion and accretion rates are high and the area is periodically subject to severe storms and cyclones, these latter accompanied by tidal bores and storm surges. Figure 5.14 shows the map of Lower Meghna Estuary.

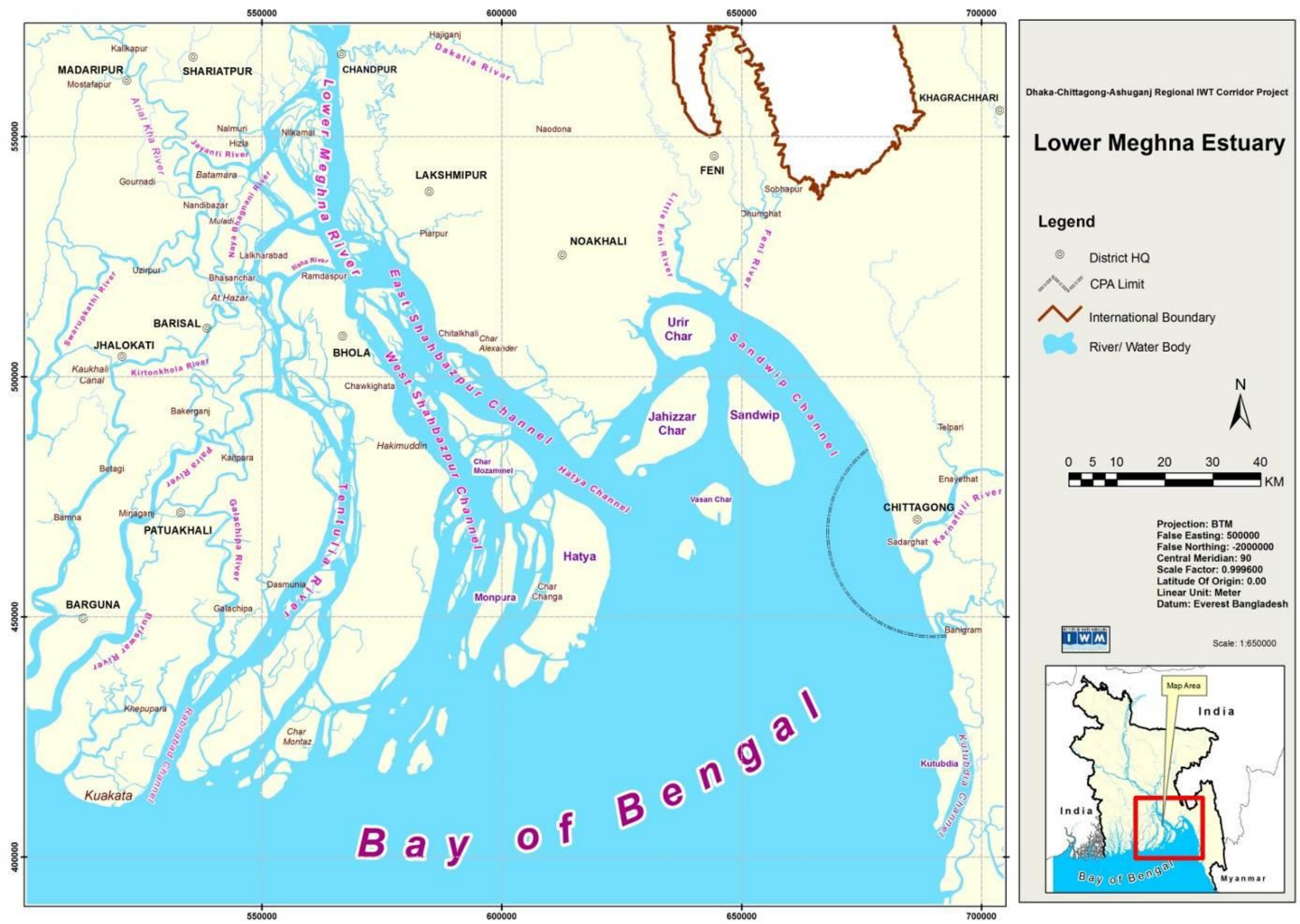


Figure 5.14: Map showing the Lower Meghna Estuary

The Lower-Meghna, Tentulia, Kirthonkhola rivers and Meghna Estuary serve as important navigation routes for Inland Water Transport, which are characterized by tidal and wave actions. The tidal wave from the Indian Ocean travels through the deeper part of the Bay of Bengal and approaches the coast of Bangladesh approximately from the south. It arrives at Hiron Point and at Cox's Bazar at about the same time. The extensive shallow area in front of the large delta causes some refraction and distortion. Also some reflection of the tidal wave occurs contributing to a significant amplification of the tidal wave in Hatia and Sandwip Channels.

Tides in the Bay of Bengal are semi-diurnal in nature, exhibiting two high waters and two low waters per day. The amplitudes of the two cycles differ slightly. Over a longer term, a fortnightly variation in amplitude between spring and neap tides is also evident, with spring tide amplitudes approximately 2.5 to 3 times higher than the neap tide. The duration of on etidal cycle is 12hr 25 minutes and duration of 2 tidal cycle is 24hr 50 minutes. The water level variation is dominated by a semi-diurnal tide with a considerable variation from neap to spring tides. In the western part of the coastal area of Bangladesh the average tidal range is approximately 1.5 m. In the area around Sandwip, the tidal range is significantly higher. Figure 5.15 shows maximum tidal variation at the west coast of Sandwip Island. It is seen the maximum tidal range is about 6.6m. The area around Sandwip island is macro-tidal with variation in tidal range of about 3 to 8 m. The area between Bhola and Hatia (Shabhazpur Channel) is meso-tidal, with tidal range of 2 to 4 m.

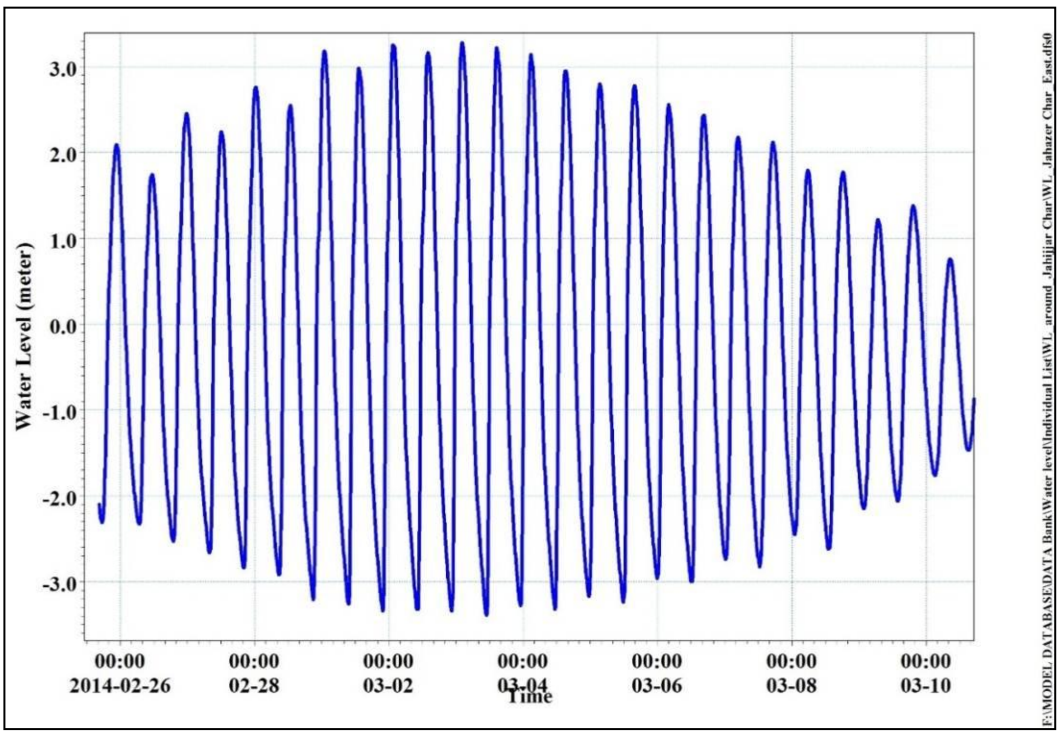


Figure 5.15: Tidal variations at the west coast of Sandwip Island

There is a considerable seasonal variation of water level in the Meghna Estuary due to huge onrush of upstream flow and wind setup in the Bay of Bengal during monsoon. This seasonal variation influences the navigability in the river and difference of navigation depth is more than a meter between dry and monsoon. Considering the importance of seasonal variation, the seasonal characteristics of the water level is ascertained.

Moving average considering 56 tidal cycles of half hourly observed water level data was carried out to find the seasonal variation of water level in the Lower Meghna river. Figure 5.16 shows the seasonal variation of the water level in the Lower-Meghna river at Chitalkhali of Lakshmipur district. It is seen that seasonal variation is about 1.4m, which also varies year to year depending of upstream flood flow during monsoon.

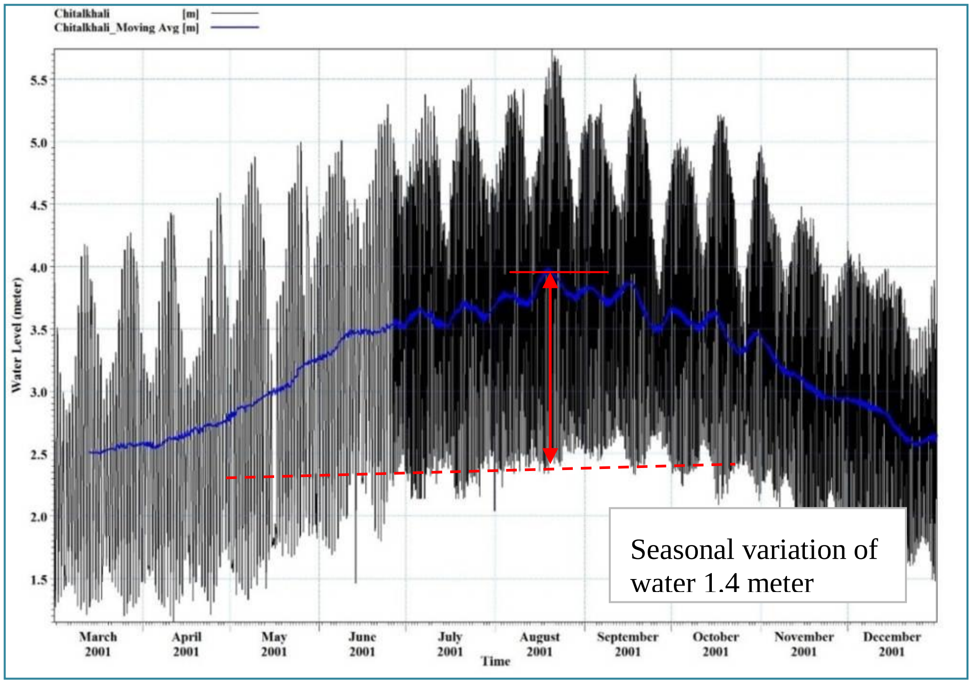


Figure 5.16: Tidal variation, tidal range and seasonal variation in the west of Sandwip Island (Source: IWM)

The seasonal variation of the mean high water level (from dry to the wet season) decreases significantly along the Lower Meghna Estuary in southwards directions. The seasonal variation of the mean high water level at Chandpur is about 3 m. The variation in the southern part of the Bangladesh coast is about 0.8 to 2.1 m.

The monthly minimum, mean and maximum water level over a year is shown utilizing the time series water level data over a period of 22 years. Figure 5.17 and Table 5.8 shows the monthly variation of water level in the Lower Meghna river at Chandpur. Considerable variation of water level is seen over a year in minimum, mean and maximum water level. It is evident from the table the water level variation is 0.18m,PWD to 5.52m,PWD showing high seasonal variation. However, the navigation depth at and around chandpur is adequate over the year.

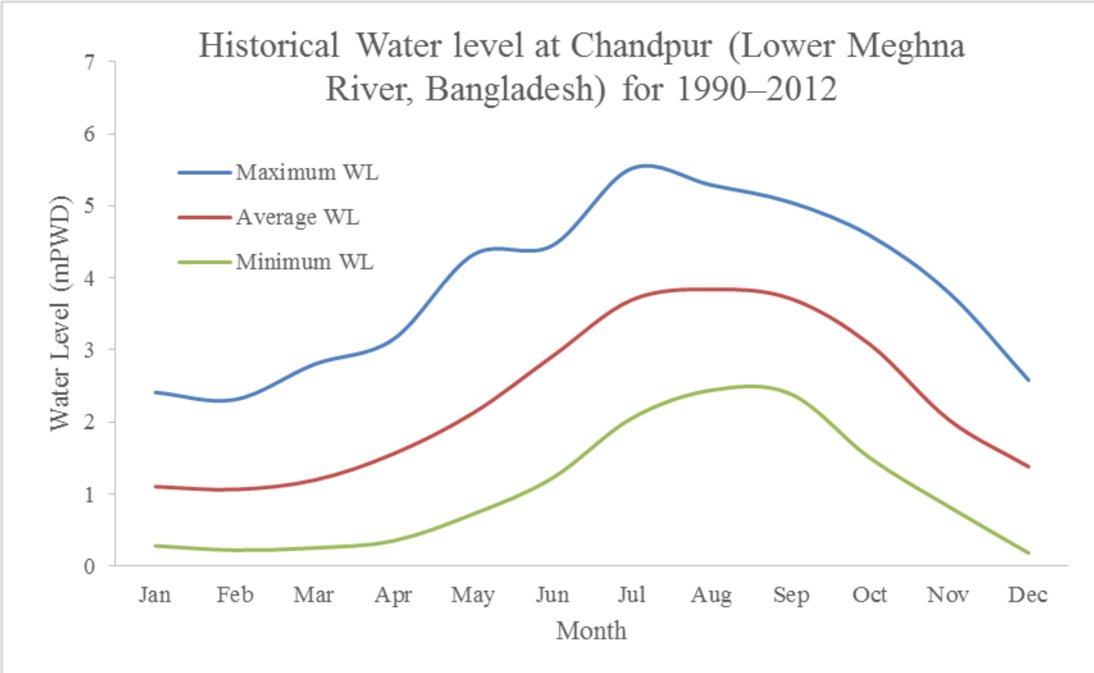


Figure 5.17: Monthly variation of water level in the Lower Meghna river at Chandpur

Table 5.8: Monthly maximum, average and minimum water level at Chandpur (Lower Meghna River,1990–2012)

Water level statistics at Chandpur			
Month	Maximum WL (mPWD)	Average WL (mPWD)	Minimum WL (mPWD)
Jan	2.41	1.10	0.28
Feb	2.31	1.06	0.22
Mar	2.8	1.19	0.25
Apr	3.15	1.56	0.35
May	4.32	2.12	0.72
Jun	4.45	2.91	1.22
Jul	5.52	3.69	2.05
Aug	5.29	3.84	2.44
Sep	5.05	3.71	2.39
Oct	4.59	3.08	1.5
Nov	3.79	2.03	0.82
Dec	2.58	1.38	0.18

It is evident from the Table 5.8 and the Figure 5.17 that there is a significant variation of monthly maximum, average and minimum water level at different months. Average monthly water level during dry season (December to May) varies from 1.06 m to 2.12m, the seasonal variation of average water level is about 2.78m over a year. It implies that on an average about 2.78m additional navigation depth is available during monsoon compared to the dry season. However, the Lower Meghna river at an around Chandpur is very deep and usually there is no navigation problem, and there is an evidence of it in the recent bathymetric survey carried out by BIWTA. Water level statistics at different locations of the Meghna estuary is presented in the Table 5.9.

Table 5.9: Water level statistics at different locations of the Meghna estuary

Station	River Name	Dry Season (November-April)			Monsoon (May - October)		
		Maximum WL (mPWD)	Mean WL (mPWD)	Minimum WL (mPWD)	Maximum WL (mPWD)	Mean WL (mPWD)	Minimum WL (mPWD)
Chandpur	Lower Meghna	2.65	1.26	0.18	4.98	3.45	1.22
Chitalkhali/Laxmipur	Lower Meghna	3.15	1.05	-0.95	4.15	2.05	-0.35
Char Ramdaspur	Tentulia	3.16	1.21	-0.06	4.38	2.35	0.66

The critical period for navigation is dry season and it is seen that the minimum water level drops considerably at the downstream of the Lower Meghna river. The minimum water level is quite low in the East Shabazpur channel and in the Tentulia river. If sedimentation occurs along the navigation channel at these locations then adequate draft for cargo traffic might not be available.

Water flow

The Lower Meghna River conveys the combined flow of Ganges, Brahmaputra and Upper Meghna rivers. Again the combined flow of Ganges and Brahmaputra is known as the Padam river flow, which meets at Lower Meghna river at Chandpur. The discharge of the Padma and Upper Meghna rivers characterise the water flow of the Lower Meghna river. Long-term record of discharge is not available at Chandpur since it is not a routine discharge gauging station of BWDB or BIWTA. Hence, discharge characteristics of the Padma river is used to characterise the water flow Lower Meghna river. The monthly mean discharge of the Padma river varies from 5800m^3/s in the month of February to 72,000m^3/s in August (Source: BWDB time series discharge data) at Baruria (Figure 5.18). The average monthly minimum flow in the Padma river is 3700m^3/s in February and 33400 m^3/s in August. These statistics is based on the time series data of discharge over a period of 42 years.

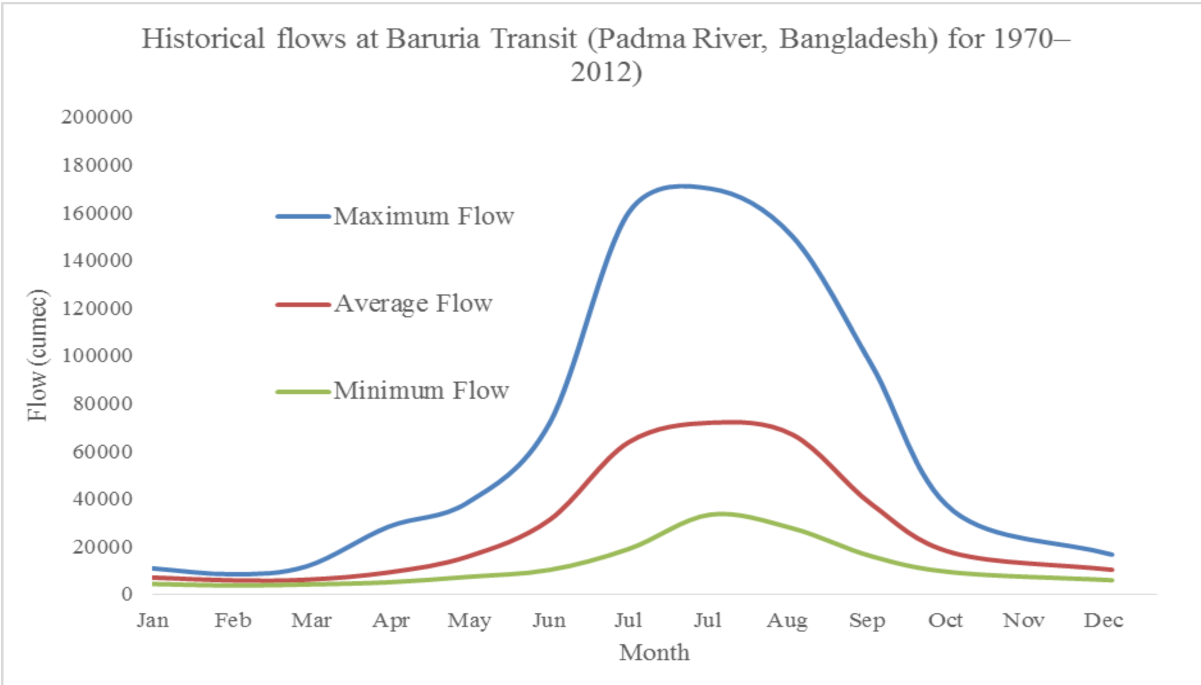


Figure 5.18: Monthly flow hydrograph of Padma river at Baruria

The water flow/discharge in the West Shahbazpur Channel between Bhola and Monpura Island is presented in the Figure 5.19. It is observed that the peak discharge may reach at 100000m^3/s.

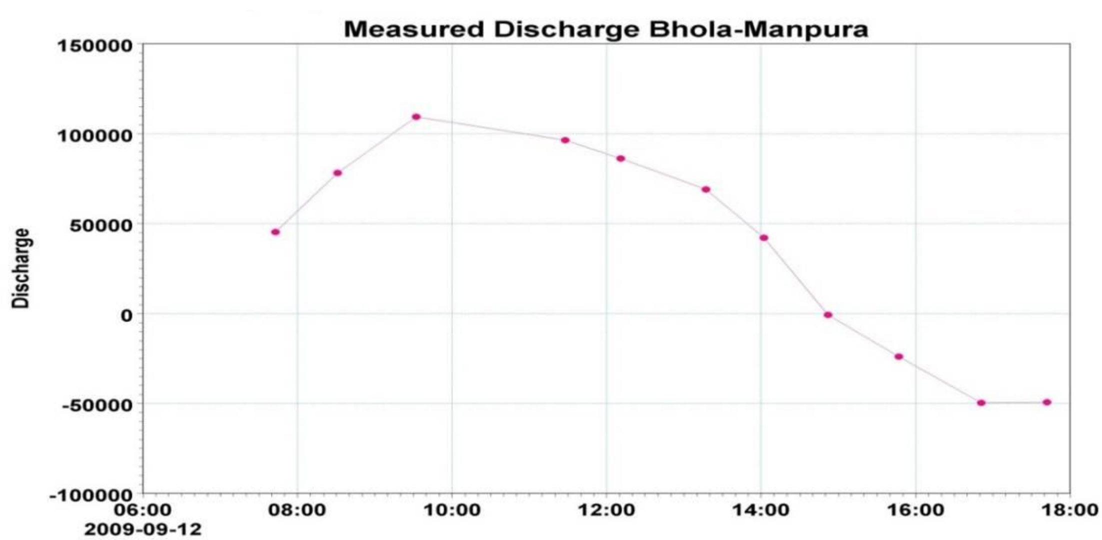


Figure 5.19: Observed discharge in a tidal cycle in the channel between Bhola and Manpura Islands

Flow distribution in the different channel of the Lower Meghna Estuary

Water flow in the channel is the independent variable to ensure the navigation depth and long term stability of the navigation channels. To estimate the overall water flow distribution in the various channels of the lower Meghna estuary the hydrodynamic conditions has been simulated for one month for both dry (February-March) and wet (August) periods for the available flow conditions of 2009. The distribution of flow among the main channels in the Meghna Estuary as found from the simulations is presented in Table 5.10 and Figure 5.20 for the dry season and in Table 5.11 and Figure 5.21 for the wet season.

Table 5.10: Overall flow distribution during Dry Season

	Maximum flow (m^3/s) during flood tide(High Tide) in Dry Season	Maximum flow (m^3/s) during ebb tide (Low Tide) in Dry Season
Hatia Channel at North Hatia	121,601	81,457
East Shahbazpur Channel (at level of Manpura)	41,480	33,737
West Shahbazpur Channel (at level of Manpura)	105,779	89,005
Tetulia	17,772	16,051
East Shahbazpur Channel (at level of Char Gazaria)	74,396	46,950
West Shahbazpur Channel (at level of Char Gazaria)	54,269	49,987

[1)] Source: IWM, 2009

Table 5.11: Overall flow distribution during Wet Season

	Maximum flow (m^3/s) during flood tide(High Tide) in Monsoon Season	Maximum flow (m^3/s) during ebb tide (Low Tide) in Monsoon Season
Hatia Channel at North Hatia	154,490	136,818
East Shahbazpur Channel (at level of Manpura)	60,373	58,019
West Shahbazpur Channel (at level of Manpura)	133,856	151,168
Tetulia	17,969	16,739
East Shahbazpur Channel (at level of Char Gazaria)	81,801	105,672
West Shahbazpur Channel (at level of Char Gazaria)	61,361	117,916

[1)] Source: IWM, 2009

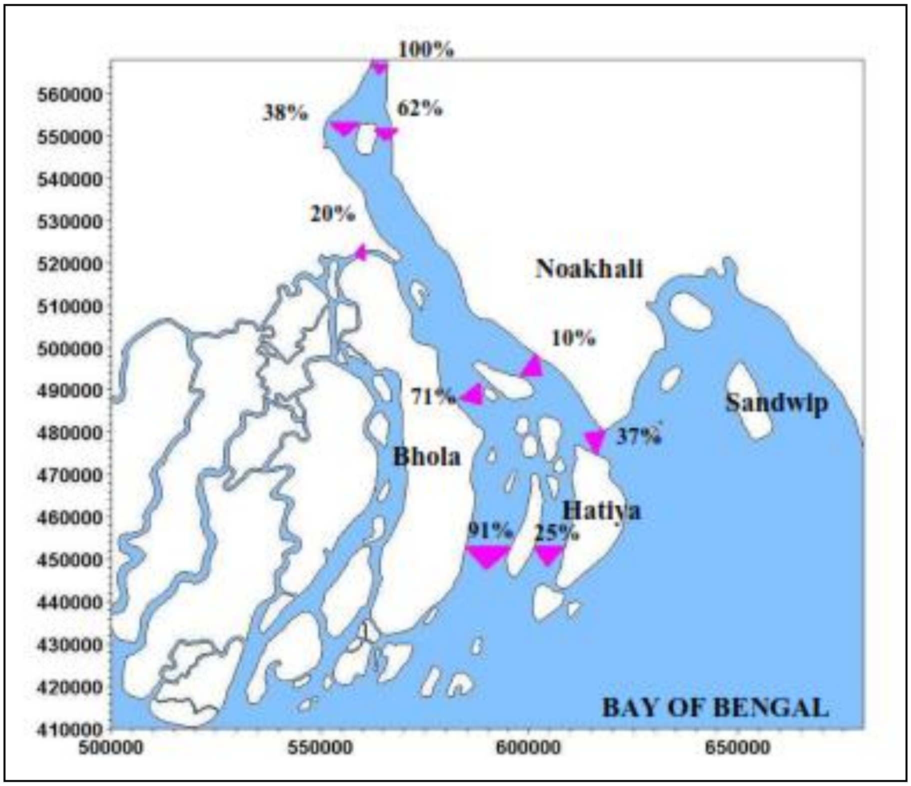


Figure 5.20: Net flow distribution in % of flow at Chandpur during dry season

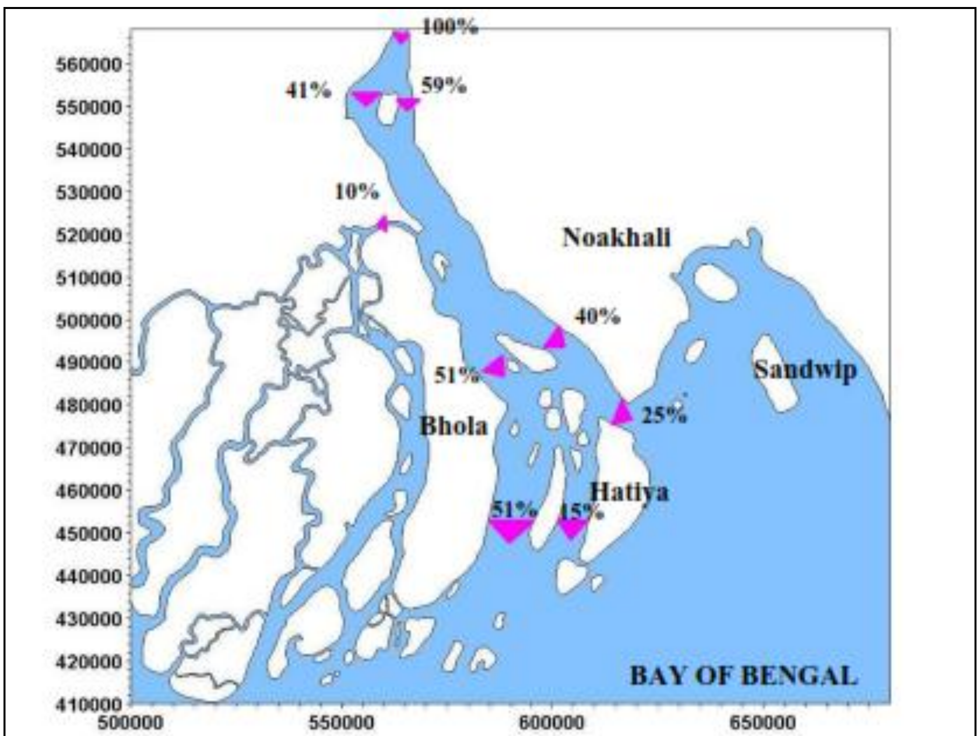


Figure 3.10: Net flow distribution in % of flow at Chandpur during wet season

Figure 5.21: Net flow distribution in % of flow at Chandpur during wet season

Hatiya channel is influenced by tide which results in northward net flow in the channel during dry season. The north tip of Hatiya is experiencing erosion and the flow in Hatiya channel has increased at present time with respect to 2000 as shown in the MES-II study. Most of the Lower Meghna river flow is conveyed along the west part of the estuary through the West Shahbazpur Channel. This is why net flow is high in this channel compared to the other channels of the river system. The model results show that continuous erosion is taking place at the east bank of Char Gazaria and west bank of Ramgati. The net monsoon flow in the channel is found relatively higher in this study than that of MES-II. The net flow through the Lower Meghna River at the east of Char Bhairabi has increased significantly than its west branch. In MES-II study approximately same net flow was found in the two branches. At present the flow through the east branch is much greater than the western branch. Comparison of the two bathymetries in the sediment budget analysis shows erosion in the east branch and deposition in the west branch, which supports this finding.

Salinity

River water salinity in coastal Bangladesh depends on the volume of freshwater discharges from the upstream river systems, the salinity of the Bay of Bengal near the coast, and the circulation pattern of the coastal waters induced by the ocean currents and the tidal propagation to the river systems. A reduction in freshwater inflows from the trans-boundary Ganges River, siltation of the tributaries of the Ganges, and siltation of other rivers following the construction of the polder system has resulted in a significant increase in river salinity in coastal Bangladesh during the dry season. Average salinity concentrations of the rivers in the coastal area are higher in the dry season than in the monsoon because of lack of freshwater flow from upstream. Salinity level generally increases almost linearly from October to late May with the gradual reduction in the freshwater flow from the upstream. The degree of salt intrusion depends on season and climatic conditions. Salt intrusion is an important factor that affects the sediment transport dynamics and hydro-morphological conditions in major portions of the coastal area, in particular during pre-monsoon and post-monsoon. During the monsoon period the salinity in the Meghna Estuary area drops considerably and the water becomes almost completely fresh in the major part of the area.

Salinity level at Chandpur is very insignificant since enormous volume of fresh water from the Padma and Upper Meghna rivers flows through the Lower Meghna river at Chandpur. The maximum salinity level is observed about 0.1ppt (0.1 gram per litre), (IWM, 2013).
Observed salinity in the Tentulia river at Ilisha Ghat shows variation of salinity level from 0ppt to 4ppt over over the period from 2012 to 2013. (Figure 5.22)

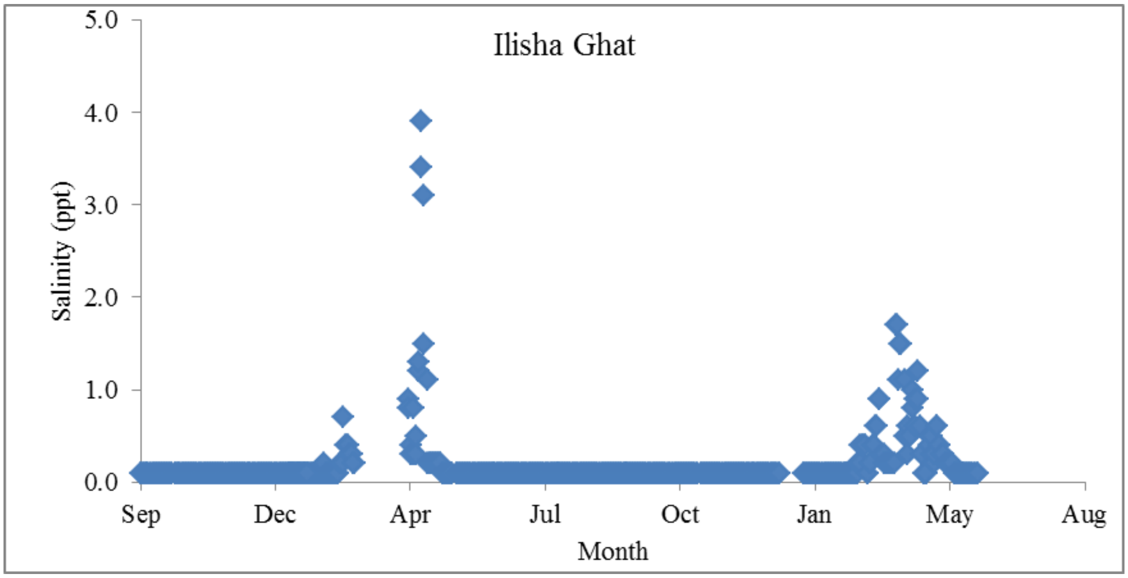


Figure 5.22: Variation of salinity level in the Tentulia river at Ilisha Ghat, 2012-2013 (Source: IWM)

Salinity at this station is zero from May to February. Salt concentration is comparatively higher during March and April. Salt concentration at this period varies from 2.0 ppt to 4.0 ppt; However the salinity level depends on upstream fresh water flow. Salinity station at Daulatkhan is located on the bank of Tajmuddin upzilla of Bhola district in the West Shabazpur Channel. Salt concentration at this station began to build up from February and reach to its peak (8.0 ppt to 9.0 ppt) in the month of April. Salinity level begins to drop from mid-April and water becomes fresh in the month of May when upstream flow is considerable. There is no salinity at this location from May to December.

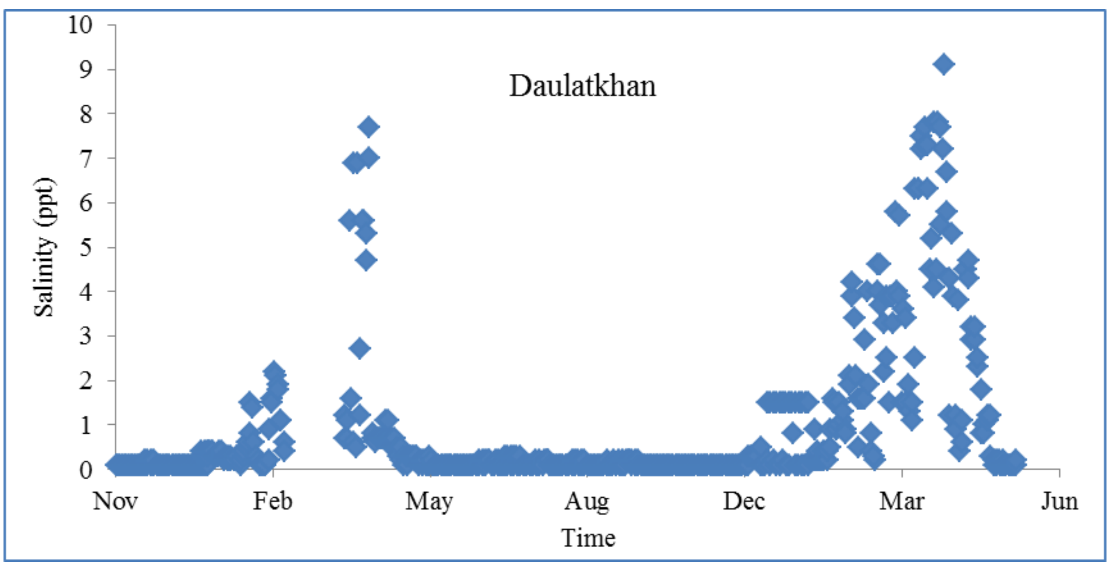


Figure 5.23: Variation of salinity level in the West Shabazpur channel at Daulat Khan, 2012-2013 (Source: IWM)

Salt concentration at Ramgati in the East Shabazpur Channel starts to build up from the beginning of September and reach to its peak at 4.0ppt to 16.0ppt in the month of April. Salt concentration drops from mid-April. (Figure 5.24)

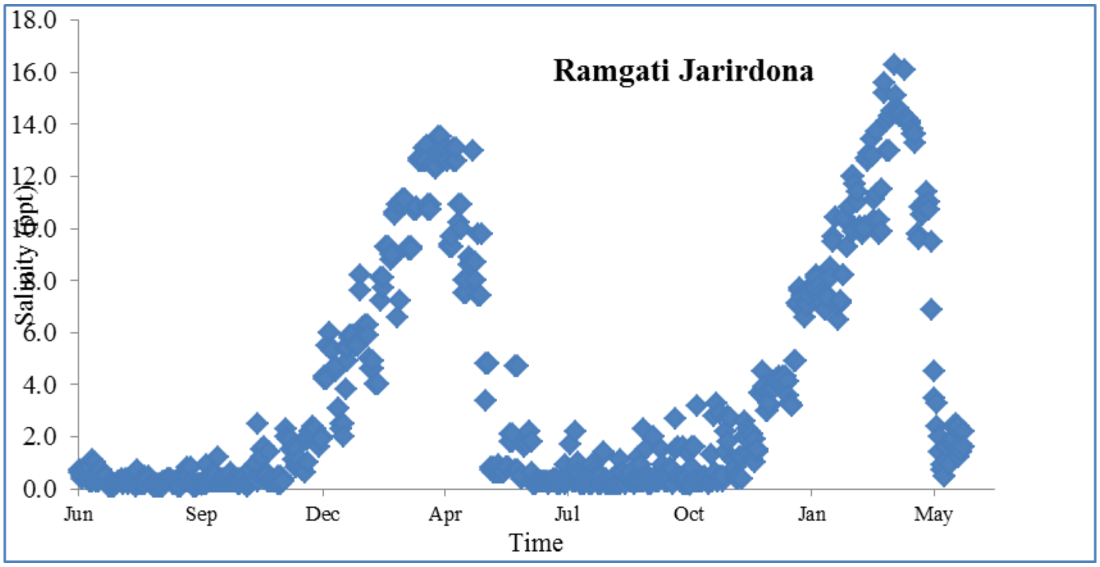


Figure 5.24: Variation of salinity level in the East Shabazpur Channel at Ramgati 2012-2013 (Source: IWM)

Wave

Vessel navigation and manoeuvring is influence by wind induced wave conditions. Also berthing place for vessel needs to be very calm enough (little or no wave influence) so that the vessel can stay at the berth without vertical movement. The influence of the wind induced waves in the Lower Meghna estuary is limited to the shallow nearshore zone and inter tidal area. Wave climate in the Meghna estuary is rather mild due to limited depth. Wave model indicates that under the South-southeast wind, the average significant wave height varies between 0.6-1.5m in the nearshore zone to 0.1-0.6m in the landward part (BWDB, 2001). In the dry season the wave is generally less than 0.6m with peak wave period of 3-4seconds. During monsoon season wave heights exceed greater 2m with periods more than 6 seconds.

Hatiya Channel to Karnafuli river , it is open sea and significant wave height is more along the navigation route. Significant wave height increases from west to east for all three dominant wind directions i) south east ii) south west and iii) north along the Bay of Bengalt. Three Wave roses have been generated from model simulation result at three locations along the navigational route. The locations are shown in the Figure 5.25. The dominant wave direction is from south and south-east here. At location 1, wave height is more and the maximum significant wave height is 1.25m in monsoon. At location 2 maximum wave height is 1 m and at location 3 maximum wave height is 0.75 m.

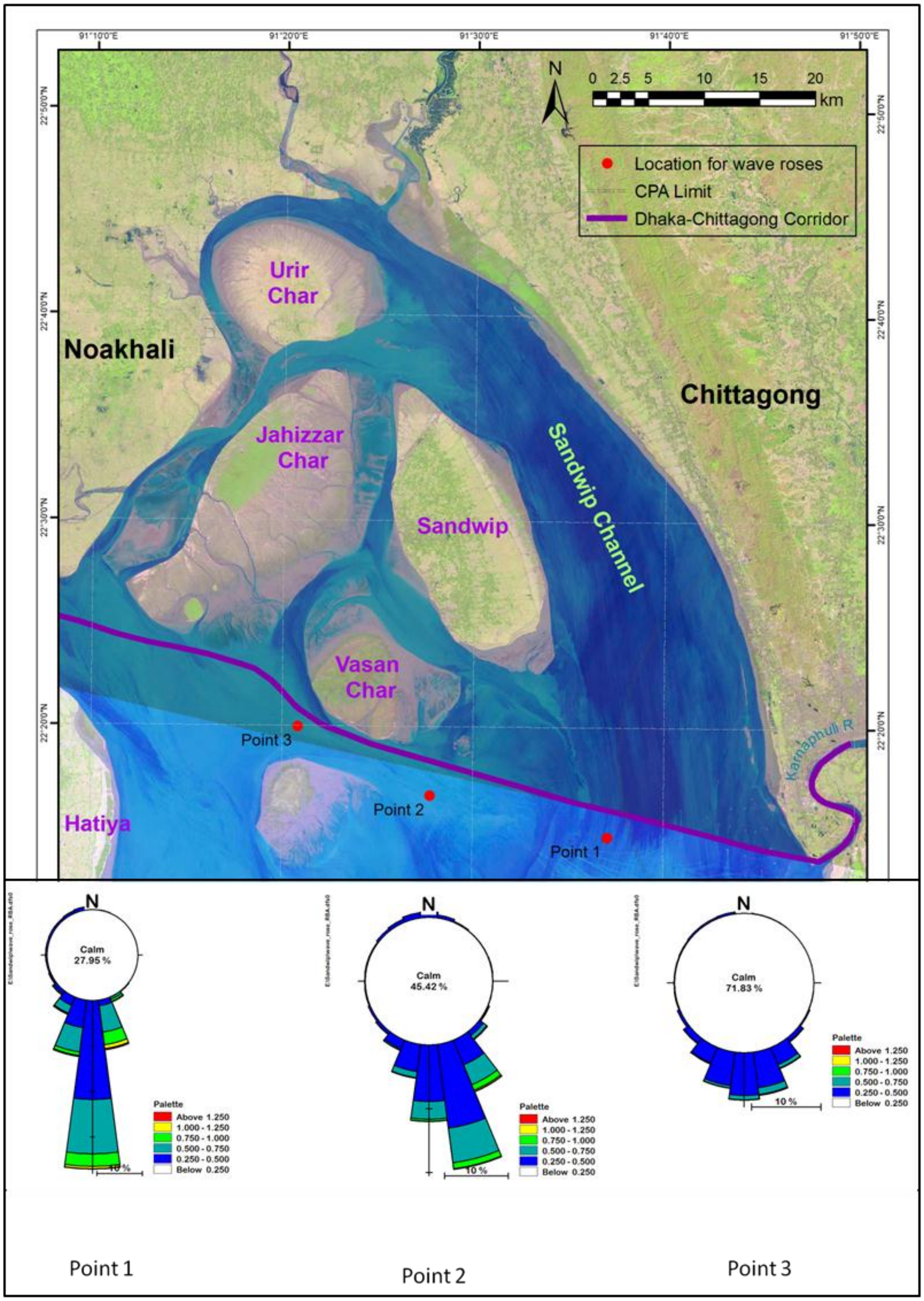


Figure 5.25: Wave roses showing direction and magnitude

Hatiya Channel to Karnafuli river, wave action is very important for vessel navigation. Hatiya Channel to Karnafuli river, it is open sea and significant wave height is more here. Significant wave height increases from west to east for all three dominant wind directions i) south east ii) south west and iii) north along the Bay of Bengalt. Three Wave roses have been generated from model simulation result at three locations along the navigational route. The locations are shown in the Figure 5.25. The dominant wave direction is from south and south-east here. At location 1, wave height is more and the maximum significant wave height is 1.25m in monsoon. At location 2 maximum wave height is 1 m and at location 3 maximum wave height is 0.75 m.

Cyclones

Cyclones pose a threat to inland water transport, lives and property in low-lying coastal regions in Bangladesh. Cyclonic storms, occasionally of severe intensity, can occur in the months of March-May and October-November, accompanied by storm surges, high winds and intense rainfall. While the loss of life during these cyclones is being progressively reduced by means of improved storm warnings and continuing construction of cyclone shelters, the damages to property, livestock, crops and livelihoods continue to take their toll.

Major tropical cyclonic disasters in 1970 and 1991 were estimated to have killed an estimated around 300,000and 140,000 people respectively. The severe cyclone which occurred in November 1970 was followed by one in May 1985, one in November 1988, one in April 1991 one in May 1997, the severe cyclone SIDR in November, 2007 and lastly the cyclone AILA in May, 2009.

Though time-series records of storm-surge height are scarce, existing literature indicates a 1.5–9 m height range during various severe cyclones. Storm-surge heights of 10 m or more have not been uncommon; for example, the 1876 Bakerganj cyclone had a reported surge height of 13.6 m (SMRC 2000).

Overall, it has been estimated that Bangladesh is on the receiving end of about two-fifths of the world’s total impact from storm surges (Murty and El-Sabh 1992). The reasons for this disproportionately large impact include the re-curvature of tropical cyclones in the Bay of Bengal; the wide, shallow continental shelf, especially in the Chittagong, Sandwip, Hatiya and Bhola Islands the high tidal range; the triangular shape at the head of the Bay of Bengal, which helps to funnel sea water pushed by the wind toward the coast, causing further surge amplification. Surges that make landfall during high tide are even more devastating. In general, it has been observed that the frequency of a 10-m high wave (surge plus tide) along Bangladesh coast is about once every 20 years, while a wave with a 7-m height occurs about once in 5 years. In addition, wind-induced waves of up to 3.0 m in height may also occur (MCSP 1993). About 19 major cyclones hit the coastal area of Bangladesh from 1960 to 2009, which is shown in the Figure 5.26. The frequency distribution of storm surge level along the navigation route was established from the simulation results of 19 cyclones generated by IWM.

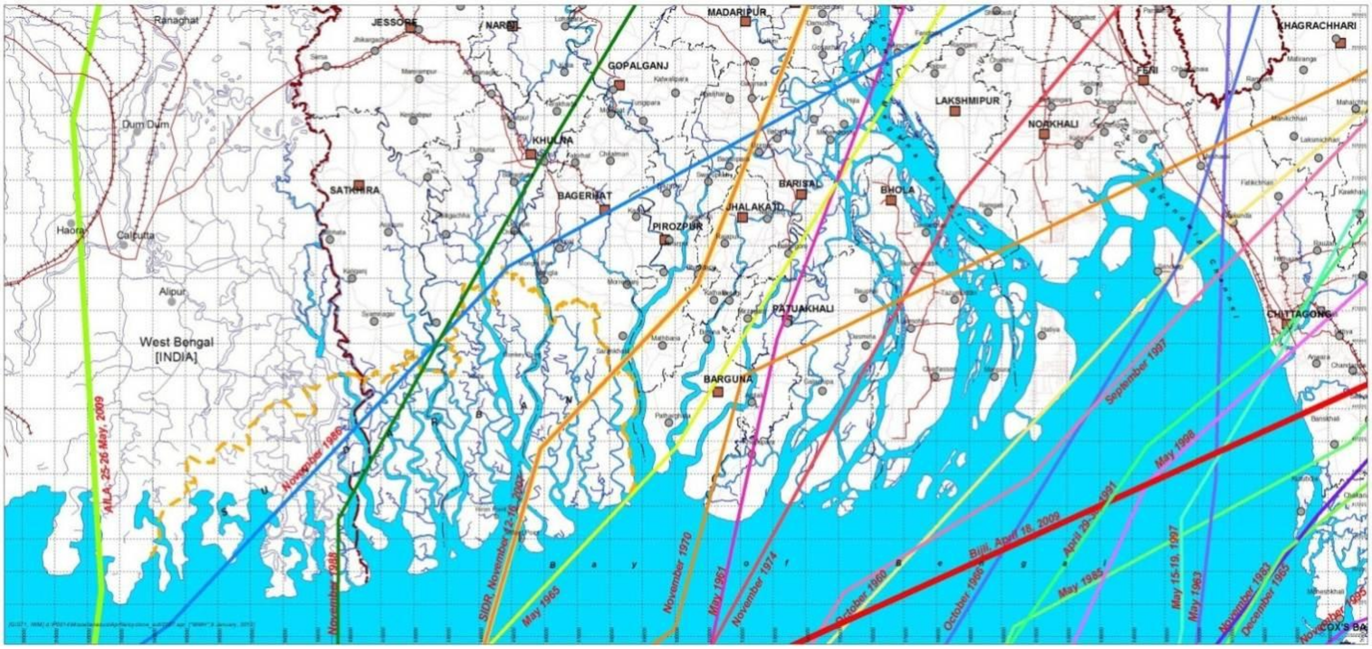


Figure 5.26: Tracks of Major Cyclones (1960-2009)

Sediment Transport and Sediment Budget

Sediment Characteristics

In the Meghna Estuary median diameter of bed samples varies between 0.016 mm to 0.2 mm, and about 50% of the samples has median diameter less than 0.063 mm (silt) (BWDB, 2001, Meghna Estuary Study). The major part of bed sediment consists of a mixture of (very) fine sand, silt and mud. The particles of silt and clay are carried by current, mainly as suspended material.

IWM analyzed bed sediment samples in 2014 near Sandwip and Jahizzer Char under the project entitled “Detailed Technical Feasibility Study for Integrated Development of Jahizzer Char”, which shows that median diameter (D_{50}) varies from 0.01mm to 0.14mm as shown in Figure 5.27.

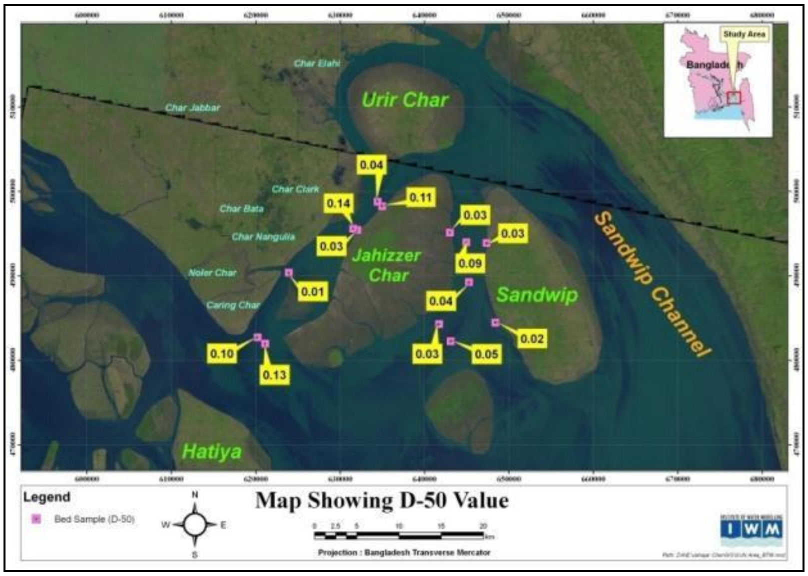


Figure 5.27: D_{50} values around Jahizzer Char

The sediment distribution curve at location-3 (as in Figure 5.25) is presented in the Figure 5.28, which shows that the median diameter is 0.03mm.

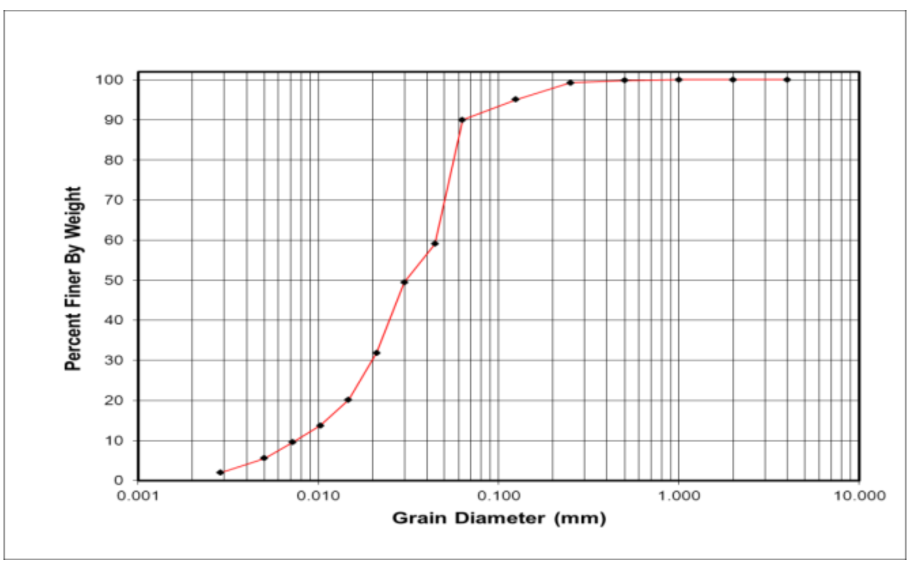


Figure 5.28: The sediment distribution curve

The characteristic particle size D50 varies from upstream to downstream of the Upper-Meghna river. The average value of D50 is about 0.14mm in the Upper- Meghna river .

The sediment concentration measurements conducted by BWDB under Meghna Estuary Study (MES) and Land reclamation project (LRP) indicated a variation of the sediment concentration during a fortnightly cycle of the spring and the neap tide. The variation of sediment concentration showed a tendency to increase towards the spring tide. The maximum depth averaged sediment concentration at spring tide was about 2-5 times higher than that at neap tide. The averaged total annual sediment discharge of the Brahmaputra, Ganges and Meghna river systems over the period 1966-1991 was about 1,100 million tons per year. About 70% of the sediment discharge consisted of fine sediment. The observed morphological changes derived from the time series of satellite images over the period 1973 to 1998 and the annual sediment discharge indicated qualitatively that the net gain of land is related to the amount of river borne sediment discharge (BWDB, 2001). The net gain of land and intertidal areas during periods of higher river borne sediment discharge is higher than that during periods of lower river borne sediment discharge.

Sediment Transport

The hydrodynamic factors that shape the Lower Meghna Estuary area are; tides, upstream river inflow, sediment transport, estuarine circulation, waves and atmospheric forcing. The resulting temporal and spatial changes in the channel and char systems in the estuary is primarily a consequence of the interaction of these factors acting all over the estuary. Interactions between these factors are complex, and mostly non-linear. Evidence of this interactions is the geomorphologic changes that occur in the estuary with the sediment transport processes. The average total annual sediment discharge of the Brahamaputra and Ganges is about 1,100 million (BWDB, 2001) tons per year. The sediment discharge of the Upper Meghna river is negligible compared to the discharge of the Brahmaputra and Ganges. It is assumed that the net deposition of sediment in the southern part of Bangladesh is related to the amount of river borne sediment discharge: during periods of high river borne sediment discharge (monsoon), the net gain of land and intertidal areas is higher than during low periods of river borne sediment discharge. The general sedimentology of the Lower Meghna Estuary is the consequence of many conditions. One of the most important condition is the sediment source, which may be the river, the adjacent delta and continental shelf from which sediment is transported by littoral currents and introduced into the estuary by upland flow and tidal action. Furthermore, within the estuary proper, sediment distribution is extremely variable reflecting the hydrodynamic conditions and the particular transport processes that are dominant in each portion of it. The circulation patterns, particularly in the lower portions of the Meghna Estuary Area are highly affected by river and tidal dynamics, resulting in characteristic morphological patterns. Flow friction and river flow decrease the tidal effect landwards as the river influence becomes progressively larger.

Sediment Budget

The tidal influence reaches about as far as the Bhairab Bazar in the Upper Meghna and at Mawa in the Padma river during dry season. The velocities in the Lower Meghna River usually decrease in downstream direction as flow expands into the estuarine section of greater cross-sectional area near the river mouth. In the transition zone of the Lower Meghna Estuary area fresh water is mixed with saltwater; sediment transport capacity diminishes and sediments are deposited. The periodic rise and fall of tide results in the temporary storage of large volumes of sea water in the estuary during high tide, followed by drainage at low tide. The volume of water exchanged by tide -the tidal prism- during pre-monsoon and post-monsoon is at least an order of magnitude greater than the river discharge. Approximately overall sediment budget in the study area over the period indicates that the deposition processes exceed the erosion processes. Erosion dominates in the northern part of the river system. High rate of sediment deposition is found in the north-east of the estuary, between Noakhali mainland, Urir Char and Sandwip. Also the area between Bhola and Hatia, and the south- west end of the estuary are accreting, with an accretion rate of 0 - 0.1 m/y. In other areas in the estuary, erosive and depositing processes are more or less in balance. Hydrographic surveys of the Meghna estuary were carried out in 1999 and 2009 by BWDB. The bathymetric maps derived from these two surveys have been compared to analyse the net sediment deposit and erosion at different places. The total Lower Meghna estuary has been divided to 7 sub-areas, which are analysed separately to examine the net deposition and erosion. The difference map showing sediment deposition and erosion patterns is presented in the Figure 5.29 and Table 5.12.

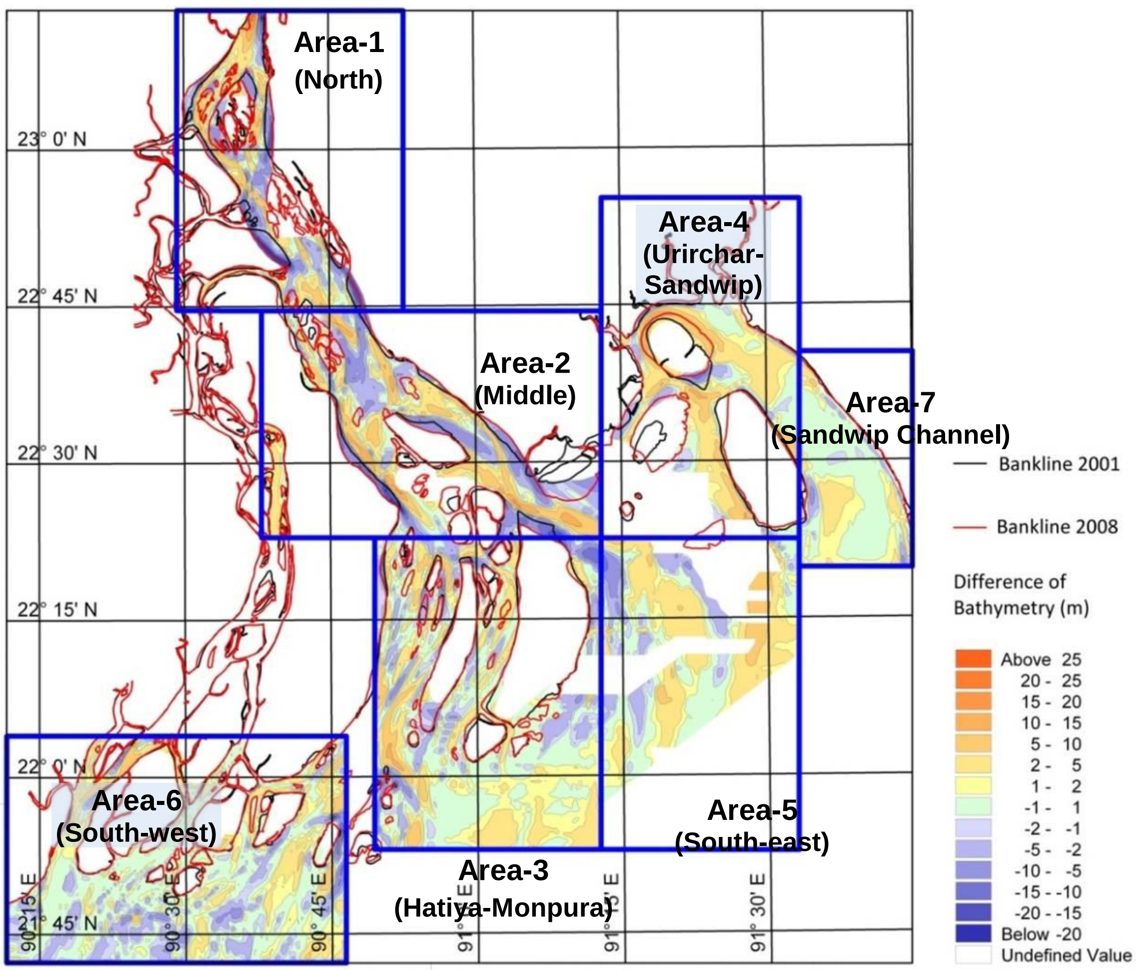


Figure 5.29: Sediment budget (1999-2009) calculations in seven sub-areas of Meghna Estuary (Source: IWM)

Table 5.12: Net change of sediment volume in the Meghna Estuary

Sub-area	Erosion		Deposition		Net Deposition			Net Change
	Volume (Mm^3)	Area (ha)	Volume (Mm^3)	Area (ha)	Volume (Mm^3)	Volume (Mm^3/yr)	Total Area (ha)	m/yr
A1	1467	27411	892	23694	-574	-57	51105	-0.11
A2	2050	45400	1908	44707	-142	-14	90107	-0.02
A3	1408	64956	1941	93801	533	53	158756	0.03
A4	366	16838	1594	44758	1228	136**	61596	0.22
A5	547	25934	1492	60422	944	94	86356	0.11
A6	672	35516	1138	59376	465	47	94892	0.05
A7	139	13383	444	34104	305	31	47487	0.06
Total	6649	229438	9409	360860	2760	276	590298	0.05

**The yearly change has been estimated dividing the total change by 9 years because 2008 survey was used instead of 2009 survey, "+"ve sign indicates sediment deposition.

The navigation route is along the sub-area of Area 1, Area 2, Area 4, Area 5 and Area 7 of the estuary. The deposition and erosion process in each sub-area is described in the following section since the deposition of each sub-area influences the navigation depth and dredging requirement.

Area 1 (northern reach of Lower Meghna)

A large char (Char Bhairabi) has been developed in the middle stream of the river deflecting the flow. Deep channels are located very close to both riverbanks. River widens, especially on the western side. Western channel moved to the west by 2-2.5km over a distance of approximately 7 km. It is evident in the satellite image of 2015 that eastern channel has been enlarged and deepen over the years and become the main navigation channel. This may locally reduce the erosion of the west bank. At the level of Chandpur, the main channel moved to the west, causing some erosion of the river bank. This area shows net erosion of 11cm over the years.

Area 2 (middle estuary)

Largest morphological change has been occurred in this area over the years characterizing the area is morphologically very dynamic. Extensive deposition is observed on the southern side (Noakhali mainland/Bouyr Char), reducing the depth of the channel and forcing the main water flow towards the northern head of Hatiya island.This results in the migration and strong deepening of the Hatia Channel, and large-scale erosion of the head of the island. At the upstream head of Char Gazaria some erosion is observed. Large and very shallow flats west of Char Gazaria extended to the west.

This is associated with the migration of the West Shahbazpur Channel, which moved very close to the bank of Bhola causing erosion of the riverbank. The net change is minor erosion.

Area-4 (Urir Char-Sandwip)

Vast accretion/sediment deposition is observed at the northern head of Sandwip. Also some accretion is found along eastern bank of Sandwip. Net change is sediment deposition.

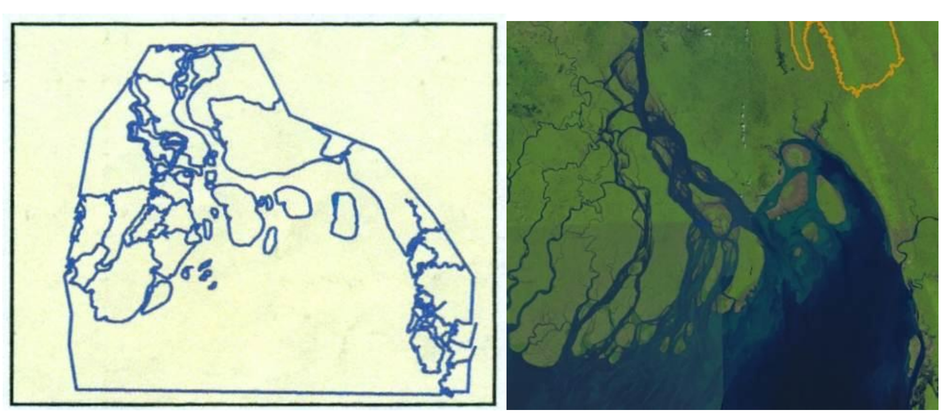
Area-5 (South-east)
In this area, south of Sandwip and east of Hatia, no large bathymetric changes are found. Shallow areas north-east of Hatia extended to the east causing migration of the Hatia Channel to the north at the level of island's northern head, and to the east in the southern course of the channel.

Area 7 (Sandwip Channel)
The Sandwip Channel remained quite stable during the period of 1999 to 2015. However, south and southwest of Sandwip island sediment deposition occurs casing navigation problems.

Geomorphological Evolution during the Last Century in the Meghna Estuary

Deltas and estuaries are generally known as areas of a net deposition of sediments either transported by the river from the upstream or supplied from the sea. The growth of the delta and the accretion of land in the estuaries is a continuous and generally a very gradual natural process interfered by the dynamics of the ever- changing courses of their channels.

A comparison of the 2015 satellite image (Figure 5.30) with the 1779 map of J .Rennell (Figure 5.30) shows a completely changed system of channels and river courses but a more or less stable coastline west of the Tetulia River. East of the Tetuliariver, however, a general tendency of seaward growth of the coastline is evident, particularly in the region Bhola Island - Hatia Island, Nijhum Dwip and in the Noahkali district. Although the overall process of accretion is dominant, areas of erosion is also visible, particularly on the river banks along the Ramgati under Laxmipur district, northeast shoreline of Bhola Island.



Rennell map 1779 Satellite image 2015

Figure 5.30: Comparison of Rennell map with satellite image of 2015

Long Term Net Accretion Rate

Several studies have examined the rates of change for coastal Bangladesh, which is presented in Table 5.13. The extent of study area, cartographic methods, interpretation of coastline and/or land features is not precisely known for all of these studies. However, in all cases where the net changes were studied over a period of 20 years or more, there was a net increase of land. The rate of change of 9.9 km2/y computed for the period 1776-1996 by EGIS (MES, 1997) compares closely with the 7.0 km2/y computed by Allison (1998). Another, more reliable chart of 1840 prepared by Commander Lloyd was compared (Allison, 1998) against a 1984 satellite image set where the rate of 4.4 km2/y was computed. The range of net land gain over time periods ranging from 23 to 220 years varies from 4.4 km2/y tot 29 km^2/y (BWDB, 2001). A comparison of the rate of change for the period of 1973-2000 with the rate of change for the period 1940-1963 shows that the magnitude of natural processes has been speeded up to some extent due by the construction of the two Meghna cross-dams (1957 and 1964) in the old course of the Lower Meghna Estuary. Table 5.13 shows the land accretion in different period

Table 5.13: Comparison of erosion and accretion rates from different studies

Length of study period (years)	Period of study	Net Change for Period (km^2)	Rate of change (km^2/y)	Reference
220	1776-1996	+2187	9.9	EGIS (1997)
192	1792-1984	+1346	7.0	Allison (1998)
144	1840-1984	+638	4.4	Allison (1998)
23	1940-1963	+279	12.1	Evsink (1983)
27	1973-2000	+508	18.8	Present Study (2001)
7	1972-1979	+213	30.4[1)]	SPARRSO and ERIM (1981)

1) *Area described as "mud flat" was considered as accreted; therefore rate of change is not comparable to the present study.*

Long Term Trends of Accretion and Erosion over the Last Decades

In the Meghna Estuary Study (BWDB, 2001), a time series of digitized satellite images from the period 1973 to 2000 was used to examine the extent of land for each date and to assess the changes in plan-form and channel system due to accretion and erosion in the estuary. The accretion and erosion pattern as seen in the Figure 5.31 demonstrates the dynamic behavior the estuary.

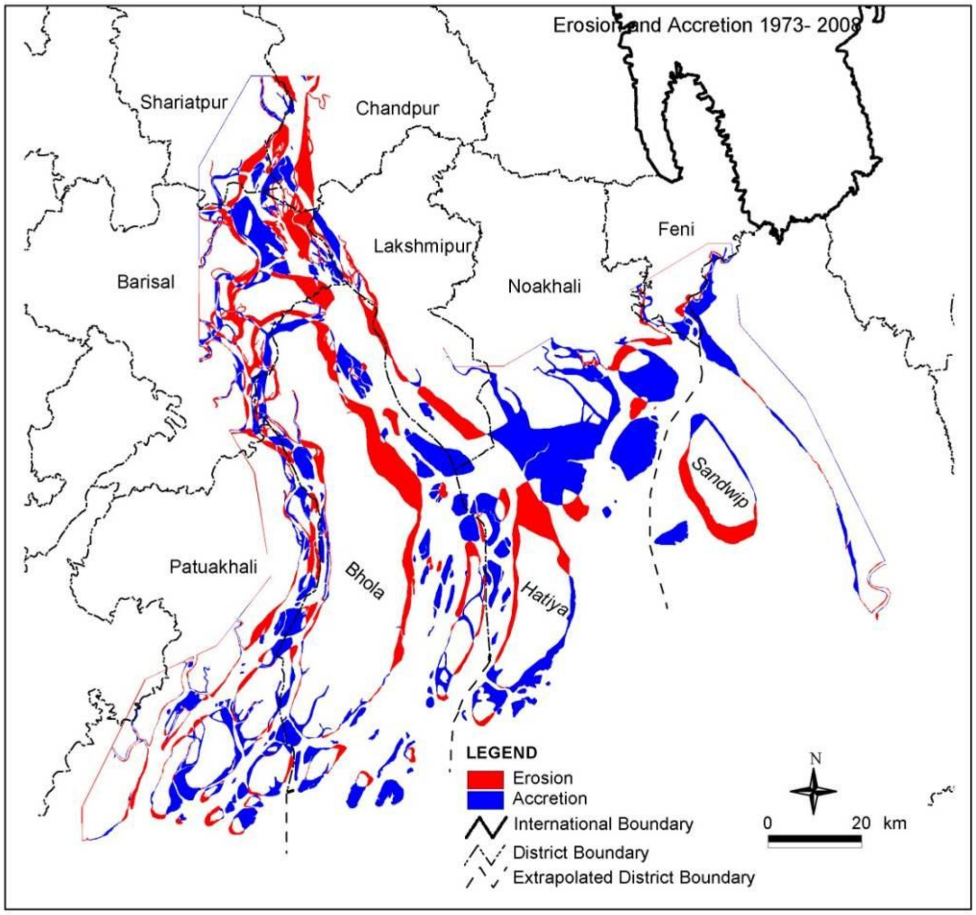


Figure 5.31: Accretion and erosion in the Meghna Estuary from 1973 to 2000

Both accretion and erosion are evident along the navigation route. The accretion trend in the west of Sandwip channel is evident over the decadesthat specifies the need of frequent dredging at this location.

Under the present study use of satellite images of 2015 is also used to see the changes of Sandwip Island and Jahizzer Char, which are adjacent to the navigation route, to investigate the shifting characteristics of shoreline. Figure 5.32 shows the bank line shifting characteristics of the Jahajer char, Sandwip and Urrichar. Continuous enlargement of Jahazer char is apparent, which poses a threat of decreasing of navigation depth in the south of this char.

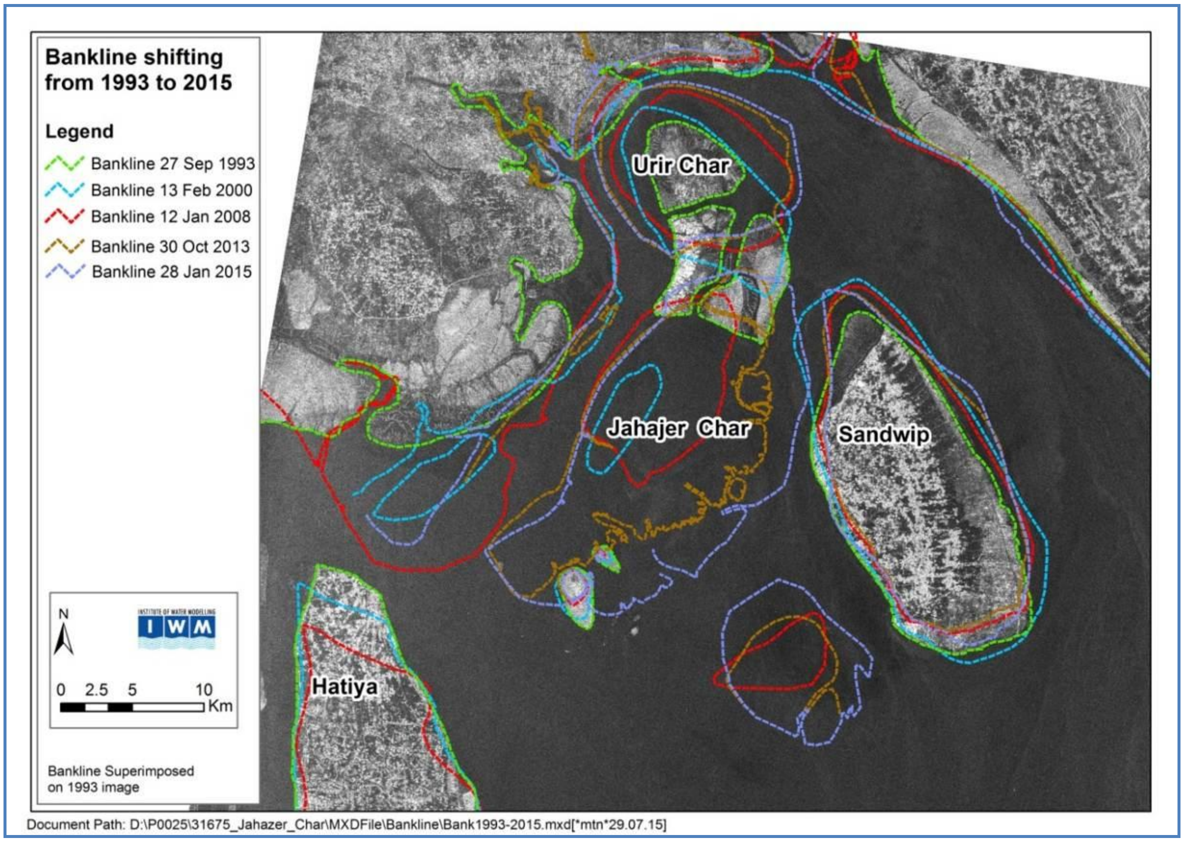


Figure 5.32: Shifting characteristics of shoreline of Jahajer char, Sandwip island and Noakhali coast from 1993 to 2015

The net change over the considered period shows an overall land gain for the Meghna Estuary system as a whole, for the period 1973-2000 of about 50,800 ha. The net change over the considered period shows that generally gain of land took place. There is a clear relation between the magnitude of maximum discharge in the estuary and the net change of land. Periods of net loss of land coincide with occurrence of very high monsoon discharges (1986, 1988, 1996, 1998), while gain of land or deposition coincides with the periods of lower monsoon discharges in the river system (BWDB, 2001). Although the long-term trend of gain of new land is dominant in the estuary, it should be mentioned that a huge amount of fertile land (in particular old land) is exposed to erosion due to migration and widening of the river system. Analysis of time series satellite image of recent years including 2015 clearly shows that a considerable amount is deposited in area northeast of the navigation channel and the Jahizzer Char is developing very fast.

There are new char areas and new areas of mud flats north-west of Sandwip and Urirchar islands, which continue to grow at high paste. Other large areas of accretion include the very large char in the Lower Meghna Channel that appears to be a consolidation and extension of Char Gazaria adjacent to the Dhaka-Chittagong Navigation route. Land erosion is associated with widening and migration of the main Lower Meghna and the Shahbazpur and Hatia Channels. The northern end of Hatia retreated very fast and there is a huge scour whole of -18mPWD. Also eastern bank of Bhola suffers from severe erosion, with its most extreme form found west of Char Gazaria. It is evident that these areas are sensitive to changes in river and sediment discharges.

5.1.4 Floodplain Hydrology

Geology in D-C Corridor and Associated River Routes

Geologically almost 85% of entire Bangladesh is underlain by alluvial and deltaic deposits borne by the river systems of the Ganges, the Brahmaputra and the Meghna. Coastal deposits are limited to narrow-strip zone along the western age of Chittagong and Cox's Bazar districts (Alam et al, 1990). The geological formation in the Dhaka-Chittagong river route and associated routes are mainly alluvial, deltaic and coastal deposits.

The river Buriganga flows through alluvial silt and clay of medium to dark grey silt to clay. The Dhaleswari River from its meeting point with the Buriganga down to the meeting point with the Meghna River flows through alluvial silt. This formation composed of fine sandy to clayey silt having light to medium-grey colour. The Meghna River until the confluence with the Padma River around Mohonpur (under Matlab North Upazila) flows through the formation of alluvial sand, which is the size from coarse sand to fine silty sand and brownish grey in colour. However, down to it until Chandpur it flows through alluvial silt for its Chandpur side (left bank) and deltaic sand for its Shariatpur side (right bank). The rest of the Meghna River, down from Chandpur, over the part of Shariatpur, entire Mehendiganj and Bhola district flows through estuarine deposits. This kind of deposits show the characteristics of silty clay to clayey silt which has brownish/yellowish appearance. However, on its left bank immediately down to Chandpur a small segment of the riparian area (broadly Haimchar, Faridganj, Raipur) composed of alluvial silt and clay.

The left flood plain of the Meghna River, after this, over the districts Lakshmipur, Noakhali and Feni is entirely composed of tidal deltaic deposits, which has characteristics of light to greenish colour and silt to clayey silt with very fine to fine sand. The area is criss-crossed by numerous tidal creeks. Also this area has some brackish-water deposits. The navigation route, downwards, along the Chittagong districts passes through beach and dune sand. With respect to formation and contents, it contains well-sorted medium to fine sand that are light to whitish-grey in colour, shell fragments, heavy minerals, rare clasts. As to the three associated routes: all the approaching routes to Barisal passes through deltaic deposits – estuarine deposits (Mehendiganj, Bhola), and tidal deltaic deposits (the rest of the route down to Barisal, then Jhalokathi). The Ghorashal route, the Shitalakhya River, passes mainly through alluvial silt. The Ashuganj Route, the Upper Meghna River flows through a river corridor that is composed of alluvial sand.

As to three ferry crossings: The Harina and Alu Bazar ferry route lies on the formation of alluvial silt and clay on its east side (Harina) and estuarine deposits on its west side (Alu Bazar). The crossing between Maju Chowdhury's Hat (under Lakshmipur Upazila) and Bhola lies on the formation of tidal deltaic deposits (Lakshmipur side) and estuarine deposits (Bhola side).

5.2 Environmental Quality

The existing environmental quality in the project influence area serves as the basis for identification, prediction and evaluation of potential environmental impacts of the proposed project interventions. The baseline environmental quality has been assessed through field studies within the impact zone and analysis the information for various components of the environment, viz. air and noise, water, and riverbed sediments. The sampling locations were in the following Figure 5.33

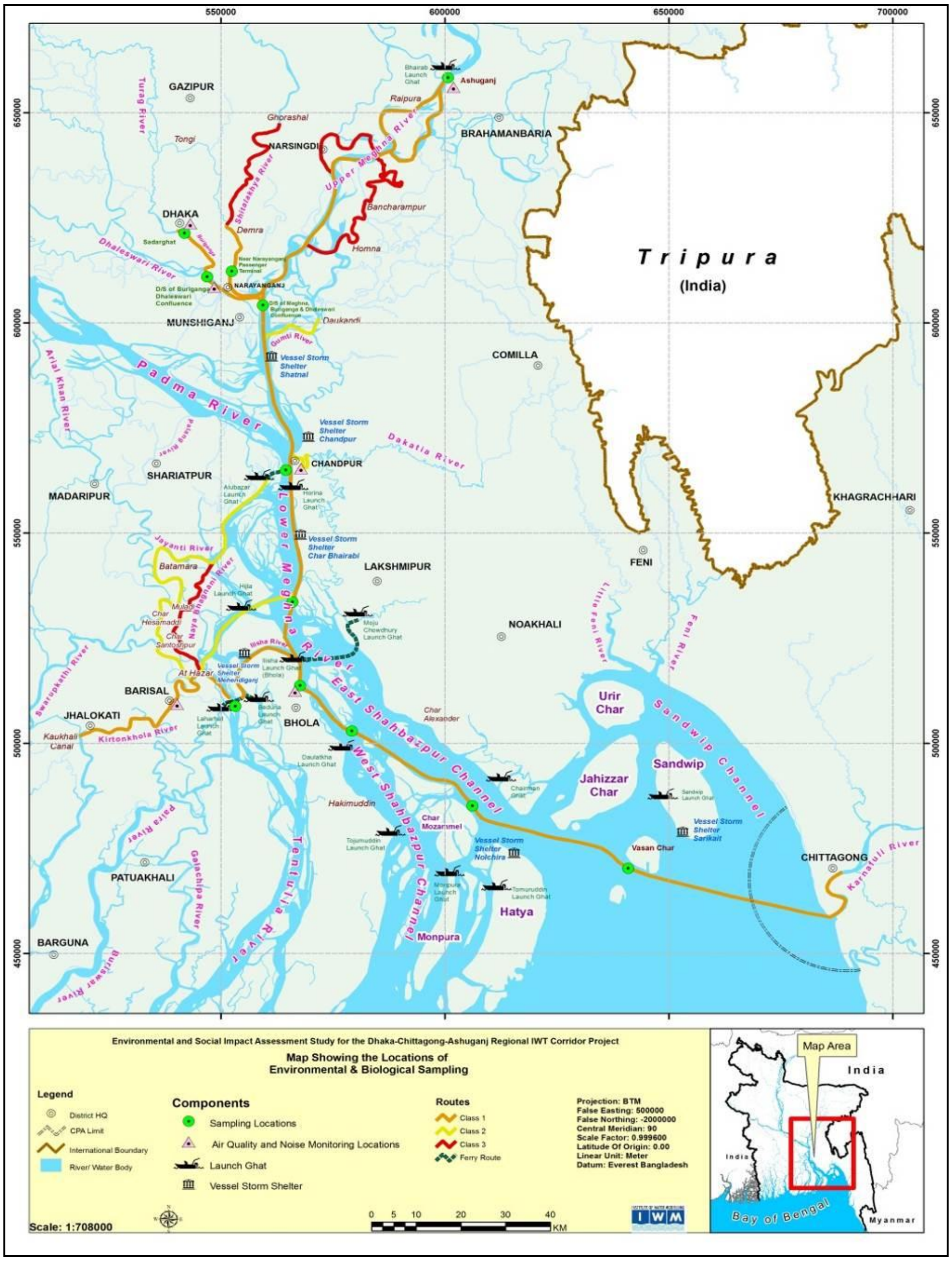


Figure 5.33: Sampling Locations along the Project Influence Area

5.2.1 Monsoon Period Data Analysis:

Surface Water

The surface water quality assessment in the project influence area has been carried out for the most important parameters namely, pH, DO, BOD, TOC, TDS, TSS and ions. The locations for sampling are shown in the Figure 5.33. The tests were undertaken in the month of September and October 2015 and the detailed analyses are incorporated with the standard values set by the DoE are shown in Table 5.14 and Table 5.15 respectively.

Table 5.14: Surface Water Quality of Rivers in Project Influence Area

Parameter	Unit	Sampling ID											
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12
pH	-	7.10	7.30	6.99	7.12	7.02	6.95	7.60	7.48	6.94	7.42	7.36	7.55
Temp	°C	25.2	24.7	25.1	25.1	25.2	25.1	24.8	25.2	24.8	25.3	25.2	25.2
Turbidity	NTU	337.0	14.9	32.7	8.06	9.60	5.32	905.0	110.0	88.5	165.0	90.1	98.0
EC	µS/cm	171.0	68.2	148.0	54.2	57.5	150.0	1193	128	147	151	139	132
DO	mg/L	6.12	5.30	5.09	5.89	5.61	3.66	5.05	5.10	5.12	5.20	5.29	0.89
BOD_5	mg/L	1.11	0.95	1.11	1.12	1.58	7.65	2.98	2.98	2.04	2.08	2.09	58.3
TOC	mg/L	10.0	6.54	1.28	<0.5	<0.5	0.67	8.04	7.83	7.28	14.7	7.43	1.24
TDS	mg/L	89.2	56.0	78.8	68.4	50.4	90.0	646	102	143	117	92.4	107
TSS	mg/L	391.0	9.60	91.0	153.0	53.0	22.8	953	110	202	301	327	109
Ca	mg/L	23.1	6.63	16.0	4.88	4.85	16.7	45.8	16.4	17.1	18.5	22.6	15.6
Mg	mg/L	10.6	2.30	4.42	2.08	2.26	4.46	38.7	4.66	5.47	6.60	7.44	4.47
Na	mg/L	5.90	3.06	5.23	3.19	3.33	5.90	130	4.48	4.80	4.40	4.20	4.40
K	mg/L	3.0	1.21	2.73	1.04	1.10	2.46	7.88	2.09	2.33	2.41	2.33	2.30
Cl^-	mg/L	1.63	6.57	1.84	1.06	1.18	1.98	459	1.93	1.58	1.41	1.33	1.35
F	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Br	mg/L	2.42	1.54	3.07	1.07	1.17	4.02	<1.0	1.81	<1.0	<1.0	1.12	<1.0
SO_4	mg/L	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
NO_3	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total PO_4	mg/L	11.4	<0.2	<0.2	<0.2	<0.2	0.58	29.7	3.15	1.33	1.32	1.17	0.77

Source: Field survey, September- October 2015, Cells in grey color shed indicate the exceedance the limit of DOE standard,

SW1- Harinaghat, Chandpur, SW2- Gozaria, Munshiganj, SW3- Boktabali Ferryghat, Narayanganj, SW4- Araihazar, Narayanganj, SW5- Ashuganj, SW6- Sadarghat, Dhaka, SW7- Near Vasan Char (Chukkhalighat, Sandwip), SW8- Near Chairman Ghat (Noakhali), SW9- Near Beduria Launch Ghat (Sripurdwip, Barisal), SW10- Near Hizla (Mehendiganj, Kaliganj) SW11- Near Ilisha Ghat (Tulatali Bazar, Bhola), SW12- Near Dawlatkhan Launchghat (Vabanipur Lanchghat)

Table 5.15: Bangladesh Water Quality Standards

Sl No.	Best Practices Based Classification	Parameters			
		Temperature (°C)	pH	DO (mg/l)	BOD_5 (mg/l)
1	Water usable for fisheries	25 - 30	6.5- 8.5	5 or more	6 or less
2	Water usable for irrigation	25 - 30	6.5- 8.5	5 or more	10 or less

Source: Environmental Conservation Rule (ECR) '97

Notes:

In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.

Electrical conductivity for irrigation water– 2250 mhos/cm (at a temperature of 25C); Sodium less than 26 percent; boron less than 0.2 percent.

Table 5.14 represents the water quality measured during field investigations at the selected locations of the project influence area. Surface water quality is represented by some selected parameters, which are crucial for agricultural activities and industries and to maintain optimum aquatic environment. The standard values of these indicators set by the Department of Environment, Bangladesh are also shown for comparison purposes.

Water Temperature- The temperature of water bodies affects fish habitats and their oxygen holding capacity. The temperature of the water bodies in the project influence area ranges from 24.7 to 25.2°C in September - October 2015. Temperature of all the samples except SW2 (Gozaria), SW7 (Vasan Char, Sandwip) and SW9 (Beduria Launch ghat, Bhola) lies within the DoE standards for both irrigation and fish habitats.

Figure 5.34: Surface water collection in the project influence area

Figure 5.35: Surface water pollution source in the project influence area

pH- The "desirable" range of pH prescribed by the DOE is between 6.5 and 8.5. This is the range, which provides adequate protection to the life of fresh water fish and bottom dwelling invertebrates. In most of the water bodies of the area, the pH range is found well within the DoE standards. The pH of water samples lies in the range of 6.95 to 7.30. However, pH value is governed largely by the carbon dioxide/carbonate/bicarbonate equilibrium. Organic substances may affect it, by change in the carbonate equilibrium due to the bioactivity of plants and in some cases by hydrolysable salts.

Turbidity- Turbidity values of the surface water samples ranges from 5.32 to 337.0 NTU. Turbidity in water is caused by suspended and colloidal matter such as clay, silts, finely divided organic and inorganic matter, plankton and other microscopic organisms. Higher turbidity in September-October can be caused by high turbulence of river water due to monsoon precipitations. Lower turbidity value might be due to the calm nature of river water. The highest values of turbidity were observed in SW1 collected from Harina ghat due to high flow of monsoon precipitation.

Dissolved Oxygen (DO) - Dissolved oxygen is necessary to many forms of life including fish, invertebrates, bacteria and plants. Decrease in DO values below the critical level of 3 mg/l causes death of most fishes and other aerobic aquatic organisms. The dissolved oxygen values ranged from 5.09 to 6.12 mg/L in twelve locations; in SW6 (Sadarghat) at Buriganga River and SW12 (Dawlatkhan Launch ghat,) at West Shahbazpur Channel was low value of 3.66 mg/L and 0.89 mg/L recorded respectively.

BOD_5-The BOD5 is a measure of the amount of oxygen that bacteria will consume in five days at 20°C while decomposing organic matter under aerobic conditions. The term also refers to a chemical procedure for determining this amount. This is not a precise quantitative test, although it is widely used as an indication of the organic quality of water. In the study area BOD5 values range from a minimum of 0.95 mg/l to a maximum of 7.65 mg/I. The highest concentration of BOD5 is 7.65 mg/L and 58.3 mg/L recorded in SW6 and SW12 accordingly which exceed the DOE surface water standard. The higher concentration of BOD means lower the DO and more hazards for aquatic animals.

Electric Conductivity (EC) - Electrical conductivity in the aquatic ecosystem is considered to be a good indicator for evaluating total dissolved solid materials in water and nature of the purity of water. Electric Conductivity in rivers is affected primarily by the geology of the area through which the water flows. Discharges to streams can change the conductivity depending on their make-up. A failing sewage system would raise the conductivity because of the presence of chloride, phosphate, and nitrate; an oil spill would lower the conductivity. EC as a water quality indicator is useful for estimating the amount of minerals, assessing the effect of diverse ions on chemical equilibrium, physiological effects on plants or animals, and corrosion rates. In the study area EC values range from a minimum of 54.2µS/cm to a maximum of 171.0µS/cm. The water sample collected from SW1 (Harina ghat in Chandpur) recorded the highest value of EC.

Total Dissolved Solids (TDS) Dissolved solids are also important to aquatic life by keeping cell density balanced. However water containing excessive dissolved solids adversely affects drinking water. Continuous use of such water may cause a general loss of condition, weakness, scouring, reduced production, bone degeneration and ultimately death. TDS may influence the toxicity of heavy metals and organic compounds for fish and other aquatic life. The natural range of TDS concentration in the water bodies of the project influence area are between 50.4 mg/l and 90.0 mg/l.

Total Suspended Solids (TSS) - The concentration of total suspended solids ranges from 9.60 mg/L to 391.0 mg/L. The water sample collected from Harina ghat in Chandpur (SW1) recorded the highest value of suspended solids.

Total Organic Carbon (TOC) – TOC in freshwaters arises from living material (directly from plant photosynthesis or indirectly from terrestrial organic matter) and also as a constituent of many waste materials and effluents. Consequently, the total organic matter in the water can be a useful indication of the degree of pollution. In surface waters, TOC concentrations are generally less than 10 mg/L unless the water receives municipal or industrial wastes, or are highly colored due to natural organic material, as in swamps. The concentration of TOC ranges from below 0.5 mg/L to 10.0 mg/L. In SW1 collected from Harina ghat in Chandpur recorded the highest value of total organic carbon.

Major Ions- Major ions are naturally very variable in surface water due to local geological, climatic and geographical conditions. All natural waters contain some sodium since sodium salts are highly water soluble and it is one of the most abundant elements on earth. The concentration of Na ranges from 3.06 mg/L to 5.90 mg/L. The highest value of Na is 5.90 mg/L found in SW1 and SW6 collected from Chandpur and Sadarghat which may arise due to sea water intrusion and, sewage and industrial effluents accordingly. In addition, the salts of calcium, together with those of magnesium, are responsible for the hardness of water. The concentrations of Ca and Mg are higher in SW1 and SW6 than other five samples. On the other hand, the nitrate and fluoride concentrations are generally below 3.0 mg/L and 0.5 mg/L respectively for all the locations. Bromine is observed ranges from 1.07 mg/L to 4.02 mg/L, its highest concentration i.e. 4.02 mg/L is observed in SW6 collected from Buriganga River.

From the present study it is found that the surface water becomes polluted from Industrial, municipal and agricultural sources (Figure 5.35). Industrial and municipal effluents must be discharged into the River after proper treatment. Moreover, higher values may also be due to the washing out of fertilizer from agricultural fields and detergents used in household purposes which ultimately disposed of into the Rivers water. Besides this, many industries have effluent treatment plants, but they are not using it.

Riverbed Sediment

The riverbed sediment is an integral component of the aquatic ecosystem providing habitat and a source of food for key components of the food web. The sediment often becomes a catchment for natural and anthropogenic toxic substances that bind to particles and settle from the water column to the riverbed. The toxicity from the buildup of these contaminants may threaten the sediment-dwelling benthic organisms, vegetative communities, and the aquatic food web that depend on them. Organisms and plants, particularly those living in the sediment, can acquire and accumulate toxic substances through epidermal contact, respiration, or by ingestion of toxins.

The riverbed sediment quality parameters collected in the project influence area during the month of September - October 2015 (Table 5.16).The collected samples were analyzed for metals (such as- magnesium, calcium, sodium, potassium and sulphate, phosphate, nitrate and heavy metals) and the analysis results are given in Error! Reference source not found.**.**

Table 5.16: Analysis of Riverbed Sediment Samples Collected from Project Influence Area

Parameter	Unit	Sampling ID												OSPAR *
		RBS1	RBS2	RBS3	RBS4	RBS5	RBS6	RBS7	RBS8	RBS9	RBS10	RBS11	RBS12	
Salinity	%	0.021	0.012	0.060	0.013	0.014	0.051	0.070	0.072	0.010	0.020	0.011	0.021	-
Total Mg	%	0.295	0.423	0.852	0.719	0.379	0.163	-	-	-	-	-	-	-
Total Ca	%	0.179	0.068	0.088	0.085	0.084	0.094	-	-	-	-	-	-	-
Total Na	%	0.010	0.012	0.028	0.022	0.018	0.011	-	-	-	-	-	-	-
Total K	%	0.099	0.204	0.612	0.599	0.414	0.093	-	-	-	-	-	-	-
Total Organic Carbon (TOC)	%	0.223	0.428	0.459	0.536	1.172	0.370	0.222	0.377	0.590	0.530	0.07	0.40	-
Total PO_4^{3-}	%	0.232	0.246	0.482	0.474	0.321	0.205	0.307	0.076	0.051	0.015	0.035	0.026	-
Total NO_3	ppm	8.00	37.96	36.28	33.89	10.63	34.20	8.87	6.85	6.14	4.30	1.44	4.72	-
Total As	ppm	0.34	0.31	1.32	0.70	1.65	0.38	0.79	1.24	0.67	0.75	0.30	1.81	30-80
Total Cd	ppm	0.13	0.12	0.10	0.21	0.11	0.11	0.24	0.17	0.18	0.14	0.11	0.10	1.0-2.5
Total Hg	ppm	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.6-1.0
Total Pb	ppm	0.12	4.56	10.25	8.14	8.36	14.63	0.52	0.57	0.112	0.124	0.113	0.110	100-120
Total Cr	ppm	11.38	24.87	45.02	39.35	32.90	10.56	27.36	42.04	21.25	11.45	7.49	9.73	150-200
Total Zn	ppm	12.16	34.95	85.68	72.27	64.05	39.84	28.53	59.07	24.99	12.46	6.04	16.15	250-500
Total Ni	ppm	56.19	56.84	79.66	51.86	33.83	82.26	8.48	28.54	10.27	2.89	2.55	6.62	50-100

*Source: Field survey, September- October 2015, BDL- Below Detection Limit (Detection Limit: Hg = 5.0 ppb), *OSPAR Guidelines for Management of Dredged Material, RBS1- Harinaghat, Chandpur, RBS2- Gozaria, Munshiganj, RBS3- Boktabali Ferryghat, Narayanganj, RBS4- Araihazar, Narayanganj, RBS5- Ashuganj, RBS6- Sadarghat, Dhaka, RBS7- Near Vasan Char (Chukkhalighat, Sandwip), RBS8- Near Chairman Ghat (Noakhali), RBS9- Near Beduria Launch Ghat (Sripurdwip, Barisal), RBS10- Near Hizla (Mehendiganj, Kaliganj) RBS11- Near Ilisha Ghat (Tulatali Bazar, Bhola), RBS12- Near Dawlatkhan Launchghat (Vabanipur Lanchghat)*

Based on the laboratory result, Hg (mercury) is the only parameter which was not detected during the test. Concentration of all the parameters in the riverbed sediment collected throughout the project influence area is below OSPAR standard limit. The highest detected concentrations of Zn and Ni are 85.68 ppm and 82.26 ppm which are found in RBS3 and RBS6 respectively. Based on the above mentioned analysis from monsoon season sampling, sediments collected from the rivers are not categorized as hazardous waste according to the OSPAR regulation. Acute toxicity level of the sediment for human health is identified as relatively harmless. The primary sources of cadmium (Cd) to the atmosphere are from municipal waste incineration and fossil fuel combustion. Non-point sources include domestic wastewater effluent, atmospheric deposition, leaching from landfills, and effluent from manufacturing processes such as pulp and paper, batteries, glass ceramics, electroplating, paints and plastics. The concentrations of Cd are below the standard limit and it ranges from 0.11 to 0.21 ppm. Total organic carbon (TOC) consists of thousands of components, including macroscopic particles (e.g. decaying leaves, grasses and plankton), colloids, particulate and low molecular weight organic and macromolecules. The organic carbon material settles on the riverbed mixing with the sands, silts and clays and contributes to the sediment composition. The TOC content of the sediment varied from 0.223% to 1.172%. The highest sediment TOC values were located in RBS5 (Ashuganj). Concentration of total organic carbon in the water gives indication of domestic wastes pollution in the rivers. The use of detergents adds chromium, arsenic etc. to the waste water. Sewage sludge if discharged into the water may be a significant source of copper, cadmium, zinc and lead. Run off from urban areas during the rainy season is rich in certain heavy metals such as copper, chromium, zinc and lead. The relative quantities depend on the factors such as road traffic conditions, land use and city planning. Lead from automobiles is released into atmosphere, which later gets deposited at surface, and finds its way in the run off. Agricultural soils are usually rich in heavy metals as a result of the use of various fungicides, herbicides, phosphatic fertilizers, organic manure and the presence of decaying plant and animal residues. The sediment deposition works as important sink for heavy metals. Most metals entering the aquatic system ultimately will find their way into sediments. The highly contaminated sediment can often be a greater source of contamination to the water column than runoff or direct discharge sources.

Groundwater

Water for human consumption should be undergone regular physico-chemical tests. Physico-chemical properties are high priorities in determining acceptability, although they may have little bearing on whether the water is safe to drink or not. Generally, the standards used to evaluate the suitability of water for drinking and domestic purposes are more restrictive than those that would be applied to water for other purposes.

The groundwater quality parameters, measured in the project area during the month of September - October 2015 (Table 5.17), were found to comply with the drinking water quality standards set by DOE. The ground water quality of the area is presented in Error! Reference source not found.

Figure 5.36: Groundwater sample collection in the project influence area

Figure 5.37: Riverbed sediment collection
in the project influence area

Table 5.17: Groundwater Quality in the Project Influence Area

Parameter	Unit	Sampling ID												DOE Standard for Drinking Water
		GW1	GW2	GW3	GW4	GW5	GW6	GW 7	GW 8	GW 9	GW 10	GW 11	GW 12	
pH	-	6.82	6.85	4.70	6.52	6.55	6.65	7.85	6.98	7.38	7.92	7.52	7.50	6.5 – 8.5
Temp	°C	24.8	25.3	25.1	24.8	25.3	24.8	24.7	25.1	25.2	24.8	25.1	25.1	20 - 30
EC	µS/cm	425.0	802.0	907.0	1062.0	324.0	987.0	552	6500	1432	829	730	539	-
TDS	mg/L	254.0	461.0	841.0	620	198.0	622.0	339	3398	736	450	395	309	1000
Ca	mg/L	38.4	29.4	97.2	151.0	19.8	101.0	51.4	181	44.7	5.55	21.9	19.3	75

Parameter	Unit	Sampling ID												DOE Standard for Drinking Water
		GW1	GW2	GW3	GW4	GW5	GW6	GW 7	GW 8	GW 9	GW 10	GW 11	GW 12	
Mg	mg/L	19.5	21.2	14.6	54.9	16.5	28.8	1.34	74.9	17.9	2.00	13.0	12.7	30 – 35
Na	mg/L	38.6	113.0	93.6	29.2	19.9	53.1	107	767	200	170	120	75.0	200
K	mg/L	4.26	2.46	25.7	5.76	3.71	5.49	1.36	20.9	5.42	1.66	4.21	4.37	12
Cl^-	mg/L	6.94	111.0	86.9	11.6	15.1	116.0	18.2	1766	169	58.6	44.4	17.5	150 – 600
F	mg/L	<0.5	<0.5	29.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1
Br	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-
SO_4	mg/L	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	400
As	mg/L	<0.005	<0.005	0.369	0.04	0.03	<0.005	<0.005	0.02	<0.005	<0.005	<0.005	<0.005	0.05
Fe	mg/L	1.34	1.19	3.14	1.31	24.7	0.35	0.63	3.24	0.42	0.30	0.98	1.02	0.3 – 1.0
Mn	mg/L	0.07	0.07	2.57	2.60	1.73	0.50	<0.05	2.10	0.08	<0.05	0.05	<0.05	0.1

Source: Field survey, September- October 2015, Cells in grey color shed indicate the exceedance the limit of DOE drinking water standard, GW1- Harinaghat, Chandpur, GW2- Gozaria, Munshiganj, GW3- Boktabali Ferryghat, Narayanganj, GW4- Araihazar, Narayanganj, GW5- Ashuganj, GW6- Sadarghat, Dhaka, GW7- Near Vasan Char (Chukkhalighat, Sandwip), GW8- Near Chairman Ghat (Noakhali), GW9- Near Beduria

Launch Ghat (Sripurdwip, Barisal), GW10- Near Hizla (Mehendiganj, Kaliganj) GW11- Near Ilisha Ghat (Tulatali Bazar, Bhola), GW12- Near Dawlatkhan Launchghat (Vabanipur Lanchghat)

Temperature: Temperature affects physical, chemical and biological processes in water bodies. As water temperature increases, the rate of chemical processes generally increases and the solubility of gases in water such as O_2, CO_2, N_2 and others decrease. The metabolic rate of aquatic organisms is also related to temperature. In project area, all collected groundwater samples have temperature within the Bangladesh standard for drinking water (20 - 30 ºC) purpose.

pH: pH is a measure of the hydrogen ion concentration in water and indicates whether the water is acidic or alkaline. The measurement of alkalinity and acidity of pH is required to determine the corrosiveness of the water. From the pH value of the groundwater samples it is observed that lowest value is found in samples collected from Boktabali ferry ghat in Narayanganj, which is 4.70 far below the permissible limit.

Electrical Conductivity: Conductivity is ability of water to carry an electrical current. This ability mainly depends on presence of anion and cations in water and also depends on mobility, valence of ions and temperature. In the present study the GW4 showed higher electrical conductivity (1062.0 mg/L) when compared to other sampling locations.

Total dissolved solids (TDS): TDS values indicate the general nature of water quality and are usually related to conductivity. However, the values of TDS of all the samples collected throughout the project influence area are within the standard limit except GW8 where conductivity was recorded 3398 µS/cm.

Major Ions: The abundance of major ions largely depends upon the nature of rocks, climatic conditions and mobility. The ion distribution is also influenced by the infinite complex surface and subsurface physicochemical environments. To asses these geochemical processes the collected water samples are chemically analyzed for the major cations (Na, K, Ca and Mg) and major anions (Cl and SO_4). In addition to Fe and F which are naturally very variable due to local geological, climatic and geographical conditions. However, the higher contents of calcium and magnesium in water are due to gypsum and anhydrite dissolution in the circulating waters. The concentrations of calcium in the study area are 97.2 mg/L, 151.0 mg/L, 101.0 mg/L and 181.0 mg/L recorded in GW3, GW4, GW6 and GW8 respectively exceeds the standard limit. Likewise, magnesium (Mg) concentrations in the study area are 54.9 mg/L and 74.9 mg/L recorded in GW4 and GW8 respectively exceeds the standard limit. Moreover, Iron (Fe) content of groundwater samples along the project influence area (GW1- 1.34 mg/L, GW2- 1.19 mg/L, GW3- 3.14 mg/L, GW4- 1.31 mg/L, GW5- 24.7 mg/L, GW8- 3.24 mg/L and GW12- 1.02 mg/L) exceeds the Bangladesh standard for drinking water (0.3-1.0 mg/L). Likewise, manganese (Mn) content of groundwater samples (GW3- 2.57 mg/L, GW4- 2.60 mg/L, GW5- 1.73 mg/L, GW6- 0.50 mg/L and GW8- 2.10 mg/L) exceeds the standard for drinking water (0.1 mg/L). Sulphate is found in small quantities in all groundwater samples which lie within the permissible limits of DOE drinking water standard. Groundwater sample (GW3) of Boktabali ferry ghat, Narayanganj contained arsenic (0.369 mg/L) exceeding the DOE tolerance limit (0.05 mg/L) for drinking water.

With the growth of industry the groundwater is made susceptible for contamination due to addition of waste materials. Waste materials from the factories percolate with rain water and reach aquifer resulting in erosion of groundwater quality. Groundwater is used for domestic, industrial, water supply and irrigation all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population, unplanned urbanization, industrialization and too much use of fertilizers and pesticides in agriculture.

Air Quality

Air quality measurements carried out during 2 to 14 October 2015 in six locations of the Project influence area (Table 5.18) and the monitoring results are given in Table 5. World Bank Group Environmental, Health, and Safety (EHS) Guidelines and Bangladesh national standards for ambient air quality are also presented in this Error! Reference source not found.. The key air quality parameters (particulate matter- PM_{10} and $PM_{2.5}$, oxides of sulfur - SOx, carbon monoxide- CO, oxides of nitrogen – Nox, ground ozone O_3) were analyzed from samples collected over an eight (8) hour period at each sampling sites.

Table 5.18: Ambient Air Quality Parameters in Project Influence Area (in µg/m^3)

Location → / Parameter ↓	AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	AAQ6	Air Quality Standards	
							DOE*	WBG EHS**
Carbon Monoxide (CO)	510.77	1016.25	254.14	319.08	802.77	421.25	10,000 (8 hour)	-
Nitric Oxide (NO)	20.61	31.84	12.51	18.22	27.76	19.07	100 (Annual)	40 (Annual)
Nitrogen dioxide (NO_2)	18.34	20.15	9.79	15.51	19.32	16.56		
Sulphur dioxide (SO_2)	16.98	23.67	11.62	15.18	20.07	16.01	365 (24 hour)	20 (24 hour)
Ozone (O_3)	11.37	15.89	8.44	10.32	14.37	12.61	157 (8 hour)	100 (8 hour)
Particulate Matter (PM_{10})	89.21	127.18	49.67	83.11	95.83	87.22	150 (24 hour)	50 (24 hour)
Particulate Matter ($PM_{2.5}$)	41.41	54.33	21.84	28.56	46.17	37.58	65 (24 hour)	25 (24 hour)
Temperature	32.69	30.83	26.71	27.70	26.34	30.43	-	-
Humidity	55.01	57.82	62.56	69.91	67.48	57.88	-	-

Source: Field survey, October 2015, AAQ1-Ashuganj, Brahmanbaria, AAQ2- Sadarghat Launch Terminal, Dhaka, AAQ3- Char Shreepur, Barisal, AAQ4- Dhunia, Bhola, AAQ5- Chandpur Launch Terminal, AAQ6- Gozaria Launch Terminal, Munshiganj,

*The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997

**World Bank Group Environmental, Health, and Safety (EHS) Guidelines

The measurement results showed achievement of all air quality standards. Based on the ambient air quality standard of DOE, air quality in the project areas can be stated as in good condition. Particulate matters PM_{10} and $PM_{2.5}$ showed concentrations of 49.67 to 127.18µg/m^3 and 21.84 to 54.33µg/m^3 which are far below the DOE standard of 150µg/m^3 and 65µg/m^3

respectively. On the other hand, all the sampling locations except AAQ3 (Dhunia, Bhola) exceeded the standard of World Bank for Particulate matters PM_{10} and $PM_{2.5}$. Details of air quality measurements are described below:

Carbon monoxide (CO): CO measured in sampling campaign in the month of October 2015 and the concentration of the samples was within DOE standard of ambient air quality. The highest value of 1016.25µg/m³ is obtained at Sadarghat launch terminal (AAQ2).

Nitric oxide (NO) and Nitrogen dioxide (NO_2): Ambient NO and NO_2 concentrations in all the sampling points showed compliance with DOE and WB standard of 100µg/m³ and 40µg/m³ accordingly. Measured concentrations for NO and NO_2 are 12.51 to 31.84µg/m³ and 9.79 to 20.15µg/m³ accordingly.

Sulphur dioxide (SO_2): Ambient SO_2 concentrations in six sampling locations showed compliance with the DOE standard of 365µg/m³ but Sadarghat (AAQ2) and Chandpur (AAQ5) cannot meet the WB standard of 20µg/m³ for SO_2 concentrations. Measured concentrations are ranges from 11.62 to 23.67µg/m³.

Ozone (O_3): The results indicated that ozone (O_3) in the six study areas are within the air quality standards of DOE and the concentration ranges from 8.44 to 15.89µg/m³.

Air Pollution Sources- Most of the sampling points located in the commercial area in nature except char Shreepur in Barisal and Dhunia in Bhola district which are in rural area. The main sources of pollution in Ashuganj, Chandpur and Gozaria are the boat traffics, local vehicles especially auto-rickshaws, trucks, locally manufactured small three-wheelers. Cooking and other fires in the area cause some pollution. In addition, various types of motor boats and launches were also sailing in the river– causing air quality deterioration. In Sadarghat, the location of air quality measurement is at the terminal area. Surrounding area of the sampling location is overcrowded which induced extensive dust emission. The measurement was done at morning and ended in the evening when launches started their journey and people began to gather at the terminal. To sum up, the air quality in the vicinity of the waterways is good as there is little industry and only a few roads. This is partly due to the effect of the biomass of project area and also partly due to the absence of emission sources.

Figure 5.38: Air quality and noise level measurement in the project influence area

Noise Level

Noise level data were collected in the same locations as air quality samples, in eight locations from 2-14 October 2015 are shown in Figure 5.38 and the test results are given in the Table 5.19. The measured noise values are within the prevailing standards set by DoE and WB (Table 5.20andTable 5.21) The technical terms and units of noise measurements employed by these standards are defined as follows:

L_{eq}= the sound level equivalent, i.e., an energy-averaged sound level that includes both steady background sounds and transient short-term sounds. The L_{eq} represents the level of steady sound which, when averaged over the sampling period, is equivalent in energy to the fluctuating sound level over the same period. The L_{eq} is commonly used to describe traffic noise levels that tend to experience hourly peaks.

dBA= A weighted measurement of sound. Since the range of sound pressure levels varies considerably, sound levels are expressed on a logarithmic scale, which compresses the range. The standard measurement unit of sound is the decibel (dB), which represents a ratio of pressure levels referenced to the 0.0002 microbar, which is considered to be the threshold audible range, of human hearing. The threshold of pain, which is of the order end of the audible range, occurs at approximately 140 decibels. Using the decibel scale, an increase of three decibels is barely perceptible and an increase or decrease of ten decibels is perceived as a doubling or halving of the sound level. Humans are capable of hearing only a limited frequency range of sound and the human ear is not equally sensitive to all frequencies. The human ear is more tolerant to higher noise levels at lower frequencies and can hear frequencies ranging from 20 hertz (Hz) to 20,000 Hz. In order to take this characteristic into account in noise measurements, a frequency weighting known as A-weighting is commonly applied to the sound pressure levels which approximate the frequency response of the human ear by placing most emphasis on the frequency range of 1,000 to 5,000 hertz. Because the A-weighted scale closely describes the subjective response of the human ear, it is most commonly used in noise measurements. Sound level measurement using A-weighting are expressed as dBA.

Table 5.19: Noise Levels in Project Influence Area

Location	Category of the area	Date	Noise (L_{eq}) in dBA
NM1	Commercial	02/10/2015	49.86
NM2	Commercial	03/10/2015	65.06
NM3	Residential and Rural	10/10/2015	55.72
NM4	Residential and Rural	11/10/2015	60.66
NM5	Commercial	13/10/2015	63.52
NM6	Commercial and Mixed	14/10/2015	53.52

Source: Field survey, October 2015

Source: Field survey, October 2015, NM1-Ashuganj, Brahmanbaria, NM2- Sadarghat Launch Terminal, NM3- Char Shreepur, Barisal, NM4- Dhunia, Bhola, NM5- Chandpur Launch Terminal, NM6- Gozaria Launch Terminal, Munshiganj,

Table 5.20: Noise Quality Standards of Bangladesh

Sl. No.	Area Category	Noise Quality Standard in dBA
A	Silent Zone	50
B	Residential Area	55
C	Mixed Area (basically residential and together used for commercial and industrial purposes)	60
D	Commercial Area	70
E	Industrial Area	75

Source: The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Notes:

1. Silent zones are areas up to a radius of 100 m around hospitals, educational institutes, and Government-declared special establishments. Use of vehicular horns, other signals, and loudspeakers are prohibited in silent zones.

Table 5.21: World Bank Group EHS Standards for Noise

Area Category	Standard Values in dBA
Residential, institutional, educational area	55
Commercial and industrial area	70

Source: World Bank Group Environmental, Health, and Safety (EHS) Guidelines

All the locations are generally within the limits prescribed by the ambient noise quality standards by DOE and WB. Minimum noise levels vary from 49.86 dB (A) at Ashuganj to 65.06 dB (A) at Sadarghat launch terminal. The value at Dhunia in Bhola is higher than the permissible limit for residential areas (55 dBA) due to passing launches and engine boats during noise measurement.

Noise Sources- Noise levels are generally low in the vicinity of the waterways as there are few sources of loud noise such as little factories, boat traffics and road traffics. Boat traffics in the river such as launch, ferry, engine boat, twallers etc. are the key sources of noise in the project influence area.

5.2.2 Dry Period Data Analysis:

Surface Water

In case of dry season monitoring, the surface water samples were collected from the month of January to February 2016 and the detailed analyses are incorporated in Table 5.22

Table 5.22: Dry Season Surface Water Quality of Rivers in Project Influence Area

Parameter	Unit	Sampling ID											
		SW1_D	SW2_D	SW3_D	SW4_D	SW5_D	SW6_D	SW7_D	SW8_D	SW9_D	SW10_D	SW11_D	SW12_D
pH	-	8.47	7.31	6.95	7.77	7.54	7.02	7.65	7.80	7.10	7.29	7.42	7.45
Temp	$^{\circ}$C	23	25	22.5	23	24.5	22	24.5	23	22.5	22.5	23	21.5
Turbidity	NTU	8.2	3.34	22.5	48.6	6.97	14.2	47.8	9.06	36.9	19.8	8.22	12.5
EC	µS/cm	264	278	560	786	129.1	1073	22450	13975	271	245	607	275
DO	mg/L	3.18	0.83	4.00	1.02	7.74	2.40	0.55	4.05	4.58	5.33	2.00	5.50
BOD_5	mg/L	<MDL	1.00	2.24	14.4	3.2	15.7	67.3	2.12	15.3	2.83	18.9	2.87
TOC	mg/L	3.56	4.89	3.17	11.48	-	10.8	3.09	1.92	7.29	8.04	<0.5	6.34
TDS	mg/L	155	191	300	492	64.5	537	14738	6583	159	136	375	147
TSS	mg/L	26	35	18.4	19	117	33.6	40.2	356	89.4	33.8	36.0	141
Ca	mg/L	-	-	35.5	-	13.89	50.6	279	162	40.2	26.2	20.3	29.5
Mg	mg/L	6.69	5.73	11.7	8.86	6.85	15.2	468	244	11.3	7.30	13.8	9.88
Na	mg/L	25	44.7	30.0	187.1	8.21	107	1071	893	7.98	7.46	86.7	10.8
K	mg/L	17.9	5.8	6.89	22.8	2.14	10.9	49.2	47.2	2.76	2.81	4.38	3.67
Cl^-	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
F	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Br	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
SO_4	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
NO3	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total PO_4	mg/L	0.19	0.69	2.38	3.84	3.43	7.24	1.50	-	-	-	-	-

Source: Field survey January-February 2016 D-Dry Season,, Cells in grey color shed indicate the exceedance the limit of DOE standard, SW1- Harinaghat, Chandpur, SW2- Gozaria, Munshiganj, SW3- Boktabali Ferryghat, Narayanganj, SW4- Araihazar, Narayanganj, SW5- Ashuganj, SW6- Sadarghat, Dhaka, SW7- Near Vasan Char (Chukkhalighat, Sandwip), SW8- Near Chairman Ghat (Noakhali), SW9- Near Beduria Launch Ghat (Sripurdwip, Barisal), SW10- Near Hizla (Mehendiganj, Kaliganj) SW11- Near Ilisha Ghat (Tulatali Bazar, Bhola), SW12- Near Dawlatkhan Launchghat (Vabanipur Lanchghat)

Water Temperature- The temperature of the water bodies in the project influence area ranges from 21.5 to 25°C in January - February 2016. Temperature of all the samples are below the DoE standards for both irrigation and fish habitats.

pH- In case of dry season, for all the samples, the pH range is found well within the DoE standards like wet season. The pH of water samples lies in the range of 6.95 to 8.47.

Turbidity- Turbidity values of the surface water samples ranges from 3.34 to 48.6 NTU. Lower turbidity value might be due to the calm nature of river water. The highest values of turbidity were observed in SW4 collected from Araihazar, Narayanganj.

Dissolved Oxygen (DO) - The dissolved oxygen values ranged from 0.55 to 7.74 mg/L in twelve locations. The concentration of DO exceeded in all the surface water samples except SW4 at Araihazar, SW10 near Hizla ghat at Mehendiganj and SW12 near Dawlatkhan Launch ghat, Bhola. However, the worst condition is observed in SW7 near Vasan Char, Sandwip which was 0.55 mg\L where the DOE standard limit for irrigation is 5 mg\L or more.

BOD_5- In the study area BOD5 values range from below detection limit to a maximum of 67.3 mg/L. The concentration of BOD5 is far more than DOE standard limit in SW4, SW6, SW7, SW9 and SW11 which are 14.4 mg\L, 15.7 mg\L, 67.3 mg/L, 15.3 mg\L and 58.3 mg/L accordingly. The best scenario in terms of low value of BOD5 is recorded in SW1 which is below detection limit.

Electric Conductivity (EC) - In dry season monitoring EC values range from a minimum of 129.1µS/cm to a maximum of 22450.0µS/cm. The entire water samples collected from the study area are within the standard limit except SW7 (Vasan Char, Sandwip) and SW8 (Chairman Ghat, Noakhali) recorded the higher value of EC.

Total Dissolved Solids (TDS) - TDS may influence the toxicity of heavy metals and organic compounds for fish and other aquatic life. The natural range of TDS concentration in the water bodies of the project influence area are between 64.5 mg/L and 14738.0 mg/L. The higher value of TDS is recorded in SW7 (Vasan Char, Sandwip) and SW8 (Chairman Ghat, Noakhali).

Total Suspended Solids (TSS) - The concentration of total suspended solids ranges from 18.4 mg/L to 356.0 mg/L. The water sample collected from Chairman Ghat, Noakhali (SW8) recorded the highest value of suspended solids.

Total Organic Carbon (TOC) –The concentration of TOC ranges from below 0.5 mg/L to 11.48 mg/L. In SW4 collected from Araihazar in Narayanganj recorded the highest value of total organic carbon and the opposite value observed in SW11 near Ilisha Ghat in Bhola.

Major Ions- The concentration of Na ranges from 7.46 mg/L to 1071.0 mg/L. The higher values of Na are 1071.0 mg/L and 893 mg\L found in SW7 and SW8 collected from Vasan Char, Sandwip and Chairman Ghat, Noakhali which may arise due to sea water intrusion. In addition, the salts of calcium, together with those of magnesium, are responsible for the hardness of water. The concentrations of Ca and Mg are higher in SW7 and SW8 than rest of the samples. On the other hand, the nitrate concentration is generally below 3.0 mg/L for all the locations. Phosphate is observed ranges from 0.19 mg/L to 7.24 mg/L, its highest concentration i.e. 7.24 mg/L is observed in SW6 collected from Buriganga River.

The test result of both seasons reveals that the surface water quality shows some seasonal variation. The results from data analysis show that the surface water quality is not acceptable from aquaculture and irrigation perspectives for the parameters such as DO, BOD5, EC during dry season. The data depicts that during the wet season, the DO level increases from 0.89 to 6.12 mg/L in twelve locations, while during dry season, the DO level drops from 7.74 to 0.55 mg/L at those locations. However, the EC measures the salinity of water and depends on the ions present in water. The values for EC in the surface water during the wet season at all the sampling locations were found within the DOE standard, which is 54.2μS/cm to 171.0μS/cm. However, during dry season the EC values varied from 129.1μS/cm to 22450.0μS/cm and at SW7 (Vasan Char, Sandwip) and SW8 (Chairman Ghat, Noakhali) recorded the higher value of EC. Moreover, the values of major ions were recorded higher in the dry season in twelve locations than the wet season. In the wet season, as the flow of the river increases which may cause the dilution of the salinity of the water, while in the dry season, the flow of the river decreases, as a result the EC and the concentration of major ions increase.

Riverbed Sediment

For dry season sampling, the riverbed sediment collected from the same location as wet season sampling during the month of January - February 2016 (Table 5.23). Also one additional sample was analysed which was taken from the branch of upper meghna river (Route-9) at the probable dredging location.

Table 5.23: Dry Season Riverbed Sediment Samples Collected from Project Influence Area

Parameter	Unit	Sampling ID												OSPAR*
		RBS1	RBS2	RBS3	RBS4	RBS5	RBS6	RBS7	RBS8	RBS9	RBS10	RBS11	RBS12	
Salinity	%	-	-	0.04	-	0.06	0.06	0.88	0.59	0.02	0.021	0.019	0.040	-
Total Mg	%	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Ca	%	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Na	%	-	-	-	-	-	-	-	-	-	-	-	-	-
Total K	%	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon (TOC)	%	0.32	0.67	0.45	0.17	0.666	0.32	0.44	0.38	0.22	0.45	0.26	0.64	-
Total PO_4^{3-}	%	0.188	0.245	0.220	0.104	0.217	0.248	0.0152	0.0154	0.160	0.148	0.176	0.127	-
Total NO_3	ppm	5.67	2.23	0.71	102.46	6.675	0.61	1.280	0.524	0.113	0.106	0.117	0.103	-
Total As	ppm	15.04	1.34	2.352	9.7	0.051	4.227	4.324	4.967	2.395	4.326	2.871	5.134	30-80
Total Cd	ppm	0.00	0.00	BDL	0.00	0.140	BDL	0.035	0.054	BDL	BDL	BDL	BDL	1.0-2.5
Total Hg	ppm	0.041	0.041	0.005	0.055	BDL	0.020	7.26	3.17	BDL	BDL	BDL	BDL	0.6-1.0
Total Pb	ppm	16.0	12.6	6.70	23.1	10.525	204.63	13.404	11.353	4.264	11.487	5.922	15.080	100-120
Total Cr	ppm	18.9	17.5	27.73	20.2	23.797	66.01	31.727	34.512	26.647	32.126	21.470	33.483	150-200
Total Zn	ppm	59.2	62.4	46.13	112.8	51.658	251.22	51.176	57.331	30.443	54.468	35.306	59.746	250-500
Total Ni	ppm	21.0	21.1	32.969	21.3	35.261	18.015	40.918	45.682	20.711	42.851	21.405	35.318	50-100

*Source: Field survey, January- February 2016, BDL- Below Detection Limit (Detection Limit: Hg = 1.0 ppb, Cd= 0.03 ppm), *OSPAR Guidelines for Management of Dredged Material, RBS1- Harinaghat, Chandpur, RBS2- Gozaria, Munshiganj, RBS3- Boktabali Ferryghat, Narayanganj, RBS4- Araihazar, Narayanganj, RBS5- Ashuganj, RBS6- Sadarghat, Dhaka, RBS7- Near Vasan Char (Chukkhalighat, Sandwip), RBS8- Near Chairman Ghat (Noakhali), RBS9- Near Beduria Launch Ghat (Sripurdwip, Barisal), RBS10- Near Hizla (Mehendiganj, Kaliganj) RBS11- Near Ilisha Ghat (Tulatali Bazar, Bhola), RBS12- Near Dawlatkhan Launchghat (Vabanipur Lanchghat)*

In case of dry season sampling, concentration of two parameters- Hg (mercury) and Pb (lead) were exceeded the OSPAR standard limit. The highest exceeded concentration of Hg was 204.63 ppm which detected in RBS6 collected from Sadarghat. On the other hand, concentrations of Pb were above the OSPAR guideline which were 7.26 and 3.17 ppm collected from Vasan char, Sandwip (RBS7) and near Chairman ghat, Noakhali (RBS8) respectively.

The test result revealed that the values of most of the ions were within the OSPAR standard limit for twelve locations during wet and dry season. In the wet season, as the flow of the river increases which may cause the dilution of the riverbed sediments, while in the dry season, the flow of the river decreases, as a result the concentration of Hg and Pb increase in the sediment collected from the estuarine rivers at Vasan char, Sandwip (RBS7) and near Chairman ghat, Noakhali (RBS8).Sediment quality is a matter of concern at the downstream of Chandpur, Upper Meghna, Lower Meghna, Shitalakhya and Buriganga.

Groundwater

The groundwater samples for dry season monitoring were collected from the same locations as wet season sampling during the month of January- February 2016 (Table 5.24).

Table 5.24**:** Groundwater Quality in the Project Influence Area for Dry Season

Parameter	Unit	Sampling ID												DOE Standard for Drinking Water
		GW1_D	GW2_D	GW3_D	GW4_D	GW5_D	GW6_D	GW 7_D	GW 8_D	GW 9_D	GW 10_D	GW 11_D	GW 12_D	
pH	-	7.90	7.72	6.90	7.54	6.76	6.85	7.66	7.88	7.08	7.85	7.58	7.20	6.5 – 8.5
Temp	°C	27	26.2	27	25.5	26	29	28	26.3	29	25.5	30	26	20 - 30
EC	µS/cm	411	763	861	712	462.1	986	29900	5950	11700	931	240	742	-
TDS	mg/L	284	469	540	430	231.1	562	17380	2905	5747	520	142	444	1000
Ca	mg/L	18.78	23.62	123	52.78	42.96	94.3	320	172	534	116	27.5	44.8	75
Mg	mg/L	7.74	10.68	23.2	23.01	26.71	31.3	558	136	308	2.05	7.5	26.2	30 – 35

Parameter	Unit	Sampling ID												DOE Standard for Drinking Water
		GW1_D	GW2_D	GW3_D	GW4_D	GW5_D	GW6_D	GW 7_D	GW 8_D	GW 9_D	GW 10_D	GW 11_D	GW 12_D	
Na	mg/L	48.7	200	11.4	148.2	1.19	31.4	1357	500	1145	186	99.8	63.8	200
K	mg/L	8.2	4.4	5.48	4.2	4.01	4.04	61.4	21.3	19.1	2.67	4.38	4.19	12
Cl^-	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	150 – 600
F	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	1
Br	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
SO_4	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	400
As	mg/L	<0.005	<0.005	<0.005	0.006	0.011	<0.005	<0.005	0.029	<0.005	<0.005	<0.005	<0.005	0.05
Fe	mg/L	1.7	0.9	1.57	22	1.75	0.36	19.3	2.43	2.89	<0.2	1.04	2.20	0.3 – 1.0
Mn	mg/L	<MDL	<MDL	2.58	0.26	5.67	0.38	0.41	2.04	0.32	<0.05	<0.05	0.06	0.1

Source: Field survey, January- February 2016, Cells in grey color shed indicate the exceedance the limit of DOE drinking water standard, GW1- Harinaghat, Chandpur, GW2- Gozaria, Munshiganj, GW3- Boktabali Ferryghat, Narayanganj, GW4- Araihazar, Narayanganj, GW5- Ashuganj, GW6- Sadarghat, Dhaka, GW7- Near Vasan Char (Chukkhalighat, Sandwip), GW8- Near Chairman Ghat (Noakhali), GW9- Near Beduria Launch Ghat (Sripurdwip, Barisal), GW10- Near Hizla (Mehendiganj, Kaliganj) GW11- Near Ilisha Ghat (Tulatali Bazar, Bhola), GW12- Near Dawlatkhan Launchghat (Vabanipur Lanchghat)

Temperature: In project area, all collected groundwater samples have temperature within the Bangladesh standard for drinking water (20 - 30 ºC) purpose.

pH: From the pH value of the groundwater samples is found within the Bangladesh standard for drinking water (6.5 – 8.5) purpose.

Electrical Conductivity: In the present study the GW7, GW8 and GW9 showed the higher electrical conductivity of 29900 mg/L, 5950mg\L and 11700 mg\L respectively when compared to other sampling locations.

Total dissolved solids (TDS): The values of TDS of all the samples collected throughout the project influence area are within the standard limit except GW7, GW8 and GW9 which were 17380 mg\L, 2905 mg\L and 5747 mg\L accordingly where the DOE permissible limit for drinking purpose is 1000 mg\L.

Major Ions: The concentrations of calcium, magnesium, sodium and potassium in the study area are recorded higher in GW7 (Vasan Char, Sandwip), GW8 (Chairman Ghat, Noakhali) and GW9 (Beduria Launch Ghat, Barisal) respectively exceeds the standard limit. It is noted that, the same results are also recorded for the surface water samples which collected from the same locations. However, five of the locations (GW2, GW6, GW10, GW11 and GW12) failed to meet the Bangladesh drinking water standard (0.3-1.0 mg/L) for Iron (Fe) content. The highest value was recorded in GW4 and GW7 are 22 mg\L and 19.3 mg\L accordingly. Likewise, seven of the tube-wells (GW3, GW4, GW5, GW6, GW7, GW8 and GW9) failed to meet the DOE standard (0.1 mg/L) for manganese (Mn) content in drinking water.

The test result shows that, only 8% of TDS value exceeds DOE standards for wet season whereas 25% of samples exceeds standard of allowable limits, which reveals that water is unsuitable for drinking. In case of iron, 66% and 58% samples exceed DOE recommended values during dry and wet season accordingly. Higher concentration of manganese noticed in 58% of the samples in dry season and 33% of the samples in wet season, which lead to unsuitability of drinking. The samples exceeding DOE recommended Calcium values is 58% in dry season but in case of wet season 33% samples exceeds DOE recommended value. However, about 25% samples are exceeding the recommended Mg, Na and K value by DOE guidelines in dry season but only 8% samples exceed in wet season. The study area is good for pH as all the water samples within the recommended value throughout the study period. Therefore, it can be concluded that the project influence area is highly associated with the iron problem, especially in dry season.

Air Quality

Air quality measurements carried out for dry season during January to February 2016 in six locations of the Project influence area and the monitoring results are given in Table 5.25.

Table 5.25: Ambient Air Quality Parameters in Project Influence Area (in µg/m^3)

Location / Parameter	AAQ1_D	AAQ2_D	AAQ3_D	AAQ4_D	AAQ5_D	AAQ6_D	Air Quality Standards: DOE*	Air Quality Standards: WBG EHS**
Carbon Monoxide (CO)	859.17	1543.50	376.72	568.12	937.42	755.98	10,000 (8 hour)	-
Nitric Oxide (NO)	37.90	56.53	29.98	40.30	50.47	40.01	100 (Annual)	40 (Annual)
Nitrogen dioxide (NO_2)	26.14	27.16	12.90	22.71	28.64	21.97		
Sulphur dioxide (SO_2)	32.08	42.88	26.09	31.46	39.33	31.45	365 (24 hour)	20 (24 hour)
Ozone (O_3)	18.53	20.07	10.57	15.77	21.11	17.54	157 (8 hour)	100 (8 hour)
Particulate Matter (PM_{10})	131.55	144.76	91.51	103.85	139.75	126.58	150 (24 hour)	50 (24 hour)
Particulate Matter ($PM_{2.5}$)	56.73	61.84	30.24	36.96	58.27	49.14	65 (24 hour)	25 (24 hour)

Temperature	23.24	26.04	22.47	22.88	22.21	22.63	-	-
Humidity	76.00	72.46	55.51	61.18	74.71	66.06	-	-

Source: Field survey, January-February 2016, AAQ1-Ashuganj, Brahmanbaria, AAQ2- Sadarghat Launch Terminal, Dhaka, AAQ3- Char Shreepur, Barisal, AAQ4- Dhunia, Bhola, AAQ5- Chandpur Launch Terminal, AAQ6- Gozaria Launch Terminal, Munshiganj,

**The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997,*

***World Bank Group Environmental, Health, and Safety (EHS) Guidelines*

Particulate matters- PM_{10} and $PM_{2.5}$ showed concentrations of 91.51µg/m^3 to 144.76µg/m^3 and 30.24µg/m^3 to 61.84µg/m^3 which are below the DOE standard of 150µg/m^3 and 65µg/m^3 respectively. On the other hand, all the sampling locations exceeded the standard of World Bank for Particulate matters PM_{10} and $PM_{2.5}$.

Carbon monoxide (CO): CO measured in sampling campaign for dry season and the concentration of the samples was within DOE standard of ambient air quality. The highest value of 1543.50µg/m^3 is obtained at Sadarghat launch terminal (AAQ2).

Nitric oxide (NO) and Nitrogen dioxide (NO_2): Ambient NO and NO_2 concentrations in all the sampling points showed compliance with DOE standard of 100µg/m^3. On the other hand, all the sampling locations exceeded the standard of World Bank for NO except AAQ1 and AAQ3. On the contrary, all the samples were within the WB standard for NO_2 (40µg/m^3). Measured concentrations for NO and NO_2 are 29.98 to 56.53µg/m^3 and 12.90 to 28.64µg/m^3 accordingly.

Sulphur dioxide (SO_2): Ambient SO_2 concentrations in six sampling locations showed compliance with the DOE standard of 365µg/m^3 but none of them cannot meet the WB standard of 20µg/m^3 for SO_2 concentrations. Measured concentrations are ranges from 26.09 to 42.88µg/m^3.

Ozone (O_3): The results indicated that ozone (O_3) in the six study areas are within the air quality standards of DOE and WB. The concentration ranges from 10.57 to 21.11µg/m^3.

Based on the ambient air quality standard of DOE, air quality in the project areas can be stated as in good condition all year round. The results of the air quality monitoring in dry season revealed relatively higher pollution level than wet season. Particulate matter PM10 and PM2.5 exceeded the standard set by WB for both of the seasons. This could be due to frequent movement of water vessels run by diesel engine and silted up the water bodies located close to the sampling points.

Noise Level

Noise level data were collected in the same locations as air quality samples, in eight locations from January-February 2016 for dry season monitoring are shown in the Table 5.26

Table 5.26: Dry Season Noise Levels in Project Influence Area

Location	Category of the area	Date	Noise (L_{eq}) in dBA
NM1	Commercial	31/01/2016	53.25
NM2	Commercial	12/02/2016	62.55
NM3	Residential and Rural	06/02/2016	56.42
NM4	Residential and Rural	07/02/2016	53.69
NM5	Commercial	29/01/2016	68.5
NM6	Commercial and Mixed	30/01/2016	60.91

Source: Field survey, January-February 2016, NM1-Ashuganj, Brahmanbaria, NM2- Sadarghat Launch Terminal, NM3- Char Shreepur, Barisal, NM4- Dhunia, Bhola, NM5- Chandpur Launch Terminal, NM6- Gozaria Launch Terminal, Munshiganj

All the locations except NM3 (Char Shreepur, Barisal) are generally within the limits prescribed by the ambient noise quality standards by DOE and WB. The value at Char Shreepur, Barisal is higher than the permissible limit for residential areas (55 dBA) due to passing launches and engine boats during noise measurement. Minimum noise levels vary from 53.25 dB (A) at Ashuganj to 68.50 dB (A) at Chandpur Launch Terminal.

The noise measurement results indicated that noise level was above the environmental standards for residential areas at one sampling point in Bhola and Barisal in wet and dry season respectively. These two sites are, as cited above, not an industrial area and therefore boat traffics in the river such as launch, ferry, engine boat, twallers etc. are the key sources of noise.

Soil sample collected from potential on land disposal sites within Project Influence area:

According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service, soil quality is the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. The soil in the project area is highly productive and suitable to support different ecosystems in balance. During the dredging period, dredged materials will be stored at some designated places in the project influence area. Hence, there is the chance of the native soil to be disturbed by the dredged material. Soil samples collected in the month of January to February 2016 from 0.5 m depth of the surface and were analyzed in the environmental laboratory of BCSIR to assess the current soil quality of the project area. Table 5.27 reflects the test results of the soil sample collected from five locations. Test report of soil analysis proved that soil collected from the project area was acidic in nature and contained acceptable amount of some major ions.

Table 5.27: Analysis of Soil Samples Collected from Project Influence Area

Parameter	Unit	Sampling ID				
		Soil 1	Soil 2	Soil 3	Soil 4	Soil 5
pH	-	6.17	6.12	6.18	5.27	7.45
EC	µS/cm	441	350	1877	735	444
Magnesium (Mg)	%	0.206	0.016	0.369	0.110	0.111
Calcium (Ca)	%	0.145	0.234	0.539	0.024	0.033
Sodium (Na)	%	0.045	0.046	0.072	0.017	0.015
Potassium (K)	%	0.123	0.113	0.287	0.150	0.215
Total Organic Carbon (TOC)	%	0.248	0.074	1.518	1.13	1.27
Total PO_4^{3-}	%	0.134	0.069	0.460	0.218	0.278
Total NO_3	ppm	10.108	3.750	98.796	0.76	95.48

Source: Field survey, January- February 2016, BDL- Below Detection Limit (Detection Limit: Hg = 1.0 ppb, Cd= 0.03 ppm), Soil 1- Char Sonarampur, Ashuganj, Soil 2- Char Chartola, Ashuganj, Soil 3- Boro Char, Munshiganj, Soil4- Selimabad, Bancharampur, Brahmanbaria, Soil5- Homna, Comilla

5.3 Biological Environment

5.3.1 General Ecosystem and Biodiversity

Overview of general ecosystem and biodiversity in the project area

Bangladesh is situated in the “oriental region”, between the Indo-Himalayas and Indo-Chinese subregions. Thecountry has a total area of 147,570 km, of which about 80 percent comprises one of the largest deltaic plains in the world, formed in the confluence of the Ganges, the Brahmaputra (Jamuna), and the Meghna rivers. The remaining 20 percent of the land area is comprised of the undulating hillocks, forested Hill Tracts. Distinct physiographic characteristics, variations in hydrological and climatological conditions, and difference in the soil properties in Bangladesh contribute in developing diverse forms of ecosystems enriched with great diversity of flora and fauna.

Rivers, Floodplains, wetlands and estuaries of Bangladesh support a myriad of species comprising biological diversity. Aquatic biodiversity of the country are also a basis of renewable resources-based economic growth and millions of people enjoy their day-to day livelihoods from these important resources. Biodiversity has a very close relationship between ecosystem services and livelihoods when allocating land and natural resources. Healthy ecosystems ensure human well-being by providing food, materials (e.g. wood, crops, fibre, fruits and vegetables) and clean water, and also by breaking down waste materials.

Diversity of ecosystems and its rich floral and faunal resources have made Bangladesh and its ecosystems resilient to natural calamities. The rich biodiversity of this land with moderate tropical climate makes it soothing for the human habitation. As an agrarian society, Bangladesh and its population heavily depend on the genetic resources of crop varieties. The history of its rich agricultural practices goes back to many centuries and farmers were highly innovative to create many cultivars using wild genetic resources. Presence of 10,000 plus rice varieties is a clear example of our vast wealth of genetic resources. Bangladesh is also one of the oldest producers of cotton and its rich and diverse collection of medicinal plants attracts attentions throughout the history. Nevertheless, the richness of species diversity, health of ecosystems and habitats has been degraded and become threatened in recent decades for a number of reasons.

Being a low-lying deltaic country, seasonal variation in water availability is the major factor, which generates different ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems.

The ecosystems of Bangladesh could be categorised into two major groups, i.e. (i) land based and (ii) aquatic. The land-based ecosystems include forest and hill ecosystems, agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category.

Protected Areas

A sound and lasting protected area program requires careful, realistic deliberation to ensure the existence of adequate legal strategies and institutional arrangements. The Constitution of the People's Republic of Bangladesh did not have any expressed provisions for the protection of wildlife and environment until 30 June 2011 when in the Fifteenth Amendment of the Constitution a new clause (18A) was introduced by the Jatiya Sangsad (National Parliament) for safeguarding and developing the environment and wildlife, under which the State will protect natural resources, biodiversity, water bodies, forest, and wildlife, and preserve and develop the environment for the present and future generations.

The project area includes the rivers Buriganga, Dhaleswari, Sitalakhya, Upper Meghna, Lower Meghna, and Meghna Estuary including the Sandwip Island and Bashan Char. Additional extensions include Upper Meghna to Ashuganj and from Chandpur to Barisal including Tetulia River. The river stretches from Sadar Ghat located on the banks of the river Buriganga in the south of the metropolitan Dhaka to Chittagong excluding the 10 km radius of the Chittagong Port Authority. This aquatic habitat represented by the above mentioned rivers and estuary consist areas that vary in their characteristics (freshwater, brackish, tidal affected, etc) and are rich in biodiversity and favour the existence of a myriad of species. The rivers either as a whole or some sections of the rivers are declared as protected under the Bangladesh Environment Conservation Act (BECA) 1995, Fish Conservation Act 1983 (updated 2010).

The rivers surrounding the capital Dhaka including the Buriganga, Turag, Balu and Sitalakhya are declared as Ecologically Critical Areas (ECA) in 2009 under the BECA 1995. Under Article 5 of the Environment Act, so far 17 ECAs have been declared in Bangladesh with the wetlands dominating the list and the Buriganga and Sitalakhya Rivers were declared as ECA in 2009.

Under Article 5 (2) of the Environment Act 1995, the following specifications for ECAs were included in the ECA gazette notification. The specification includes the following activities that are prohibited in ECAs:

- Cutting natural forests and trees or harvest
- All kinds of hunting and killing of wildlife
- All kinds of activities harmful for habitats of fauna and flora
- Activities those can damage/alter natural characteristics of land and water
- Establishment of industries those pollute soil, water and air
- Any other activities harmful for fishes and other aquatic fauna

Despite the rivers being declared as ECAs, they face tremendous pressure and threats due to the developmental activities, mostly industries and many of the restrictions imposed under the ECA Rules are not followed due to the lack of monitoring and enforcement. : List of ECAs declared under the Bangladesh Environment Conservation Act 1995 is mentioned in Table 5.28.

Table 5.28: List of ECAs declared under the Bangladesh Environment Conservation Act 1995.

S.No.	Name of the ECA	Year of Declaration	Within Project Area
1.	Sundarban Reserve Forest (10 km periphery on all sides)	1999	-
2.	Cox's Bazaar – Teknaf Peninsula sea beach	1999	-
3.	St. Martin's Island, Cox's Bazaar	1999	-
4.	Sonadia Island, Cox's Bazaar	1999	-
5.	Hakaluki Haor, Sylhet-Maulavibazaar	1999	-
6.	Tanguar Haor, Sunamganj	1999	-
7.	Marjat Baor, Jenaidah-Jessore	1999	-
8.	Gulshan – Baridhara Lake, Dhaka Metropolitan	2001	-
9.	Buriganga River	2009	✓
10.	Turag River	2009	-
11.	Balu River	2009	-
12.	Sitalakhya River	2009	✓
13.	Jaflong-Dauki River, Sylhet	2015	-

Bangladesh had always been predominantly an agricultural based country and in early days pollution was never even felt in this region. Since early sixties, of necessity, industries of various kinds started to spring up slowly. It appears that ecological imbalance is being caused continuously due to discharge of various industrial wastes into air and water bodies. It has also been found that the intensity of pollution caused by the factories and industrial units depend on their type, location, raw materials, chemical effects, production process and discharge of gaseous, liquid and solid pollutants to the natural environment.

A survey in 1999 revealed that the water of Buriganga, Turag, Dhaleshwari, Balu, and Narai flowing around the greater Dhaka city had been completely polluted. The report concluded that the water of these rivers posed a serious threat to public life and was unfit for human use. The water of the Buriganga, which in dry season between October and April becomes almost stagnant with upstream drying up, is so polluted and the water, mixed with filth and human waste, looks like a black gel in places, emitting a strong stench and devoid of any life. However the following fish species (Table 5.23) were recorded for the Buriganga River (Ahmed et al. 2010) which were considered not fit for human consumption and Sitalakhya River (baseline survey, November 2015).

The Sitalakhya River also suffered from similar conditions except that the Sitalakhya received untreated industrial wastes from urea fertilizer plants, textile mills and other industries. The principal polluting agent being higher concentration of dissolved ammonia from the Urea Fertilizer Factory of Ghorasal. Though ammonia is toxic for most of the aquatic species some fish can tolerate high concentrations of NH_4 by detoxification. Higher concentration of NH_4 caused incidents of water borne and skin diseases and rendered the habitat not livable for aquatic species like freshwater fish, turtles, etc. Considering this the government declared the Buriganga and Sitalakhya Rivers as Ecologically Critical Areas to arrest further deterioration of the ecosystem in 2009. However, declaring the river as an ECA made little difference due to lack of enforcement and the situation is at the mercy of the polluters.

The recent hydrographic survey indicates that no section of the Buriganga River will be dredged. However, a small section (3,300 m^3) of the Sitalakhya River (near Kathpatti, Narayanganj) has been proposed for dredging. Common fishes of the Buriganga and Sitalakhya Rivers and their breeding period is presented inTable 5.29.

Table 5.29: Common fishes of the Buriganga and Sitalakhya Rivers and their breeding period.

Scientific name	**Local name**	**Buriganga**	**Sitalakhya**	**Breeding Period**
Gudusia chapra	Chapila	√		May - Oct
Glossogobius giuris	Bele	√		May - Oct
Cirrhinus reba	Tatkeni	√		Apr - Jul
Channa punctatus	Taki	√	√	Jun - Oct
Mystus vittatus	Tengra	√		Apr - Aug
Pseudeutropius atherinoides	Batashi	√		May
Notopterus notopterus	Foli/Foloi		√	Jul - Oct
Rhinomugil corsula	Kholla/Bata		√	Jul - Oct
Clarias batrachus	Magur		√	Jul - Aug

Samples analyzed during the baseline establishment of D-C project it was found that Pb was 14.63 ppm and 10.25 ppm in two sampling stations of Buriganga whereas Ahmed et al., 2010 mentioned the Pb concentration was 69.75 ± 4.13 mg/kg in three other different sampling points of Buriganga River and they varied on the basis of seasonal variation. Project team recorded that 0.10 and 0.11 ppm Cd were evident in the Buriganga River. On the other hand, 3.33 ±0.77 mg/kg Cd, Ni - 200.45 ±29.21 mg/kg. Zn, As, Cr, Hg was recorded in diverse concentration as well.

Dredging may cause changes in the benthic environment and may also pose threat and disturbance to the benthic and other aquatic animals through physical changes in the habitat, aquatic environment and species composition. Certain activities harmful for habitats of flora and fauna are prohibited in the ECAs. For example, dredging may change the physical characteristics of some section of the river bed affecting the benthic fauna and the aquatic biodiversity. However it is assumed that dredging activity may be allowed in the ECAs provided adequate mitigation measures are taken. Moreover, appropriate dredged material management will minimize any damage or harm to the environment or the habitats.

It may be noted that the Buriganga and the Sitalakhya are already under tremendous environmental stress from the industrial effluents, illegal encroachment, land use changes and dredging may not cause any harm provided the guidelines of the EMP are followed. This may possibly assist in getting the environmental clearance from the Department of Environment (pers. comm. with the DOE).

Hilsa Sanctuary

Hilsa is a major cash crop of Bangladesh and the hilsa fishery contributes to about 1% of the national GDP. In order to protect the hilsa fishery the government under the Protection and Conservation of Fish Rules 1985 (SRO No. 301 Law/2011 dated 29 September 2011) declared the following areas as hilsa fish sanctuary areas. The project area south of Shatnal fall within the areas demarcated as protected for hilsa fishery and spawning ground. List of Hilsa fish sanctuaries and fishing ban period as notified by the government under the Protection and Conservation of Fish Rules 1985 is mentioned bellow in Table 5.30

Table 5.30: Hilsa fish sanctuaries and fishing ban period as notified by the government under the Protection and Conservation of Fish Rules 1985

Hilsha Fish Sanctuary Area	Boundary Point	Period Fishing banned
From Shatnol of Chandpur to Char Alexander of Laxmipur (100km stretch of Lower Meghna)	Shatnol Point (90^{O}37.12'E and 23^{O} 28.19'N); Char Alexander Point (90^{O}49.30'E and 22^{O} 40.92'N)	From March to April of each year
Char Ilisha to Char Pial of Bhola District (90km stretch of Shahbazpur Channel, a tributary of Meghna River)	Char Ilisha Mosque Point (90^{O}38.85'E and 22^{O} 47.30'N); Char Pial Point (90^{O}44.81'E and 22^{O} 05.10'N)	From March to April each year
Bheduria of Bhola district to Char Rustam of Patuakhali (100km stretch of Tentulia River)	Bheduria Ferry Ghat Mosque Point (90° 33.89'E and 22° 42.31'N) Mandol Bazaar (Char Rustam) (90° 31.40'E and 21° 56.32'N)	From March to April each year
Whole 40km stretch of Andermanik River in Kalapara Upazila of Patuakhali District	Golbunia Point (90° 19.20'E and 21° 57.68'N) Confluence of Bay of Bengal and Andermanik River (90°	From November to January each year

Hilsha Fish Sanctuary Area	Boundary Point	Period Fishing banned
	3.91'E and 21° 49.43'N)	
20 km stretch of Lower Padma between Naria-Bhedorganj Upazila of Shariatpur in the north and Matlab Upazilla of Chandpur and Bhedorganj Upazilla of Shariatpur in the south	Kachikata Point of Bhedorganj UZ of Shariatpur district in the northeast (90^O32.60'E and 23^O 19.80'N) Bhomkara Point of Naria UZ of Shariatpur District in the northwest (90^O28.80'E and 23^O 18.40'N) Beparipara Point of Matlab UZ of Chandpur District in the southeast (90^O37.70'E and 23^O 15.90'N) Tarabunia Point of Bhedorganj UZ of Shariatpur District in the southwest (90^O35.10'E and 23^O 13.50'N)	From March to April each year

According to amended Rule 13 of the Protection and Conservation of Fish Rules 1985 catching of all kinds of fishes is prohibited in the hilsa sanctuary during the period mentioned. Further under the same Rule hilsa spawning ground has been identified and fishing is banned during the peak spawning period mentioned in Table 5.31.

Table 5.31: Fishing ban period due to Peak Spawning Period of hilsa fish

Hilsa Spawning Ground Boundary Point	Peak Spawning Period
1	**2**
Mayani Point, Mirsarai, Chittagong in the northeast (91^O 32.15'E and 22^O 42.59'N) Paschim Syed Awlia Point, Tajmuddin, Bhola in the northwest (90^O 40.58'E and 22^O 31.16'N) North Kutubdia Point, Kutubdia, Cox's Bazaar in the southeast (90^O 52.51'E and 21^O 55.19'N) Lata Chapali Point, Kalapara, Patuakhali in the	Five (5) days before and five (5) days after the fullmoon, including the day of fullmoon, that is total eleven (11) days of the moon which will first appear in the Bangla month of Ashwin each year

southwest (91^{O}12.59'E and 21^{O} 47.56'N)	

Additionally, the government from time to time imposes ban on fishing activities for the protection and conservation of fishes particularly hilsa (http://www.thedailystar.net/backpage/2-month-ban-fishing-five-rivers-784831).

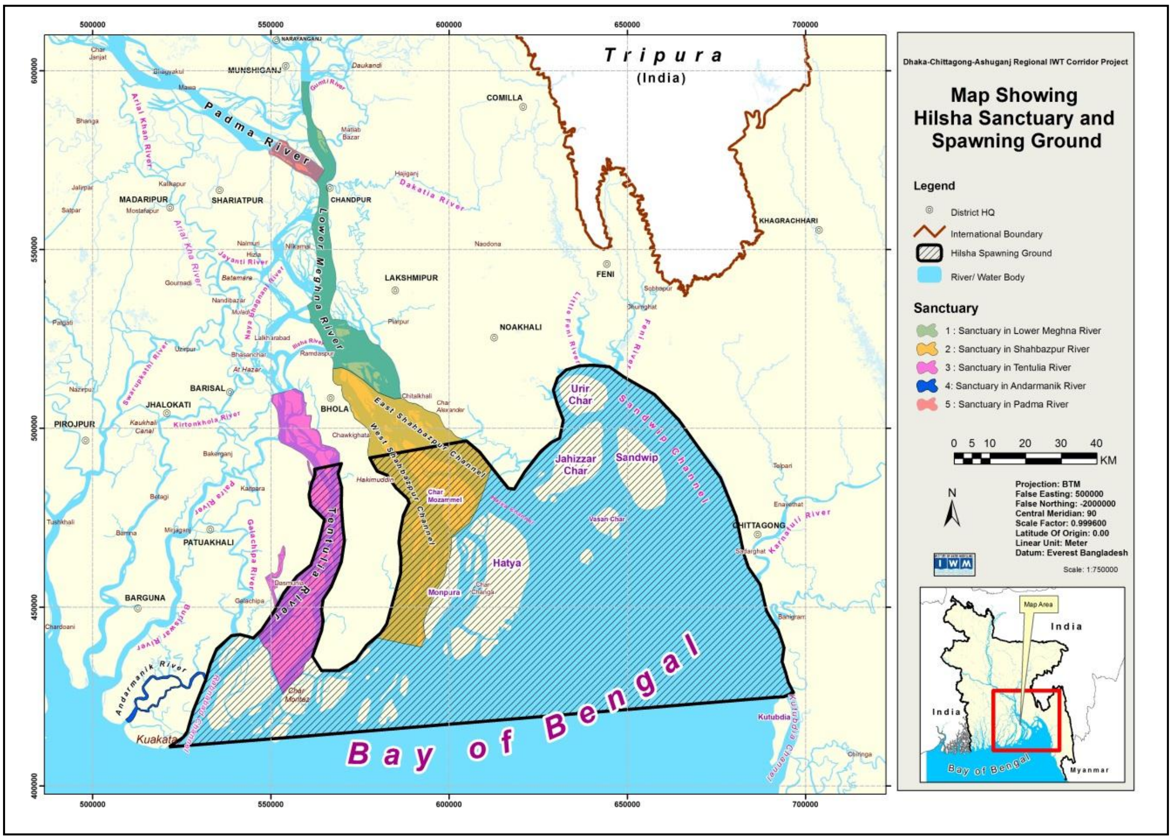


Figure 5.39: Hilsa sanctuaries and spawning area (in shade) declared by the government.

Critical and natural habitats

The ecosystems of Bangladesh could be categorized into two major groups, *i.e*. (i) terrestrial, and (ii) aquatic. The land-based terrestrial ecosystems include forest and hill ecosystems, agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category. Each of the ecosystems has many sub-units with distinct characteristics as well. Bangladesh is classified into twenty five bio-ecological zones Figure 5.40 some of which are constituted of one or more than one type of ecosystems. The Project Influence Area (PIA) consists of bio-ecological zone categories 4b, 4c, 4e, 8b, 8d, 11, and 12 which are briefly described below.

Each of the bio-ecological categories contains a unique set of characteristics based on which the species composition varies. Some of the categories share the same species whereby the species have to adapt themselves to that particular niche.

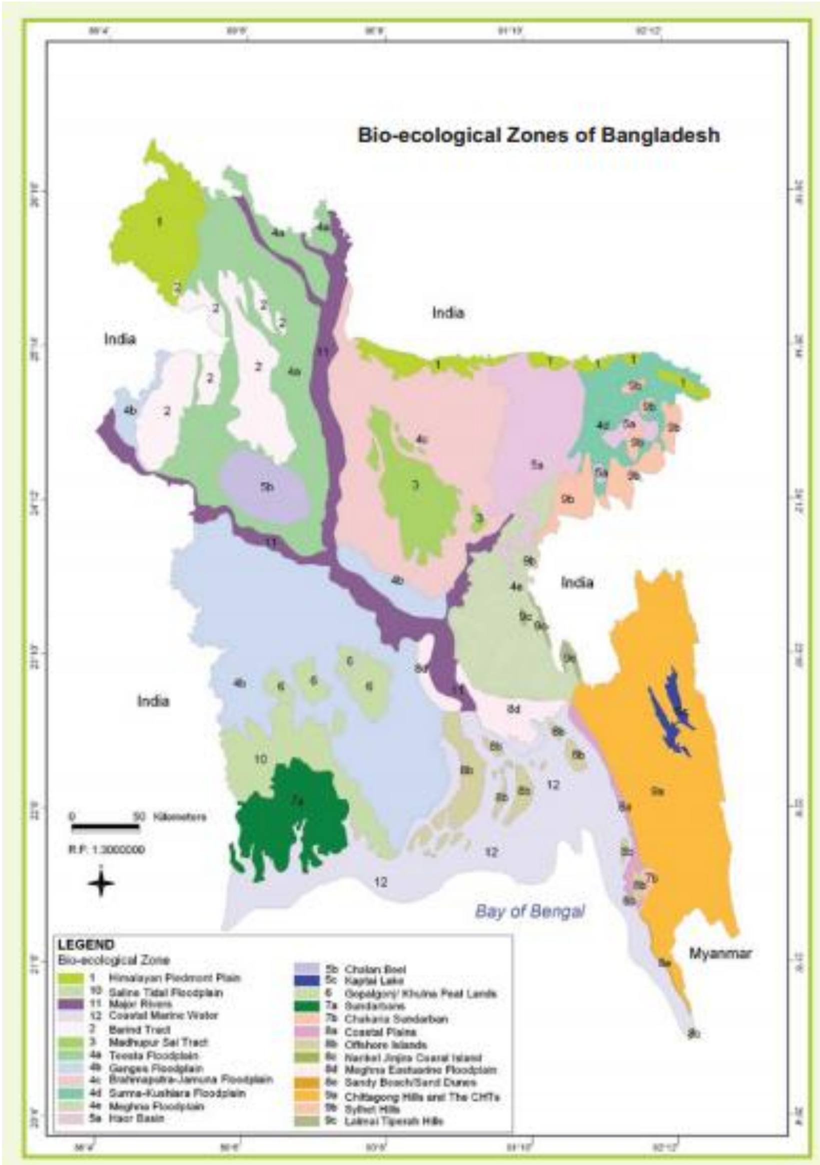


Figure 5.40: Bio-ecological zones of Bangladesh (Source: IUCN 2002)

Zone 4b. Ganges Floodplain

The Ganges floodplain is basically consists of the active floodplain of the Ganges River and the adjoining meandering floodplains. The adjoining meander floodplains mainly comprise a smooth landscape of ridges, basins and old channels. Gangetic alluvium is readily distinguishable from the Old Brahmaputra, Jamuna and Meghna sediments by its high lime content. The Ganges channel is constantly shifting within its active floodplain, eroding and depositing large areas of new char lands in each flooding season but is less braided than the Brahmaputra-Jamuna. Interestingly both plant and animals move and adapt with the pattern of flooding (Brammer 1996). The floodplain is characterized by mixed vegetation, presence of a lot of stagnant waterbodies, and channel, rivers and tributaries in this zone and support habitats favourable to a rich biodiversity. The areas covering Buriganga River ECA and Dhaleshwari River up to the confluence with the Meghna River fall within this zone.

- Zone 4c. Brahmaputra-Jamuna Floodplain

The mighty Brahmaputra (=Jamuna) is comparatively new and its course is clearly distinguishable from the older Brahmaputra. Brahmaputra-Jamuna Floodplain comprises the active channel of the Brahmaputra River and the adjoining areas of the young floodplain lands formed with the shifting to its present course – the Jamuna River. The main river course is strongly braided, consisting of several interconnected channels which erode to form new lands during each flooding season. Some portion of the Sitalakhya River fall within this zone.

Zone 4e. Meghna Floodplain

Created mainly by the deposition of the sediments brought by the Old Brahmaputra River.Added depositions from the Meghna River itself and by some minor rivers flowing down from the Tiperrah Hills. The floodplain occupies a low-lying landscape of chars and many broad meandering channels. The Meghna sediments are mainly silty and clays and sandy Brahmaputra sediments occur at the surface on some ridges in the north. Seasonal flooding from the Meghna is mainly deep. Basin sites are submerged early and drain late. This floodplain area has a slightly irregular ridge and basin relief, but also has large mounds used for settlement and cultivation. Seasonal flooding was formerly moderately deep, fluctuating in depth twice daily with the tides in the south, but flooding is mainly shallow and by rainwater within the area protected and drained by the Chandpur irrigation project.

The estuarine landscape is quite different from that on river and tidal floodplains. This sub-unit occupies almost the level land within and adjoining the Meghna estuary. It includes both island and mainland areas. New deposition and erosion are constantly taking place on the margins, continuously altering the shape of the land areas. The sediments are deep silts, which are finally stratified and are slightly calcareous. In many, but not all parts, the soil surface becomes saline to varying degrees in the dry season. Seasonal flooding is mainly shallow, but fluctuates tidally, and is caused mainly by rainwater or non-saline river water. Flooding by salt water occurs mainly on the lamed margins and during exceptional high tides during the monsoon; also when storm surges associated with tropical cyclones occur.

Southern portion of the floodplains lie within the hilsa sanctuary and spawning area as well as in an Important Bird Area declared by the BirdLife International.

Zone 8b. Offshore Islands

The zone covers the islands in the estuary – Bhola, Hatiya, Sandwip, Bashan Char, etc. Shapes of the island are continuously changing as a result of erosion and tidal insurgence. The islands have extensive intertidal mudflats rich in alluvium and benthic fauna that constitute the major staging areafor the migratory waders. The islands lie within the hilsa spawning area and in an Important Bird Area declared by the BirdLife International.

Zone 8d. Meghna Estuarine Floodplain

The newly accreted mudflat is the main physiographic feature. Erosion and deposition is constantly taking place on the land margins, thereby altering the shape of the land. The soil surface in certain areas becomes saline to varying degrees due to the tides. Seasonal flooding is usually by rain or exceptionally high tides when storm surges associated with cyclones occur. The accreted intertidal lands are important wintering grounds for the migratory birds. The area falls within the hilsa sanctuary and hilsa spawning area.

Zone 11. Major Rivers

Bangladesh – a delta - is a land of rivers drained by four major rivers: the Ganges-Padma, Brahmaputra-Jamuna, Meghna and Teesta. Together they cover 7% of the country's area and support a myriad of species. A diverse range of species are dependent on these river systems. Some portion of the Padma and most of the Lower Meghna comprise the hisla sanctuary.

- Zone 12. Coastal & Marine Waters

  The coastal zone has its own dynamics and a very distinct terrain. The coastal zone comprised by the complex delta of the Ganges-Brahmaputra-Meghna river system has immense biological resources. It carries an estimated annual sediment load of 2billion tons subjected to the coastal dynamic processes leading to land accretion and erosion. The northern section of the Zone 12 comprise the hilsa spawning area.

The WB Policy (OP 4.04) describes the conservation of natural habitats, like other measures that protect and enhance the environment, to be essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank also supports, and expects borrowers to apply a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank- promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

Meghna River is one of the major rivers in Bangladesh, especially famous for its great estuary that discharges the flows of the Ganges-Padma, the Brahmaputra-Jamuna and the Meghna itself. The Meghna has two distinct parts. The Upper Meghna from Kuliarchar to Shatnal is a comparatively small river. The Lower Meghna below Shatnal is one of the largest rivers in the world because of its wide estuary mouth. The Lower Meghna is at times treated as a separate river.

The Upper Meghna Flood Plain is a dominant freshwater environment inhabited by freshwater plant and animal species. The floodplain comprises a nutrient rich freshwater ecosystem supporting high fish production, and many aquatic species some of which are now endangered. Native waterfowl and migratory birds, freshwater turtles and other reptiles and amphibians depended on this system, and the area was rich in biodiversity. The construction of embankments along some sections of the Upper Meghna, effluents from the industries entirely changed the ecosystem. The free migration patterns of fish from the floodplain to the Meghna River and vice versa was disrupted, and fish production. Intensive agriculture and reduction in wetland areas have affected the habitat of migratory birds, freshwater turtles. The pressure from the increasing human population on the natural resources has affected the ecosystem. However the water quality is still favourable for many of the aquatic species like the turtles, otters, Gangetic dolphins, etc.

The Lower Meghna River conveys the combined flows of the Brahmaputra, the Ganges and the Upper Meghna rivers and the discharge into the Meghna estuary is dominated by these three major rivers reinforced by the Dhaleshwari. All the three rivers are large. The Dhaleshwari-Meghna and the Padma are each 5 km wide at the confluence. The Lower Meghna has several small chars (braid-bars) in it, which create two main channels, of which the large eastern one is 5 to 8 km wide. The western channel is about 2 km in width. Near Muladi the 1.5 km wide Safipur River is an offshoot from the right-bank. Further south, the Lower Meghna shifts into three channels: west to east flowing Tentulia (Ilisha) River, the Shahbazpur and the Bamni (now nonexistent). The Ilisha is a 5 to 6.5 km wide channel separating Bhola Island from the Barisal mainland. Shahbazpur Channel, 5 to 8 km wide, separates Bhola from Ramgati and Hatiya Islands and at its mouth are the Manpura Islands.

One of the obvious features of the Lower Meghna is the braid bars exposed during periods of low flow and/or dry season, which are responsible for the multi-channel cross-section. Studies of the river have shown two distinct braid bar levels, those with elevations which are very close to bank top level and lower bars which are submerged during the majority of high in-bank flows. The upper sand bars, known as either islands or attached chars, are relatively stable and vegetated and are often inhabited. They can be considered as parts of the flood plain contained within the braid belt, only submerged during over bank flows. The lower braid bars are unstable and are being continually re-worked by the river.

Among the critical natural habitats within the project influence area some of the important ones like the reed lands, coastal mudflats have been described as the VECs.

Threatened and important species (as per national and IUCN designations)

Each of the bio-ecological categories contains a unique set of characteristics based on which the species distribution and composition varies. Some of the categories share the same species whereby the species have to adapt themselves to that particular niche.

All wildlife species including butterflies are protected under the Bangladesh Wildlife (Conservation & Security) Act 2012. The Protection and Conservation of Fish (Amendment) Act, 1995 mentions about the prohibition of killing fishes in destructive ways (like poisoning, polluting fish habitat, etc), prohibition of catching, carrying or selling of fries, fingerlings and brood of rui (*Labeo ruhita*), kalbaus (*L. calbasu*) and gonia (*L. gonius*), catla (*Catla catla*), mrigel (*Cirrhinus mrigala*), hilsa jatka (*Tenualosa ilisha*) <23 cm during November to May; pangas (*Pangasius pangasius*) <23 cm during Nov-April; and shilong (*Silonia silondia*); shol (*Channa striata*); and Ayre (*Mystus aur*) <30cm during Feb-Jun; and prohibition of catching fries, fingerlings and post larvae throughout the year in the coastal region.

About 267 species of freshwater fish inhabit the water bodies of Bangladesh (Rahman 2005, Mustafa 2013) of which about 200 species are small indigenous fishes (SIS). According to the IUCN Bangladesh (2000) fifty four (54) species (=20%) are endangered. The IUCN Redlist is currently being updated and the numbers and categories of fish species may change. Table 5.32 will describe threatened vertebrate animal species found in the Project Influence Area. Photograph of some endangered and vulnerable species are given shown in Figure 5.41.

Table 5.32: List of some of the threatened fish species found in the Project Influence Area

Sl. No	Local Name	Common Name/English Name	Scientific Name	Status (IUCN Bangladesh 2000)	Presence in study area
1	Rita, Ritha	Rita	*Rita rita*	Critically endangered	✓
2	Pabda	Pabdah Catfish	*Ompok pabda*	Endangered	✓
3	Bagair/ Garua	Dwarf Goonch	*Bagarius bagarius*	Critically	
4	Gajar/ Gajal	Great snakehead	*Channa marulius*	Endangered	✓
5	Gachua/Gaira/ Telo Taki/Chang	Walking snakehead	*Channa orientalis*	Vulnerable	✓
6	Kuchia	Gangetic mud eel/	*Monopterus*	Vulnerable	✓

Sl. No	Local Name	Common Name/English Name	Scientific Name	Status (IUCN Bangladesh 2000)	Presence in study area
		Cuchia	*cuchia*		
7	Chenua/Sisir/ Cheuna	Sisor catfish	*Sisor rhabdophorus*	Critically endangered	
8	Ek thota	Wrestling half-beak	*Dermogenys pusilla*	Threatened	✓
9	Napit Koi/ Kala/ Koi/Bot Koi	Dwarf Chameleon Fish	*Badis badis*	Endangered	✓
10	Bhol/Bol/ Buggua	Trout Barb/ Indian Trout	*Raiamas bola*	Endangered	
11	Laubuka/Chap Chela/ Kash Khaira	Indian Glass barb/ Indian Hatchet fish	*Laubuca laubuca*	Endangered	
12	Along/ Etang/ Sephalia	Bengala Barb/ Bengal Barb	*Megarasbora elanga*	Endangered	
13	Darkina/ Leuzza Darkina	Gangetic Scissortail Rasbora	*Rasbora rasbora*	Endangered	✓
14	Pipla/ Pipla Shol/ Tila Shol	Barca Snakehead	*Channa barca*	Critically endangered	✓
15	Boa mach/ Boa baim/ Telkoma/ Banehara	Indian Mottled Eel	*Anguilla bengalensis bengalensis*	Vulnerable	✓
16	Kumirer Khi/ Kota Kumirer Khil	Deocata Pipefish	*Microphis deocata*	Endangered	
17	Joia/ Hiralu/ Tila/ Koksa/ Chedra	Hamilton’s Barila	*Barilius bendelisis*	Endangered	
18	Khoksa	Vagra Barila	*Barilius vagra*	Endangered	
19	Pabda	Pabo catfish	*Ompok pabo*	Endangered	✓
20	Gonia/Ghainna/ Goni	Kuria labeo	*Labeo gonius*	Endangered	✓
21	Gang magur/ Kan Magur	Grey Eel catfish	*Plotosus canius*	Vulnerable	✓
22	Tengra	Assame Batasio	*Batasio tengana*	Endangered	✓

Sl. No	Local Name	Common Name/English Name	Scientific Name	Status (IUCN Bangladesh 2000)	Presence in study area
23	Shilong	Silond catfish	*Silonia silondia*	Endangered	✓
24	Kajuli/ Baspata	Jamuna Ailia	*Ailiichthys punctata*	Vulnerable	
25	Ghora mach/ Ghora muikha	Pangusia labeo	*Labeo pangusia*	Critically endangered	
26	Napte Khoira/ Madhumala	Frail gourami	*Ctenops nobilis*	Endangered	
27	Bacha	Batchwa Vacha	*Eutropiichthys vacha*	Critically Endangered	✓
28	Guizza/ Guizza Ayre	Giant river catfish	*Sperata seenghala*	Endangered	✓
29	Sarpunti/ Deshi Sar Punti	Olive barb	*Puntius sarana*	Critically Endangered	✓
30	Raikhor/ Tatkini/ Aikhor	Reba Carp	*Cirrhina reba*	Vulnerable	✓

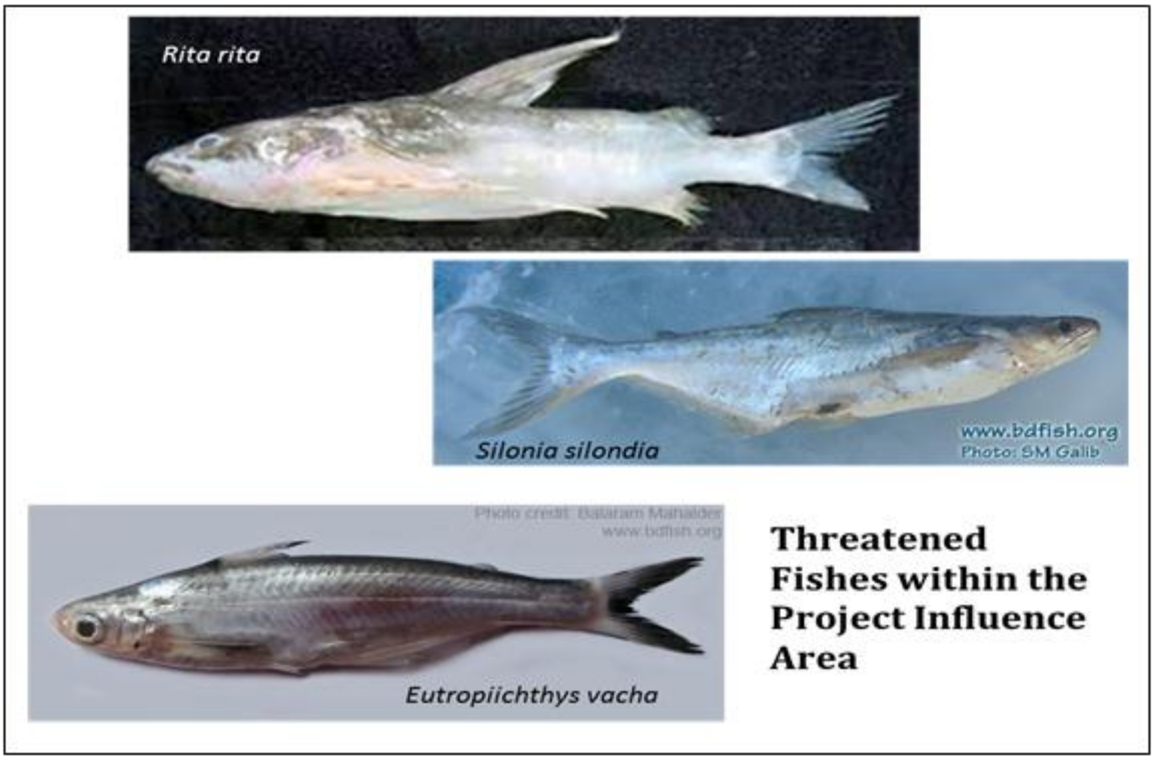


Figure 5.41: Some threatened fishes within the Project Influence Area (Photos © BFRF)

Seasonal differences may yield different composition of fishes like for example the species diversity and abundance based on the water quality, water depth, etc. As an example some of the differences in the fish species for the Buriganga and Sitalakhya Rivers observed during the dry season field visit are given in the Table 5.33 below. During wet season species diversity was more compared to the dry season. Species found during the dry season were more 'hardy', can tolerate higher degree of environmental stress and had additional 'lungs' other than the gills.

Table 5.33 Seasonal variation of some of the common fish species found in the Buriganga and Sitalakhya Rivers

River Name	Wet Season	Dry Season
Buriganga (Sadar Ghat)	Mola, Taki, Bailla, Puti	Singh, Taki
Sitalakhya	Mola, Keski, Tengra, Bailla	Singh, Taki

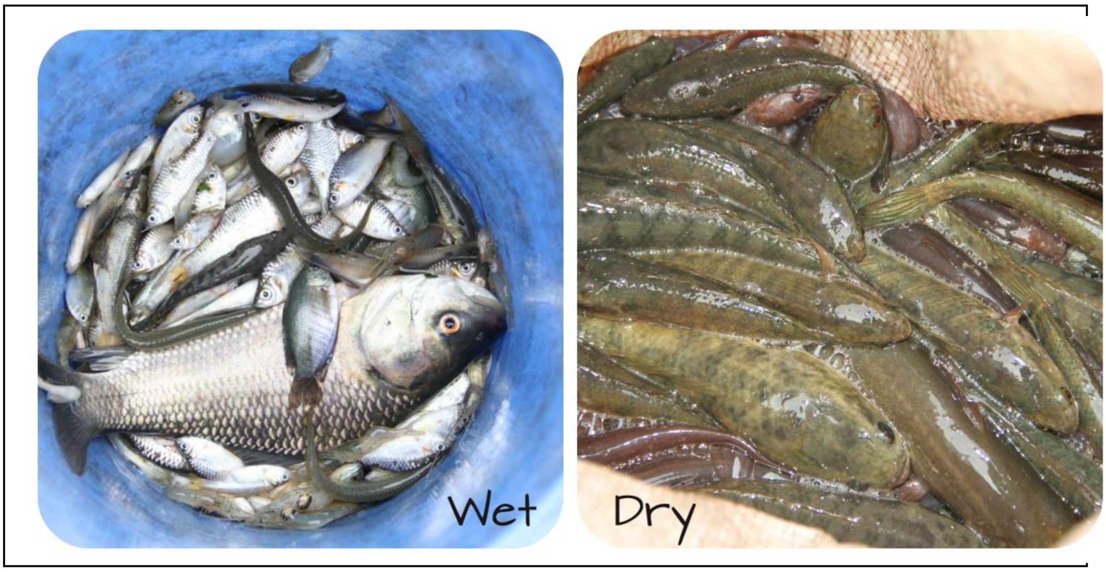


Fig. 5.42. Common fish species from the Buriganga River during the wet and dry seasons (Photos © CARINAM).

Table 5.34: List of some amphibians in the project area [PD - Ponds; AG - Agri land; HS - Homesteads; GL - Grassland; FL - Fallow land; TS – Trees; VC – Very Common, C – Common, UC – Uncommon, R – Rare; VC – Very Common, C – Common, UC – Uncommon, R – Rare]

S.No.	Scientific Name	English/Local Name	Habitat	Status
1	*Duttaphyrnus melanostictus*	Common Asian Toad	FL	VC
2	*Euphlyctis hexadactylus*	Green Frog	PD, GL	R
3	*Hoplobatrachus tigerinus*	Indian Bull Frog	PD, GL, AG	C
4	*Uperodon globulosus*	Balloon Frog	FL, AG	UC
5	*Kaloula pulchara*	Painted Bull Frog	HS, GL	UC
6	*Euphlyctis cyanophlyctis*	Skipping Frog	PD	VC
7	*Fejervarya* spp	Cricket Frog	PD, GL, FL	C
8	*Microhyla ornata*	Ornate Narrow-mouthed Frog	FL, GL	UC
9	*Hylarana tytleri*	Leaping Frog	GL, AG, FL	UC
10	*Polypedates leucomystax*	Four-lined Tree Frog	TS, HS	UC

Figure 5.43: Some amphibians within the project area: Top left- Green Frog; Top right: Bull frog; Bottom left: Jerdon's Bull Frog; Bottom right: Common Toad (Photos © CARINAM)

During the dry season survey young and juvenile toads, skipping and cricket frogs were mostly observed in the fallow lands, along the river banks and ponds/ditches.

The project influence area contains both the threatened and endangered species. Threatened species are those species which are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range or locally within a country like Bengal Skimmer, Smooth-coated C [illegible] which is in danger of extinction throughout all or a signi [illegible] within a country like Gangetic Dolphin, Northern River T [illegible]

Table 5.35: List of some endangered and threate [illegible] ence for breeding period of turtles see Rashid & Swinglar [illegible]

Scientific Name	English Name	[illegible]	[illegible]
Batagur baska	Four-toed Terrapin, Northern River Terrapin	CR	[illegible] Meghna, Estuary; breeding period Feb-April
Batagur dhongoka	Three-striped Turtle	EN	Lower Meghna; breeding period Feb - April

Scientific Name	English Name	Status	Comment
Hardella thurjii	Crowned River Turtle	VU	Widespread but rapidly declining, Upper & Lower Meghna adjoining areas; breeding period Nov-Jan
Chitra indica	Narrow-headed Softshell Turtle	EN	Rivers; Padma, Jamuna, Meghna, Brahmaputra, Dhaleswari rivers and their major tributaries. The nesting season extends from February to May, September – November during which *C. indica* lays multiple clutches.
Pelochelys cantorii	Giant Asian Softshell Turtle	EN	River mouths & estuary. Nesting sites include riverbanks as well as seacoasts; breeding period Feb-April
Nilssonia gangeticus	Ganges Softshell Turtle	VU	Rivers, estuary; mates from August to January and lays multiple clutches. The first clutch of eggs is laid between mid-August and late-September, the second between mid-October and late-November, and the third between mid-December and January.
Lepidochelys olivacea	Olive Ridley Turtle	EN	Nests on sandy beaches of the St. Martin's Island and Meghna estuary chars & Sundarban RF; breeds round the year peak Nov - Jan
Chelonia mydas	Green Turtle	EN	Nests on sandy beaches of the St. Martin's Island and Meghna estuary chars & Sundarban RF; breeding peak Aug - Oct
Eretmochelys imbricata	Hawksbill Turtle	EN	Rarely nests on sandy beaches of the St. Martin's Island and Meghna estuary chars, forages in the estuary; breeding peak Nov - Jan

Table 5.36: List of endangered and threatened birds in the project area

Scientific Name	English Name	Status	Comment
Aythya baeri	Baer's Pochard	EN	World's main wintering area but major decline
Aythya nyroca	Ferruginous Duck	NT	Winter visitor; declining population
Pelargopsis amauroptera	Brown-winged Kingfisher	NT	Off-shore islands, Sundarban RF holds main population in world
Calidris pygmaea	Spoonbill Sandpiper	CR	Perhaps as few as 100 breeding pairs remaining.

Scientific Name	English Name	Status	Comment
Tringa guttifer	Nordmann's Greenshank	EN	Very small population which is declining as a result of the development of coastal wetlands throughout its range
Limosa lapponica	Bar-tailed Godwit	VU	Rapidly declining population, primarily to destruction of its wintering grounds
Limnodromus semipalmatus	Asian Dowitcher	EN	Moderately small population overall, rapid decline, owing primarily to destruction of its wintering grounds (BirdLife International 2001)
Rynchops albicollis	Bengal Skimmer	VU	Vulnerable because its population is undergoing a rapid decline as a result of widespread degradation and disturbance of lowland rivers and lakes
Haliaeetus leucogaster	White-bellied Sea Eagle	VU	Vulnerable because its population is undergoing a rapid decline as a result of widespread habitat degradation

Table 5.37: List of threatened mammals in the project area

Scientific Name	English Name	Status	Comment
Prionailurus viverrinus	Fishing Cat	EN	Steady declining population
Vulpes bengalensis	Bengal Fox	VU	Population declining steadily
Lutrogale perspicillata	Smooth-coated Otter	VU	Drastic decline in most of the rivers, wetlands
Platanista gangetica	South Asian River/ Gangetic Dolphin	EN	Population declining, threats from increasing navigation, pollution and intentional captures
Orcaella bravirostris	Irrawady Dolphin	EN	Mostly in the estuary and upstream depending on the salinity gradient

Figure 5.44: Critically Endangered Northern River Terrapin (*Batagur baska*) (left), and endangered Crowned River Turtle (*Hardella thurjii*) (right) occur within the project influence area. (Photos © CARINAM)

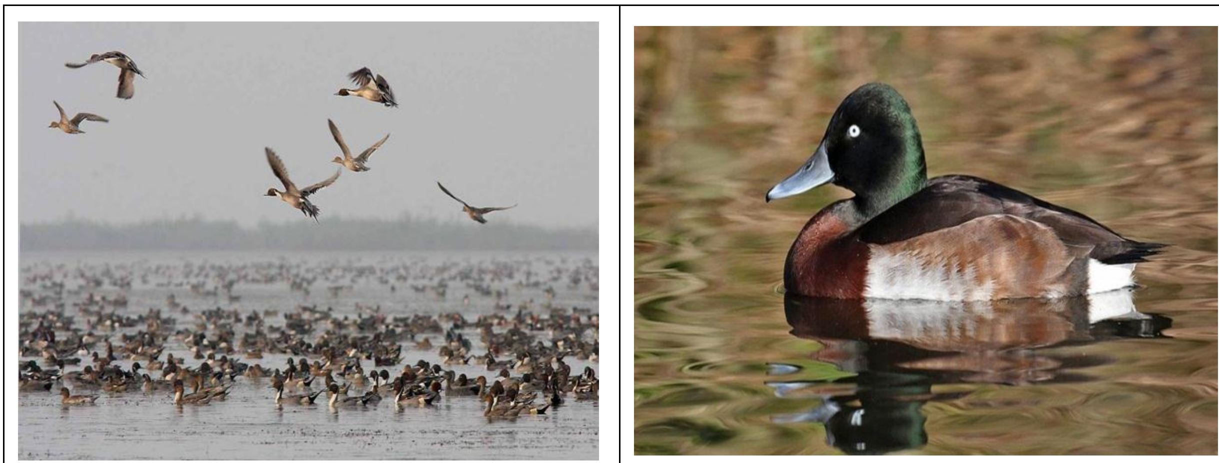


Figure 5.45: Wetlands including rivers host migratory ducks during winter (left), the endangered Baer's Pochard (right) (Photos © CARINAM)

Identification of Valued Environmental Components

Valued Environmental Components (VECs) are defined as fundamental elements of the physical, ecological, biological or socio-economic environment, including the ecosystem, ecosystem services, air, water, soil, terrain, vegetation, wildlife, fish and land use that may be affected by a proposed project. VECs may vary by project, industry, and geographic region, to reflect the nature of the potential project effects and the environmental, economic, social, heritage, and health context within which the project is implemented.

One other term that needs to be understood is 'effect pathway'. Effect pathway refers to the cause-effect linkage between a project activity and a VEC. In some cases, the project-VEC interaction comprises a direct impact, while in others the project may affect the VEC indirectly, by causing changes in the natural or human environment on which the VEC depends. For example, a project may affect local economic activity by altering water quality, which may in turn adversely affect a fish population, which may in turn reduce the fishing success of commercial or subsistence fishing activity. In this example, water quality and fish are intermediate components along an effect pathway between the project and the ultimate receptor VEC - economic activity.

VECs are at the heart of impact prediction, knowing more about how and why they are chosen and if they adequately represent cumulative effects (CEs) it may fulfill the purpose of Environmental & Social Impact Assessment (ESIA).

Upper Meghna: Wetland Biodiversity/Dolphins/Otters

Meghna River is one of the major rivers in Bangladesh, especially famous for its great estuary that discharges the flows of the Ganges-Padma, the Brahmaputra-Jamuna and the Meghna itself. The Meghna has two distinct parts. The Upper Meghna from Kuliarchar to Shatnal is a comparatively small river. The Lower Meghna below Shatnal is one of the largest rivers in the world because of its wide estuary mouth. The Lower Meghna is at times treated as a separate river.

The Meghna receives the Old Brahmaputra on its right at Bhairab Bazaar. A little above the confluence, the Meghna has a railway bridge-'Bhairab Bridge'-and a road bridge-'Bangladesh-UK-Friendship Bridge' over it. The width of the river there is three-quarters of a kilometre. Several small channels branching off from the Meghna and meandering through the lowland bordering the Tippera Surface receive the flow of a number of hilly streams and rejoin the main river downstream. The most important of these offshoots is the Titas, which takes off south of Ghatalpar and after meandering through two long-bends extending over 240 km rejoins the Meghna through two channels in Nabinagar Upazila. Other offshoots of the Meghna are the Pagli, Kathalia, Dhonagoda, Matlab and Udhamdi. The Meghna and these offshoots receive water of a number of hilly streams from the Tripura Hills. The important hill streams are the Gumti, Kakrai, Kagni, Dakatia, Hawrah, Sonaiburi, Harimangal, Pagli, Kurulia, Balujuri, Sonaichhari, Handachora, Jangalia and all of these are liable to flash floods (Banglapaedia 2015).

The Upper Meghna Flood Plain is a dominant freshwater environment inhabited by freshwater plant and animal species. The floodplain comprises a nutrient rich freshwater ecosystem supporting high fish production, and many aquatic species some of which are now endangered. Native waterfowl and migratory birds, freshwater turtles and other reptiles and amphibians depended on this system, and the area was rich in biodiversity. The construction of embankments along some sections of the Upper Meghna, effluents from the industries entirely changed the ecosystem. The free migration patterns of fish from the floodplain to the Meghna River and vice versa was disrupted, and fish production. Intensive agriculture and reduction in wetland areas have affected the habitat of migratory birds, freshwater turtles. The pressure from the increasing human population on the natural resources has affected the ecosystem. However the water quality is still favourable for many of the aquatic species like the otters, Gangetic dolphins, etc.

The Gangetic Dolphin (*Platanista gangetica*) or 'shishu/shushuk' (in Bangla) is found in most of the areas of the Ganges-Brahmaputra-Meghna river system including Nepal, India and Bangladesh. This species is rated as 'Endangered' by the International Union for Conservation of Nature (IUCN) Red List (2010) with the wild populations decreasing drastically within the range countries. These dolphins share the same ranks as the tigers and great apes that are listed as a species endangered by trade on Appendix I of Convention on International Trade of Endangered Species of Flora & Fauna (CITES). The species is listed as a 'flagship species' by World Wide Fund for Nature (WWF).

Water abstraction upstream decrease river depth and the appearance of sand bars during winter season cause danger to the dolphins as the river is divided into small segments, causing a segregation of populations in deeper pools, narrowing of the gene pool, increase in the intensity of fishing, increase in river traffic, pollution due to release of untreated effluents from industries, incidental and/or intentional capturing for oil extraction for use as fish attractant, liniment and aphrodisiac, etc., have become the major threats for its survival.

The freshwater dolphins being an iconic species for the river ecosystem serve as a link between people and freshwater and a symbol of a healthy ecosystem. The positive side for the conservation by the presence and increase in the population of dolphins will mean that rivers are clean enough to draw water supplies, there is more and diverse assemblage of fish to support people and dolphins, effluents will need to be adequately treated before release, enough water in the rivers to reduce saltwater intrusion, restoration of floodplains, etc.

Seasonality, food availability and environmental conditions of the water are the main factors of the Ganges River dolphin for its habitat use/preference (Hussain et al. 2011). Water depth increases during the monsoon months and decreases during the winter and summer months. During the winter and summer months, dolphins usually remain concentrated in the deeper sections (*kums*) of the rivers. This was reflected in the higher number of sightings during the winter and summer months and lower number of dolphin sightings during the monsoon months in the rivers (Rashid et al. 2015). Optimum water depth preferred by the Ganges River dolphin throughout the year is mostly available in sections where scours in the river exist. Secondly, most river fishes occur or should have occurred in the scours of the rivers during the winter and summer months (Hussain 2010). The dolphins feed on fishes hence distribution, composition and abundance of their prey may also play an important role in the distribution and abundance of dolphins and consequently habitat utilization. Kasuya and Haque (1972) mentioned that the area from Upper Meghna to south of Gualanda is a goldmine for the dolphins and the numbers are considerably less upstream in the north.

Table 5.38: Gangetic dolphin density in different rivers of Bangladesh and neighbouring India.

Author/Year	Location	Dolphin Density
Kasuya and Haque, 1972	Lower Meghna	0.22/km
Kasuya and Haque, 1972	Upper Meghna& Upstream of Bhairab Bazaar	1.43/km
Smith et al. 2006	Sunderbans, Bangladesh	0.47/km
Smith et al. 2001	Lower Sangu River, Bangladesh	1.36/km
Smith et al. 2001	Karnaphuli River, Bangladesh	0.47/km
Sharma et al. 1995	Chambal River, India	0.27/km
Sinha, 1997	Bhagirati River, India	0.37/km
Sinha et al. 2000	Downstream between Kahalgaon and Manihari [near Katihar], India	3.40/km
Sinha et al. 2000	Ganges mainstem, between Maniharighat and Buxar, India	1.50/km
Choudhary et al. 2006	Vikramshila Gangetic Dolphin Sanctuary, Bihar, India	1.80/km
Wakid, 2009	Brahmaputra [856 km], Assam, India	0.23/km
Rashid et al. 2015	Padma River: Shangram – Dhalar Char, Pabna, Bangladesh	0.53/km
Rashid et al. 2015	Jamuna River: Dhalar Char – Nagdemra, Pabna, Bangladesh	1.45/km

Accidental killing of dolphin in the form of by-catch in net fishing is a major threat for dolphins in the rivers of the project area. It was reported that accidental killing of dolphins through getting trapped or entangled in fishing nets were higher than the past. Other threats for dolphins in the rivers included oil spill from boats and ships, river erosion, low water depth during winter, use of harmful fishing gears (especially current net) and making cross dam of bamboos across rivers for fishing. As reported by local people, the practice of intentionally trapping and/or killing of dolphins in the rivers for commercial reasons are gradually gaining momentum for oil extraction. Remains of the dolphin body, particularly the head, are used in the brush pile fishery – certain sections of the river close to the banks is fenced using bamboos and piles of tree branches are used to provide a temporary refuge for the fish during the dry season when water level gets low. During dry season the fenced area is netted and fishes are caught. By putting the remains of the dolphin body and head together with the tree branches fishes are attracted by the smell as they decompose.

The Lower Meghna supports both the Ganges Dolphin and Irrawady Dolphin (Fig. 5.46). However their distribution is marked by the salinity depending on seasonal freshwater discharge. The ecological boundary follows salinity and turbidity gradients, and implies that long-term monitoring of dolphin distribution patterns may prove insightful into the impacts of declining freshwater flows on other aquatic biota (Smith et al. 2006). The narrow geographic band between the coastline and the Swatch of No Ground (southwest of the Meghna estuary) is unique habitat for the seasonally mobile population of the Irrawaddy dolphin (*Orcaella brevirostris*). Farther offshore but still occurring in habitat influenced by freshwater inputs is the Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*). Then, a relatively short distance from the fluvial habitat is the Swatch-of-No-Ground where a burst of biological productivity created by upwelling currents supports large groups of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), Pantropical spotted dolphins (*Stenella attenuata*) and Spinner dolphins (*Stenella longirostris*), as well as a possible resident population of Bryde's whales (*Balaenoptera edeni*). The Meghna estuary is occasionally visited by Whale Shark (*Rhincodon typus*).

Fig. 5.46. Gangetic Dolphin (left, © BCDP) and Irrawaddy Dolphin (right, © BTT) found in the project influence area.

There are three species of otters in Bangladesh. One of these is the smooth-coated otter (*Lutra perspicillata*). Smooth-Coated Otters like large rivers, lakes, peat swamp forests, coastal mangroves, estuaries and rice fields, provided there is ample bankside vegetation for cover and escape, and deep soil for digging natal holts. The area occupied by these animals has reduced significantly in the last 10 years as development; alteration of their habitat is taking a toll. It is considered that their decline may be occuring faster than generally thought. Increasing human population across its range is putting this species under pressure through habitat destruction (wetland reclamation), pollution (pesticide and agricultural run-off leading to eutrophication of waterways and reduction in prey biomass), and serious, widespread conflict with aquaculturalists and fishermen who kill them as pests and competitors, and deliberate trapping for fur. Although technically legally protected throughout the country uder the Wildlife Act 2012, this is laxly enforced.

Fig. 5.47. The fast declining threatened smooth-coated otter (*Lutrogale perspicillata*), a key species of the wetlands (Photo: © CARINAM).

Lower Meghna: Hilsa sanctuaries/Irrawady dolphins/ Important Bird Areas/Sea turtle mating & nesting/ Northern River Terrapin

The Lower Meghna River conveys the combined flows of the Brahmaputra, the Ganges and the upper Meghna rivers and the discharge into the Meghna estuary is dominated by these three major rivers reinforced by the Dhaleshwari. All the three rivers are large. The Dhaleshwari-Meghna and the Padma are each 5 km wide at the confluence. The Lower Meghna has several small chars (braid-bars) in it, which create two main channels, of which the large eastern one is 5 to 8 km wide. The western channel is about 2 km in width. Near Muladi the 1.5 km wide Safipur River is an offshoot from the right-bank. Further south, the Lower Meghna shifts into three channels: west to east flowing Tentulia (Ilisha) River, the Shahbazpur and the Bamni. The Ilisha is a 5 to 6.5 km wide channel separating Bhola Island from the Barisal mainland. Shahbazpur Channel, 5 to 8 km wide, separates Bhola from Ramgati and Hatiya Islands and at its mouth are the Manpura Islands. Bamni now is said to be nonexistent.

One of the obvious features of the Lower Meghna is the braid bars exposed during periods of low flow and/or dry season, which are responsible for the multi-channel cross-section. Studies of the river have shown two distinct braid bar levels, those with elevations which are very close to bank top level and lower bars which are submerged during the majority of high in-bank flows. The upper sand bars, known as either islands or attached chars, are relatively stable and vegetated and are often inhabited. They can be considered as parts of the flood plain contained within the braid belt, only submerged during over bank flows. The lower braid bars are unstable and are being continually re-worked by the river.

The biological profile of plankton from the Padma, Meghna and Tetulia reference river sites during 2011 spawning season of hilsa showed that in total of 58 taxa of plankton were present. Of which, 19 taxa (32.76%) were of phytoplankton and 39 taxa (67.24%) of zooplankton. Phytoplankton group belonged to Cyanophyceae (6 taxa), Chlorophyceae (7 taxa) and Bacillariophyceae (6 taxa) while zooplankton including Protozoa (10 taxa), Rotifera (19 taxa), Copepoda (4 taxa), Cladocera (5 taxa) and Ostracoda (1 taxon). The average abundance of plankton was recorded as 194.05 ± 82.58 indiv/l.

Gangetic Dolphin/Irrawady Dolphin

The Lower Meghna supports both the Ganges Dolphin and Irrawady Dolphin and have been described above. However their distribution is marked by the salinity depending on seasonal freshwater discharge. The ecological boundary follows salinity and turbidity gradients, and implies that long-term monitoring of dolphin distribution patterns may prove insightful into the impacts of declining freshwater flows on other aquatic biota (Smith *et al*. 2006).

Sea Turtles

The coastal waters and the Bay of Bengal support five species of sea turtles – Olive Ridley turtle (*Lepidochelys olivacea*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*), Loggerhead Turtle (*Caretta caretta*) and leatherback (*Dermichelys coraicea*). Among the five species female turtles of three species - Olive Ridley, Green and Hawksbill – have been recorded to nest (Rashid 1997, Rashid & Islam 2006). Female turtles have often been netted by the fishermen in the Lower Meghna River. Mating has been observed in areas south of the Sandwip Island in the Lower Meghna estuary and in the Bay near the Swatch of No Ground. The males usually stay in off-shore areas for mating with the females and do not come near-shore while the females use the favourable sandy beaches of the islands and the coastline for nesting.

Figure 5.48: Left: Hawksbill Turtle (©MLA); Right: mating Olive Ridley Turtles (©NATHAB)

Freshwater Turtles

Some of the freshwater turtle species have also been recorded in the Lower Meghna estuary. One of the top three critically endangered turtle species – Northern River Terrapin *Batagur baska* forages in the Lower Meghna Estuary and the Sundarban. Bangladesh is the last stronghold for this species as natural population of this species has been extirpated from the other range countries – Myanmar and India. A few other endangered species like Narrow-headed Freshwater Turtle (*Chitra indica*), Asian Giant Turtle (*Pelochelys cantorii*) (Fig. 5.49) also share the same habitat.

The Upper Meghna and the other river network support several other species like Crowned River Turtle (*Hardella thurjii*), Three-striped Turtle (*Batagur dhongoka*), Tent River Turtle (*Pangshura tentoria*), Gangetic Softshell Turtle (*Nilssonia gangeticus*) and some of the common species like Peacock Softshell (*Nilssonia hurum*), Roofed Turtle (*Pangshura tecta*), Yellow Turtle (*Morenia petersi*) and Spotted Flapshell (*Lissemys punctata*). These freshwater turtles are in great demand locally for consumption as food by people of a particular religious faith and are collected / hunted illegally by the fishermen and some professional hunters/collectors.

The newly accreted sand dunes/bars at Lower Meghna estuary are important breeding ground of turtles which required to be kept undisturbed during nesting period).

Fig. 5.49. Critically endangered turtle - *Pelochelys cantorii* (left) (Photo © CARINAM) and endangered *Nilssonia gangeticus* (right) (Photo © CARINAM). These species are also soughtafter for human consumption.

Important Bird Area

The Asian Waterbird Census (AWC) is the only ongoing flyway level collation of annual waterbird count data that covers East, Southeast and South Asia and Australasia; has data that was collected by Government agencies, NGO's and individuals; often stored in national databases and shared with the Asian Waterbird Census; is regionally coordinated by Wetlands International (WI) and implemented through a network of national partners - government and/or NGOs, including WI & BirdLife International national partners and is coordinated jointly by the WI-South Asia office and the WI-Netherlands offices.

Figure 5.42: Critically endangered birds within the project influence area. Top: Spoonbill Sandpiper (©Sayam) with its migration route; Middle: Bengal Skimmer (©Indraneil); Bottom left: Asian Dowitcher (©Yui), and Botton right: Nordmann's Greenshank (©LPB).

The Padma-Jamuna-Meghna Rivers as well as the Lower Meghna estuary are also key habitats for some of the migratory and local resident waterbirds, including some globally critically endangered birds (Fig. 5.50). Considering the importance of the riverine and estuary ecosystems and as the staging and refuelling areas for migratory birds the BirdLife International has declared some areas as Important Bird Areas (IBA) (Fig. 5.51). The globally critically endangered species in the Lower Meghna estuary include Spoonbill Sandpiper, Asian Dowitcher, Nordmann's Greenshank, Bengal Skimmer, Black-bellied Tern, Oystercatcher, Bar-headed Geese, Graylag Geese, etc. The rivers support ducks like Ruddy Shelduck, Widgeon, Pintail, etc.

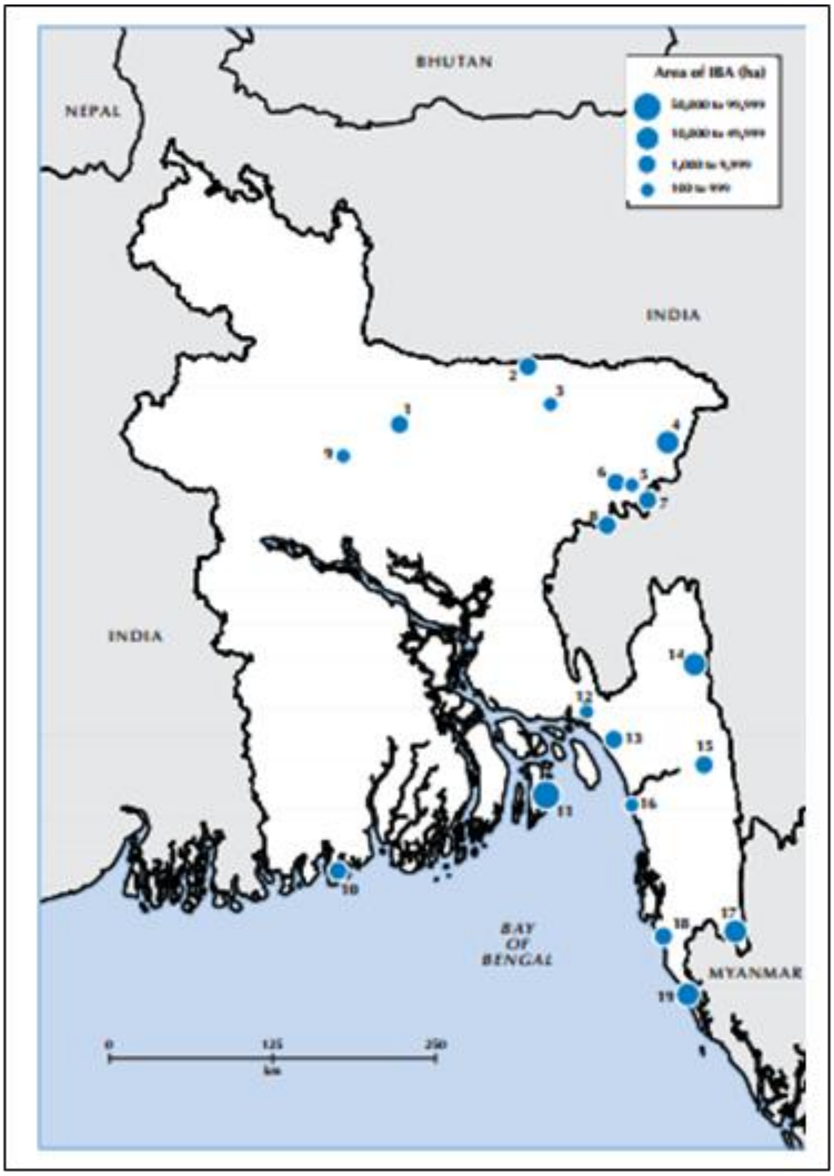


Figure 5.51: Important Bird Areas of Bangladesh (Source: BirdLife International)

Duars/Kums: Large fish & Dolphin Conservation.

Scour holes (locally known as duars/kums) or the deep subaqueous holes are the deepest points of the river system usually formed at the river bends and/or at the junctions of tidal creeks. They may form in tidal environments where the flow direction alternates over the tidal cycle and scoured by turbulence. This primarily takes place during the flood tide when the flow divides into branch channels and excessive macro-scale turbulence exists, which tends to surpress normal boundary layer development. Such scours feature in tidal creeks, at the confluence of rivers and at the river bends. These scours act as a refuge for some mammals (dolphins, turtles) and some large fishes (chital, pangas, baghaire, etc.) during the dry season when water levels are low.

River bathymetric data may reveal the location of such scours and those with depth less than 5m should be avoided for in-river disposal of dredged materials. If filled up by disposing the dredged materials these unique niches for some of the species may be altered and the species may either migrate to some other suitable site or leave the area once for all.

Coastal Mudflats: Migratory birds roost/wintering/ staging grounds

Waterbirds are one of the most remarkable components of global biodiversity. Their long migrations and tendency to concentrate in large numbers on wetlands makes them visible and charismatic. Their management hinges on collection of reliable long-term information and the International Waterbird Census (IWC) implemented over the last five decades through the efforts of thousands of experts (many of them volunteers) around the world and coordinated by Wetlands International provides a basis for counting and assessing the status of many waterbird species and populations.

Waterbirds cover thousands or even tens of thousands of kilometres every year during their annual migratory cycle between their breeding and non-breeding areas. Thus many countries share the responsibility. Bangladesh has shared the responsibility for monitoring and management of waterbird populations since 1987 when important wetlands were identified and documented in the Asian Wetland Directory. The Bangladesh Forest Department, Department of Environment collaborate with the NGOs to jointly support the efforts and the Asian Waterbird Census aggregate counts from national monitoring schemes into the International Waterbird Census. These counts are used to monitor the status and trends of waterbird species. The analyses allow us to support major international and national policies to conserve and manage waterbird populations and key wetland sites. Bangladesh shares both the Central Asian Flyway and the East Asian - Australasian flyway (Figure 5.43).

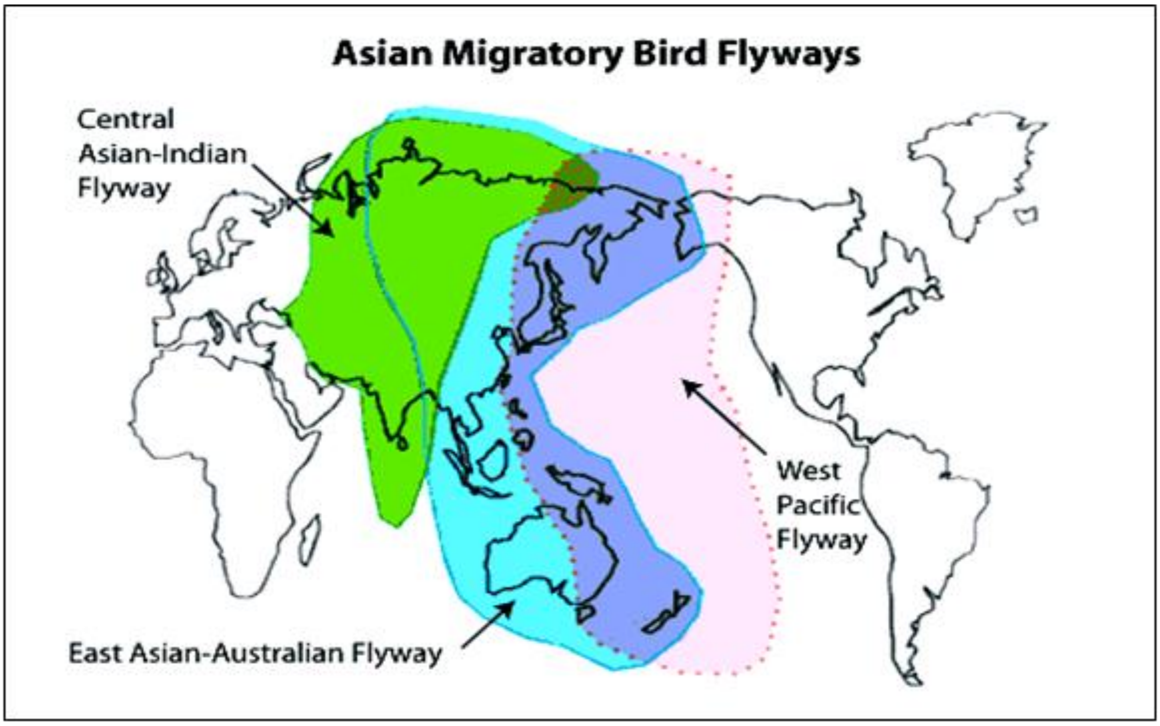


Figure 5.43: The Asian Migratory Bird Flyways: Bangladesh shares both the Central Asian-Indian and East Asian-Australian Flyways.

Bangladesh is participating in the Asian Waterbird Census since 1987 where several sites (chars and off-shore islands) in the Lower Meghna Estuary are regularly monitored for migratory birds on an annual basis. The surveys are conducted on a voluntary basis involving NGOs, and occasionally the government entities in the month of January (between 7th and 25th) every year as this is the period when the migratory birds are most active. However in the last few years due to delayed setting in of winter season the migration pattern is changing so the survey periods are extended into the month of February.

The annual monitoring information generated through the AWC provides a major data source for the Waterbird Population Estimate (WPE) reviews. The WPE is the official reference for countries to designate Ramsar Sites based on the 1% criterion.

It was during these annual censuses that some of the critically endangered waterbirds like Spoonbill Sandpiper, Nordmann's Greenshank, Asian Dowitcher, Bengal Skimmer, Bartailed Godwits, etc., were known to winter in the Bangladesh coasts. For example, the spoonbill sandpiper flies all the way from Camchatka, Siberia to spend the winter in the coastal islands of Bangladesh. It is worthy to know that the world population is known to be around 1200 birds and Bangladesh hosts more than 10% of the global population which makes the coasts, estuary and off-shore island an important area for migratory bird conservation.

- Hilsa Fishery

Hilsa (*Tenualosa ilisha*) is one of the flagship diadromous fish species of Bangladesh that migrate only through the Ganges-Meghna river system route. The biological profile of plankton from the Padma, Meghna and Tetulia reference river sites during 2011 spawning season of hilsa showed that a total of 58 taxa of plankton were present. Of which, 19 taxa (32.76%) were of phytoplankton and 39 taxa (67.24%) of zooplankton. Phytoplankton group belonged to Cyanophyceae (6 taxa), Chlorophyceae (7 taxa) and Bacillariophyceae (6 taxa) while zooplankton including Protozoa (10 taxa), Rotifera (19 taxa), Copepoda (4 taxa), Cladocera (5 taxa) and Ostracoda (1 taxon). The average abundance of plankton was recorded as 194.05±82.58 indiv/l. The highest abundance of total plankton (692 indiv/l) was observed in Godagari, Rajshahi and was lowest (4.00 indiv/l) in Charghat, Rajshahi. The highest abundance (49 indiv/l) of total zooplankton was observed in Godagari and lowest (1 indiv/l) in Charghat with mean value of 19.46 ± 4.12 indiv/l. The highest species richness (SR = 45) was observed in Daulatkhan, Bhola and the lowest (SR = 3) in Charghat, with mean value of 17.10±4.408. Shannon-Weiner species diversity index (H′) ranged from 3.334 in Daulatkhan to 1.5 in Charghat, with mean value of 2.717 ± 0.147. Based on the plankton profile it may be concluded that the biological quality of hilsa migratory river was not alike throughout the route which may restrict the migration upstream and spontaneous spawning of hilsa (Ahsan *et al*. 2012).

The confluences of Padma-Meghna and Tetulia River are very significant habitat. It plays an important role as the major nursery and breeding ground of national fish, hilsa (*Tenualosa ilisha*) and many other commercially important riverine fishes. Hilsa is primarily a plankton feeder and its food includes blue green algae, diatoms, desmids, copepods, cladocera, rotifer, etc. Hence, the Department of Fisheries (DOF) has earmarked sanctuaries for hilsa in the Lower Meghna and associated rivers.

Species diversity is a measure of the diversity within an ecological community that incorporates both species richness and the evenness of species abundances. Diversity indices are good indicator of pollution in aquatic ecosystem. Ahsan *et al*. 2012 found that diversity index of the hilsa migratory route ranged from 1.500 to 3.334 with mean value of 2.717 ± 0.147. Lower Meghna, particularly areas adjoining Daulat Khan contained the highest diversity index – 3.334. Diversity Index value greater than 3.00 indicates clean water. Values in the range of 1.00 to 3.00 are characteristics of moderately healthy conditions and values less than 1.00 characterize heavily deteriorated condition. Based on diversity index, the abundance of plankton was not found alike throughout the migratory route of Hilsa during the spawning period which might be one of the major restrictions for the easy migration of Hilsa as plankton is the major food for this flagship migratory fish.

Mangroves: Nursery for fisheries resources, natural barrier against storm/tidal surges , carbon sink

The coastal islands in the Meghna Estuary have been planted with mangrove species by the Forest Department. Bangladesh is one of the first countries to start mangrove plantation in the newly accreted land/chars along the coast/estuary since 1960s (Fig. 5.53). This plantation program has created opportunities for the local people with natural resources, protected the coastal dwellers from tidal surges and facilitated land accretion. So far more than 200,000 hectares of land has been planted with mangroves (*Avicennia* sp., *Sonneratia* sp.) and mangrove-associated species. The Forest Department is also coordinating with other organizations like BWDB by planting trees to protect the coastal embankments.

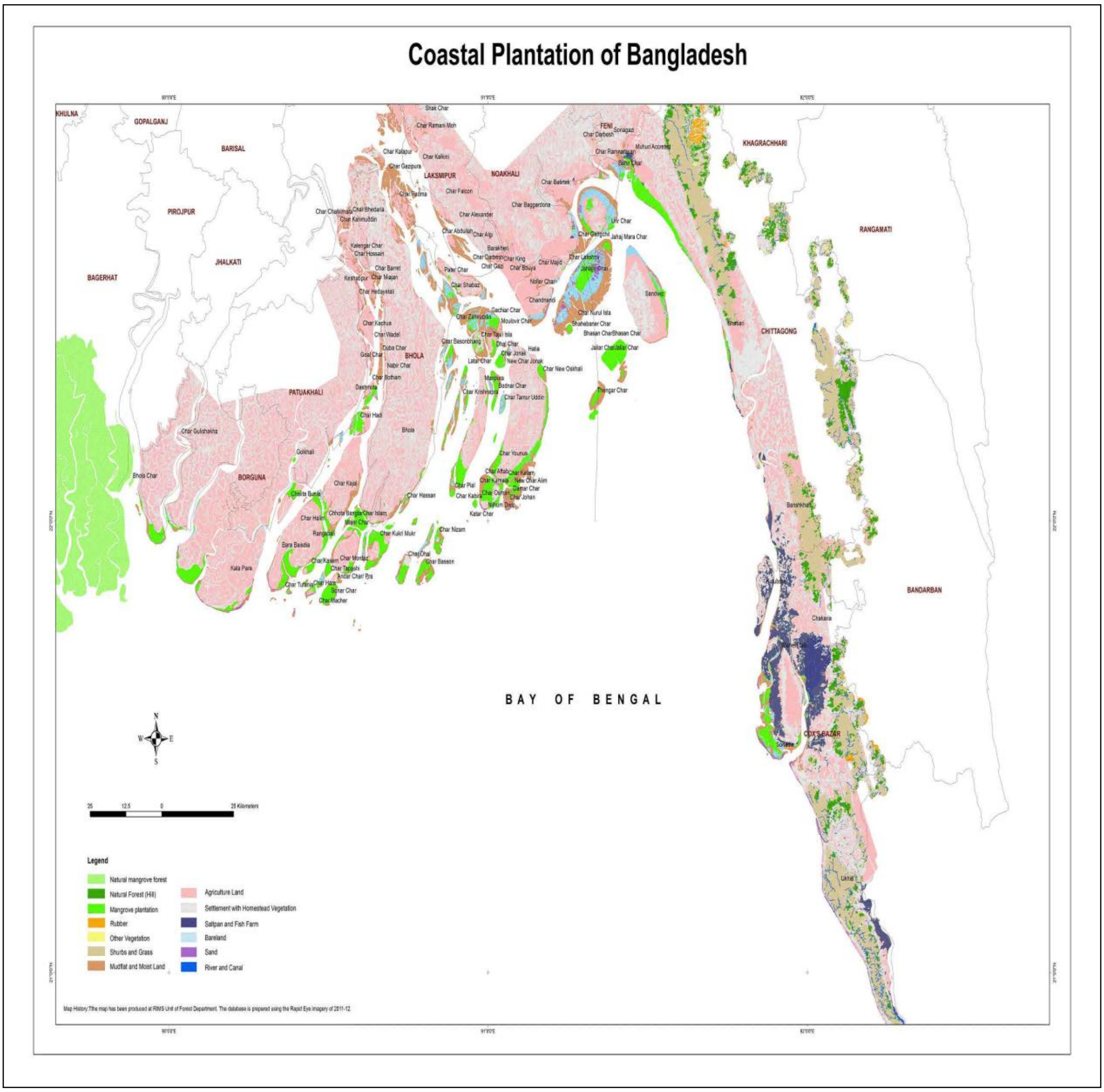


Figure 5.53. Coastal plantation (in bright green) by the Bangladesh Forest Department. (Source: RIMS, Forest Department)

Char lands/Lower Meghna Islands: Bashanchar, Sandwip

The west coast of the Sandwip Island was severely eroded in the past and for the last 5-7 years sediment accumulation has started and several kilometres of sandy beach/mudflat is observed during low tide. Similar is the case with Bashan Char. The east coast of Sandwip Island and Bashan Char has mangrove plantations done by the Forest Department (Fig. 5.54). However, the shallow waters due to sedimentation make it difficult to approach the west coast of Sandwip and the west and south coasts of Bashan Char (Fig. 5.55).

Figure 5.44 Mangrove plantation and eroded river bank of the Sandwip east coast

Figure 5.45 Bashan Char at a distance - shallow water makes it difficult to approach

Figure 5.46 A glimpse of the different habitat types of Sandwip Island

Figure 5.47. Fish landing at the river bank, Sandwip and the early morning wholesale fish auction

Water Quality: Aquatic resources conservation

It is necessary to monitor the water quality on a regular basis (see section on physical environment) as water quality acts as:

- ecological indicators: to characterize and monitor change in the state of various physical, chemical, and biological aspects of the environment relative to defined quality targets with thresholds for management action
- socio-economic indicators: to measure whether environmental quality is sufficient to maintain human health, human uses of resources, and favourable public perception
- governance indicators: to monitor the progress and effectiveness of management and enforcement practices towards meeting environmental policy targets

5.3.2 Riverine Biodiversity

Rivers tend to have longitudinal profiles which are concave open to the sky. This means that within any one river, there is typically a succession of types of water course with steep slopes near the source to minimal slope near the mouth. This succession is by no means always adhered to, and many major rivers, through accidents of terrain, alternate between fast-flowing, rocky and slow-flowing, muddy stretches. Thus, after torrential upper courses, rivers show several successive reaches of floodplain and rapids along their length. The different types of water course plainly support different communities of living organisms and this has formed the basis for several systems of geographical and ecological zoning. Ecologically, such distinctions have value as they generally correspond to many differing conditions including flow, slope or bottom type, which determine the types of plant and animal community living in them. This classification divides the river course into two main classes - the rhithron and the potamon.

The rhithron is defined as the region extending from the source to the point where mean monthly temperatures rise to 20°C, where oxygen concentrations are always high, flow is fast and turbulent and the bed is composed of rocks, stones or gravel with occasional sandy or silty patches. The potamon is the region where monthly mean temperatures rise to over 20°C, oxygen deficits may occur, flow is slow and the bed is mainly sand or mud. Three sub-zones are distinguished - the epipotamon, the metapotamon and finally, the hypopotamon, which is that brackishwater zone affected by marine waters. The rivers in the Project Influenced Area are mainly of the potamon type.

The potamon regulated rivers consists only of the channel which may be meandrine or braided in form. In flood rivers, however, there are two major components to the potamon: (i) the channel, and (ii) the floodplain. The floodplains typically include the following features:

(a) the river channel;

(b) oxbows or oxbow lakes representing the cut-off portion of meander bends;

(c) point bars - loci of deposition on the convex side of curves in the river channel;

(d) meander scrolls - depressions and rises on the convex side of bends formed as the channel migrates laterally down valley by the erosion of the concave bank;

(e) sloughs - areas of dead water formed both in meander-scroll depressions and along the valley walls as flood flows move directly down valley scouring adjacent to the valley walls;

(f) natural levees - raised berms or crests above the floodplain surface adjacent to the channel, usually containing coarser materials deposited as floods flow over the top of the channel banks. They are most frequently found at the concave bank. Where most of the silt load in transit is fine-grained, natural levees may be absent or nearly imperceptible;

(g) backswamp deposits - overbank deposits of finer sediments deposited in slack water ponded between the natural levees and the wall or terrace riser;

(h) sand splay - deposits of flood debris usually of coarser and sand particles in the form of splays or scattered debris.

The main channel or channels of the river and its anabranches usually retain water, but not necessarily flowing water, at all times of the year. As the river enters its alluvial plain it starts to meander forming wide convoluted channels whose curves are proportional to river width. In some larger rivers, the Lower Meghna, for example, braided channels occur in which the islands form levees with depression lakes at their centre. Where such braided channels occur the lateral floodplain is sometimes limited in width and its whole extent may come to be contained within the main channel. The floodplain is itself divided into two components: (i) the plain itself which is seasonally inundated, but remains dry for at least part of the year, and (ii) the standing waters which remain in the plain during the dry season. These variations provide ecological niches supporting a myriad of species.

Description of the biodiversity particularly the fishes and wildlife (amphibian, reptiles, birds and mammals) has been given.

Key species (e.g. species that require migration between Indian ocean, Bay of Bengal and Meghna estuary such as hilsa and barramundi; endangered species such as dolphins and turtles; economically important species)

Notable among the species that concerns the project are anadromous (migrate from saline to freshwater for breeding) or catadromous (opposite of anadromous) are listed below:

Table 5.39 : Notable among the species that concerns the project

Species	Behaviour
Hilsa	Adults migrate to freshwater/brackish water for spawning; later migrate to the sea and after getting bigger and becoming adult returns to the rivers/estuary for laying eggs.
Pangas	Pangasius is a highly migratory riverine fish species that makes long-distance migrations over several hundred kilometers between upstream refuge and spawning habitats and downstream feeding and nursery habitats. Pangasius is omnivorous, feeding on algae, higher plants, zooplankton, and insects, while larger specimens also take fruit, crustaceans and fish.
Prawn/Shrimp	Some species live near the shore, hiding in mud or sand, or in crevices of the stones; some others swim about in groups in deep,

	cold water. Bangladesh has very rich source of prawns in the Bay of Bengal, estuaries and freshwater. A total of 56 species is reported, of which 37 are salt water, 12 are brackish water, and 7 are freshwater in habitats. Some species migrate in between lower and higher saline zones.
Batagur baska	A critically endangered turtle, anadromous in habit, moves upstream from the estuary to lay eggs on the river banks and beaches as well.
Ganges Dolphin	A freshwater species, sometimes seen in the estuary but clear habitat boundary based on the salinity. Ganges River dolphins are not generally known to occur in salinities greater than 10 ppt, rarely up to 23ppt. Migrates to deeper sections (scour holes) of the rivers during dry season when the water levels are low.

Aquatic & River Bank (Terrestrial) flora

Aquatic plants are plants that have adapted to living in aquatic environments (saltwater or freshwater). They are also referred to as hydrophytes or macrophytes. These plants require special adaptations for living submerged in water, or at the water's surface. The most common adaptation is aerenchyma, but floating leaves and finely dissected leaves are also common. Aquatic plants can only grow in water or in soil that is permanently saturated with water. They are therefore a common component of wetlands. The principal factor controlling the distribution of aquatic plants is the depth and duration of flooding. However, other factors may also control their distribution, abundance, and growth form, including nutrients, disturbance from waves, grazing, and salinity.

Aquatic vegetation can be broken down into a number of communities or types. Each type is an aggregated assemblage of particular plant species, and is characteristic of a particular set of environmental conditions (hydroperiod, flow regime, water quality, soil, etc.) and likewise the distribution of wetland species is influenced by the fluctuating hydrological regime. Different plant communities occupy different habitats along the gradient of flooding and moisture.

Elements of the sequence of plant communities, or sometimes the entire sequence, may be absent from particular landscapes due to disruption from human activities. In the Project Influence Area, eight communities of aquatic vegetation were identified:

1. Submerged plants
2. Free floating plants
3. Rooted floating plants
4. Sedges and meadows

5. Floodplain grassland (transitional; includes sedge/meadow and reed swamp species, and grass species)
6. Reed swamp
7. Crop field vegetation
8. Homestead vegetation

Submerged plants remain fully submerged for their entire life cycle, except for the flower which occurs above the water surface. Some are rooted to the bottom and some are freely suspended. All of these plants are monocotyledons, from ten pretty closely related families including Aponogetonaceae, Hydrocharitaceae, and Potamogetonaceae.

These plants are, for obvious reasons, highly susceptible to seasonal water level fluctuations and can be found in the floodplains the community expands in area during the monsoon and contracts with the coming of the dry season. The plants start growing when water levels start rising at the very beginning of the monsoon, persisting throughout the wet season for as long as ample water is present. When the water starts receding, most of these plants flower and fruit very quickly, thereby assuring offspring in the next year; though most of these species have rhizomes and can also reproduce vegetatively. Where the water recedes further, the plants become desiccated and decompose; in permanent water bodies, they can survive for a much longer period.

The composition and prevalence of this community varied with the river bank landscape. In the shallow areas of the river banks, particularly Dakatia River and flood plains *Hydrilla* (kureli, jhangi), *Chara*, *Sagittaria* (chhotokul) and *Aponogeton* (ghechu) were the most abundant species (Figure 5.48).

Figure 5.48: Submerged plants (Photo © CARINAM)

Free floating vegetation consists of plants that are most commonly found floating freely on and collecting nutrients from the water; most of them can also survive for a certain period with their roots on or in moist soil. This community is common but not dominant and comprised plant species from the classes Angiosperm and Pteridophytes. The most dominant family in this community is Lemnaceae. Other common families are

Salviniaceae, Lentibulariaceae and Pontederiaceae. At the species level *Eichhornia* (kochuripana), and *Salvinia* (kuripana, indurkan, tetulapana), *Lemna* (khudey pana), *Pistia* (topa pana) were found.

This community is also affected by water level fluctuations, though they are in general less dependent on water and more adaptable than the submerged plants. Before the monsoon begins, they are found growing luxuriantly in the stagnant water. They persist as the water rises, but as flooding becomes general they tend to move out into the rivers. Their main mode of propagation is vegetative, though many members of this community can produce seed.

Rooted floating plants root deeply in the soil and float leaves and flower on the water surface. To accomplish this, most plants have very long stalks for both leaf and flower, and a stem that remains under water, sometimes beneath the soil; a few plants have long stems rather than long stalks. The most dominant families in this community are Nymphaeaceae and Menyanthaceae. At the species level *Nymphaea stellata* (nilshapla), *N. nouchali* (sada, raktoshapla), *Nymphoides cristatum* (chandmala), *N. indicum* (panchuli), are common (Figure 5.49).

Figure 5.49: Free floating (top) and rooted floating (below) (Photos © CARINAM)

These plants are also susceptible to seasonal water level fluctuations. In the permanent beels they can survive and regenerate for the whole year. But in seasonally flooded areas, the rhizomes or seeds remain buried under the soil during the dry season and then start sprouting with the arrival of water. As water levels increases, they then elongate their stems or leaf and floral stalks. They typically start flowering on a large scale when the water starts receding just after the peak flood. Almost all the plants of this community can propagate vegetatively as well as sexually.

Sedges and meadows comprise the ecotone (transition area between two communities, such as floodplain and grassland, and as such usually exhibiting competition between species common to both) consisting of amphibian plants (plants that can tolerate wet or dry conditions). Usually, the leaves of these plants are exposed to the air and the roots remain under water, though inundation and desiccation are tolerated to some degree (Figure 5.50). This community has the highest species diversity of all.

Figure 5.50: Sedges, meadows and grasslands (Photos © CARINAM)

The most dominant families in this community are Cyperaceae and Polygonaceae, followed by Gramineae and others. At the species level *Polygonum* (kukra, bishkatakali, and others), and various species of *Cyperus* (mutha), *Phragmites* (nol khagra) are more or less common. Some other species like *Ipomoea fistulosa* (dhol kalmi), *Monochoria hastate* (baranukha, kechur) and *Typha* (hogla) are common. Most of the plants of this type are rhizomatous and can propagate vegetatively, but all of them produce seed as well. Generally this vegetation type occupies the water margin and is also dominant in the charlands.

Floodplain grassland prefers reasonably well-drained land affected by flooding of fairly short duration, typically found in plain lands between river banks and homesteads. The community consists of various medium to high grasses. Species like *Vetiveria zizanioides* (binna) and other associated species like *Phragmites karka* (khagra, nol), *Saccharum spontaneum* (khag), *Sclerostachya fusca* (khuri), and *Arundo donax* (baranol). Small annual grasses, herbs, *Polygonum* and *Cyperus* are common in the dry season. In the newly formed chars there is a presence of a mixture of plant species, grasses, tree seedlings that suggest that the grassland community may not be a climax type, though the succession process seems to be very slow. Waterbirds, particularly the waders may fully utilize such grasslands.

Reedlands were found mostly in the chars and in some cases river banks that were low and affected by tide and dominated by *Typha* sp. The peripheral areas of the chars are fairly deeply flooded during the flood season and dry out during the dry season. The grasses *Phragmites karka* (khagra, nol) and *Saccharum spontaneum* (khag, aisha) predominate. Some sedge/meadow grasses are also found here, in lesser amounts, such as *Vetiveria zizanioides* (binna, gandhabena), *Sclerostachya fusca* (khuri), and *Arundo donax* (baranal, gobanal). Other than the grasses, woody shrubs like *Ficus heterophylla* (bonolat, baladumur), and *Lippia javanica* (bhuiokra) are also found. Another prominent species is *Asclepias* sp., a climber from Asclepidiaceae family. Mature reeds attain heights of three to four meters. (Fig. 5.61)

The community is composed principally of perennials, making it particularly vulnerable to utilization pressure. The reed lands are under threat and sustainable harvesting is possible if a rotation of at least three years is allowed, but indiscriminate reed cutting for converting to agricultural land, industrial raw material, and fuel.

River bank and homestead vegetation is a very important plant community, though a synthetic one. The community includes two types of plant: those cultivated for their economic value, and those that are self-propagating. Plants of the first category can be found all along the river banks and adjacent rivers, and composition within this type is more or less uniform. The composition within the second type is more interesting, in that it reflects the composition of nearby natural communities, including communities and species that have otherwise vanished locally, and contains some strong clues as to local vegetation composition in times past. The dominant homestead trees comprise rain tree

(*Samanea saman*), koroi (*Albizzia procera*), some *A. richardiana*, few Hizal (*Barringtonia racemosa*), koroch (*Pongamia pinnata*), and Borun (*Trewia nudflora*). Other than these were the fruit trees like mango (*Mangifera indica*), Custard Apple (*Annona reticulata*), Guava (*Psidium guajava*), jackfruit (*Artocarpus heterophyllus*). Among the odd species were *Dillenia indica* (elephant apple; chalta), *Alstonia scholaris* (Indian Blackboard Tree, chatim). The backyards comprised herbs and shrubs of various species and saplings of fruit trees and other naturally grown species providing a refuge for some of the wildlife like monitor lizards, fishing cats, etc.

The homestead cultivated plants are the dominant floristic composition of the river bank. The trees which are most common and occupied the major canopy of the area are *Albizia odoratissima, Albizia saman, Artocarpus heterophyllus, Cocos nucifera, Litsea monopetala, Mangifera indica, Phoenix sylvestris, Pongamia pinnata, Thespesia populnea* and *Terminalia catappa*. Dominant herbaceous plants of the area are *Cynodon dactylon, Oenanthe javanica, Phyla nodiflora* and *Scoparia dulcis* respectively. Most commonly cultivated crops are *Arachis hypogaea, Citrullus lanatus, Solanum tuberosum, Solanum melongena, Solanum lycopersicum, Oryza sativa, Piper betle, Cucurbita maxima, Ipomoea batatus* and *Lathyrus sativus*. (Fig. 5.51)

Figure 5.51: Reedland (above) and homestead vegetation (below). (Photos © CARINAM)

The plant diversity in some of the off-shore islands and chars in the Lower Meghna estuary include mangrove plants like *Acanthus illicifolius, Excoecaria agallocha, Sonneratia apetala, Derris scandens* and *Tamarix indica*. Mangrove plantation started during 1967-68 in newly accreted land in the Meghna estuary. Under the Green Belt Social Forestry Programme (funded by the World Bank), the Noakhali Coastal Forest Division planted both indigenous and exotic species like *Phyllanthus emblica, Dalbergia sissoo, Casuarina equisetifolia, Acacia auriculiformis, Azadirachta indica* and *Acacia mangium*, etc., from 1981-82. The characteristic vegetation along the river bank homestead is evergreen in nature. Few plants like *Terminalia spp, Albizia spp, Zizyphus mauritiana, Erythrina fusca, Bombax ceiba, Cassia fistula* and *Crateva magna* are deciduous, seasonally changing the landscape colour.

A list of homestead trees species observed along the river banks within the Project Impact Area is presented as an Annex.

People depend much for their livelihood on the cultivated plants around the homestead area for the high population density in the area. Where possible they always clear the lands for the cash crop cultivation, degrading plant diversity in the area. Grazing by domestic animals also alter the vegetation. Destruction of homestead vegetation, agricultural extension, introduction of exotic species and drought are threats to the flora of the area.

Birds (especially migratory)

The wetlands are the important habitat of migratory waterbird population. There are more than 650 bird species in Bangladesh, out of which more than 250 are Migratory. The wetlands are the abode of about 70 species of resident waterbirds including ducks, grebe, cormorants, bitterns, herons, egrets, storks, rails, jacanas, finfoot, waders, gulls, turns, skimmers etc. and many other water dependant birds. As mentioned in the IUCN Red Book, about 100 species of migratory birds regularly or occasionally visit the country.

"The Asia-Pacific Migratory Waterbird Conservation Strategy" 2001-2005, identified 50 species of migratory waterbirds as threatened, out of which 14 species occur in Bangladesh. In addition to that eleven species of resident waterbirds are also identified as threatened (The Red Book of Threatened Birds of Bangladesh, 2000).

The project influence area comprises areas that cover two important flyways of migratory birds. In fact, Central Coast of Bangladesh is the cross-road of East Asia -Australasian and Central Asian - Indian Flyways. Central Coast of Bangladesh particularly the offshore islands are possibly the best place for the wintering of shore birds in Bangladesh. These sites support more than 200,000 migratory birds either as their wintering ground or as staging ground during winter quarter. This is mainly because of its pristine habitat and a huge foraging and roosting ground. A total of about 98 species of shorebirds has so far been recorded from the coasts. Important sites at the central coasts are NijhumDweep, Char Bahauddin, Dhal Char, Char Jonak, Char Nogila, Patar Char and Kalkeniy Char and many more. Highest number of birds arrived in the central coasts are belongs to wetlands birdswaders (50000) gulls, terns and egrets (80,000), ducks and geese (50000).

The important threatened species are Masked Finfoot (*Heliopais personata*; not in the project area), Indian Skimmer (*Rhynchops albicollis*), Black-headed Ibis (*Treskeornis melanocephala*), Greater Adjutant (*Leptoptilos dubius*), Lesser Adjutant (*L. javanicus*), Baikal Teal (*Anas formosa*), Baer's Pochard (*Aythya baeri*), Ferruginous Pochard (*Aythya ferina*), Wood snipe (*Gallinago nemoricola*), Nordmann's Greenshank (*Tringa guttifer*), Spoon-billed Sandpiper (*Eurynorynchus pygmeus*).

Some of the rare species of birds those who visit regularly: Bar-headed Geese, Grey Lag Geese, Eurasian Spoonbill, Black-headed Ibis, Goliath Heron, Asian Dowitcher, Spotted Green Shank, Spotted Red Shank, Spoon-billed Sand Piper and Indian Skimmer. These birds start visiting the site from October and return in the month of April. The early migrants are Common Sandpiper, Wagtail, Lesser Sandplover, Whimbrel, Brown-headed gull, etc. The list of migratory birds is presented in Annex.

I. Migration Routes, Staging Sites, and Non-breeding Areas

Migratory routes for waterbirds are yet to be identified; however, basic data are available that can be used in delineating the same.

Table 5.40: key breeding areas, key staging areas and non-breeding areas of the country's water birds

Key breeding areas	Key staging areas	Non-breeding areas
o *Haor* areas such as Tanguar, Hail, Hakaluki etc. o Sundarbans o Coastal mangroves apart from Sundarbans like Hatia, Nijhum Dweep etc.	o Haor areas of the North west o Off shore Islands like Nijhum Dweep etc.	o All aquatic bodies of the country

Existing threats to riverine ecosystem

The river water degrades continuously due to industrial effluent. There is a stinky smell of decomposed river water when there is heavy discharge of effluent.

Household and human wastages are directly dumped to river water.

Presence of large infrastructural construction in several spot.

Different types of non degradable materials were found here.

On the river there are huge amount of water vehicles like, boat, trawler, launch etc.

There are many rice mills on the bank of *Dakatia*river which produce a huge black smoke and pollute air.

Brick fields, sand & stone storages were seen on the bank of many rivers.

5.3.3 Estuarine and Coastal Ecology

Bangladesh is endowed with vast marine and coastal waters having an area of about 1.5 times more than that of her total land mass. The environment is under the dynamic interface between terrestrial systems and marine systems dominated by wave actions and tidal currents from the Bay of Bengal. The land territory of Bangladesh is linked to the seabed and subsoil in the Bay by a singular process of erosion and deposition that has (a) lifted much of Bangladesh's landmass out of the sea, and (b) shaped the highly unusual seabed throughout the Bay (ITLOS, 2010). The countries exclusive economic zone (EEZ) spans 166,000 sq. km and the shelf area covers roughly 66,440 sq. km. Bangladesh sits in a broad and deep concavity at the northern limit of the Bay of Bengal, with Myanmar to its east and India to its west (ITLOS, 2010).

Fish and other estuarine/coastal fauna diversity and key species

Meghna river estuary is the largest estuarine ecosystem of Bangladesh which is still unknown, unmanaged and unmonitored. Cage culture of tilapia in Meghna River is presently a dominant water use pattern in this area. Down to Chandpur, this area is hydrographically referred to as the Upper Meghna. After the Padma joins, it is referred to as the Lower Meghna which falls to the Bay of Bengal. The Meghna empties into the Bay of Bengal via four principal mouths, named Tetulia, Shahbazpur, Hatiya, and Bamni. During lunar periodicity (full moon and New moon) higher abundance of fishes were reported by the fishermen.

Migration Patterns of *Hilsa*

Hilsa shad (*Tenualosa ilisha*) is anadromous in nature, i.e., capable of enduring in a wide range of salinity and migrating long distance from marine habitat to up-stream freshwater. *Hilsa* lives in the sea for most of its life but migrates to inland freshwater through rivers in Indian sub-continent for spawning (Ahsan, et al., 2014).

The fish migrate from the sea to the freshwater for spawning. The maximum takes place during full moon of the Bengali month of Asween (October) of each year (Rahman et al. 2012). The larva hatch and within one to two months convert into Juvenile called Jatka. The Jatka explore in to the fresh water rivers in schools and visits diverse parts the river top up to the river Padma (Ganges). After six to eight months due to the anadromous nature they migrate back towards the Bay of Bengal. After maturation, the fish again migrate back to the same spawning ground i.e., Padma (Ganges)-Meghna.

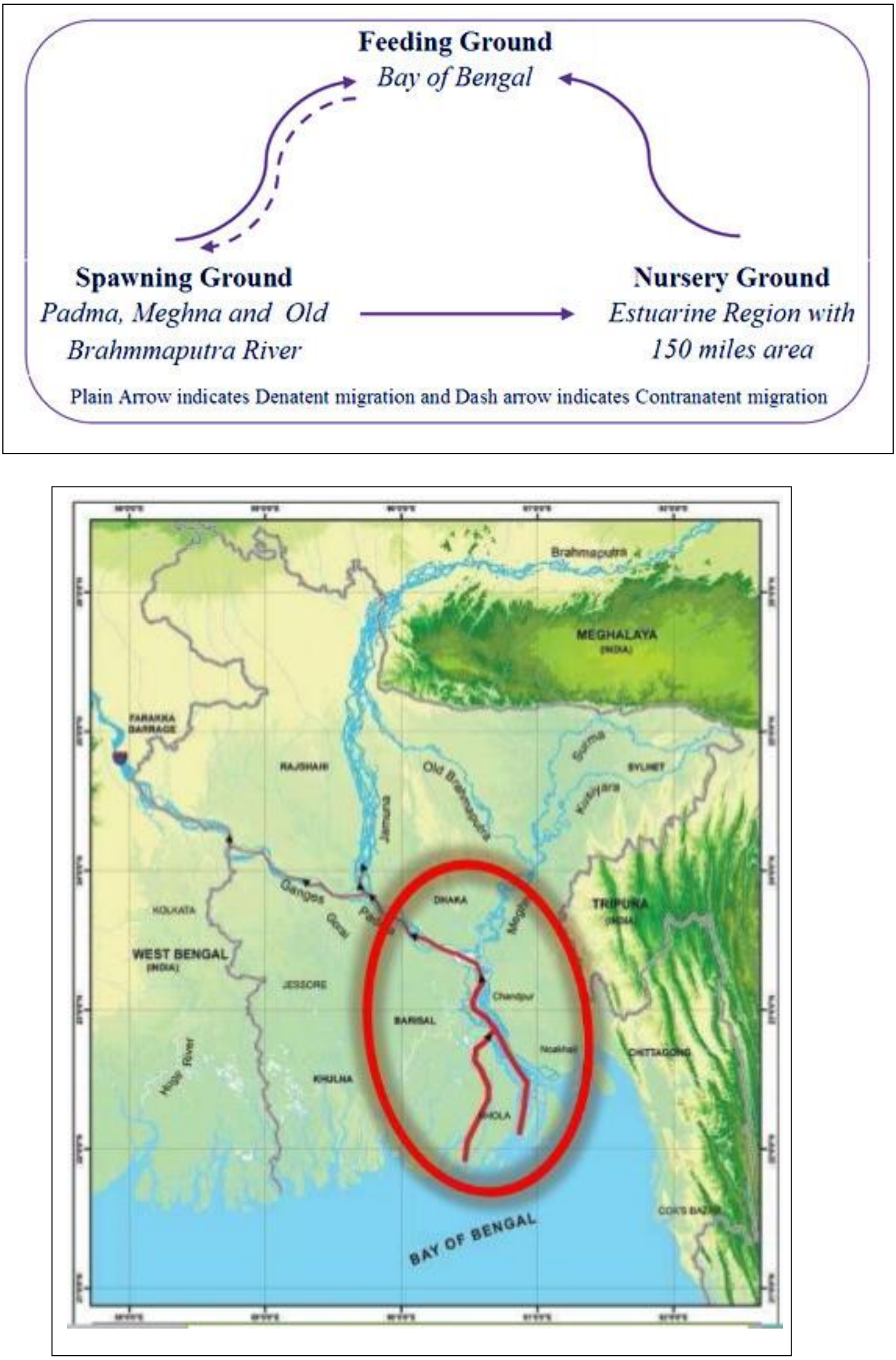


Figure 5.52: Migratory route of hilsa.

river system to breed (Rahman et al. 2012; Ahsan et al. 2014). As said by some authors, some stocks of Hilsa are permanent residents of the rivers and do not migrate into the sea (Islam, 1986). Qureshi (1968) has suggested that the breeding grounds are mostly located in the Meghna and its tributaries. The main *Hilsa* fishing season starts with the commencement of the monsoon when adult fish migrates up the rivers for spawning. The main peak season is September and October in all environments (Islam, 1986).

Table 5.41: Threshold Values of Physico-Chemical Parameters for *Hilsa* Migration, Breeding and Rearing in Bangladesh:

	Breeding Activities	**Nursery Activities**
Depth	20 m and above for migration and pre-breeding congregation	Comparatively shallower depth near river-estuarine margins above the congregation grounds
Turbidity (NTU)	100-140	Comparatively low turbid areas (70-80 NTU)
Temperature (°C)	29.3-30.2	29.8-30.8
Salinity (ppt)	<0.1	<0.1
DO (ppm)	5.0-6.8	4.8-6.8
pH	7.70-8.30	7.9-8.40
Chlorophyll (µg/l)	0.114-0.180	0.140-0.180

Source: Ahsan, et al., 2014

Here, NTU=Nephelometric Turbidity Unit, ppt= parts per thousand, ppm= parts per million, µg/l= micrograms per liter

<u>Hydrological features:</u>

Sediment concentration:

Meghna Estuary region of the Northern Bay of Bengal experiences the most dynamic morphological changes like formation of new islands and erosion of coastal areas under significant sediment supply from the rivers. Nearly a billion tons of sediment enters into the northern Bay of Bengal through the Brahmaputra/Jamuna, Ganges and Upper Meghna rivers. Compared to other two rivers sediment input in the estuary through the Upper Meghna River is relatively small. A part of the sediment forms new land in the estuary, another sets off lateral and vertical accretion of the shelf area, and the rest is lost forever through the canyons in the ocean floor (Goodbred and Kuehl, 1999). Concentration of materials held in water in suspension by turbulence (suspended sediment) is measured with a view to computing the amount of sediment present in water column at a particular moment. Sediment is eroded, transported, and deposited by water. This erosion, transportation, and deposition of sediment by flowing water is important on both long and short term time scale in terms of land form development and also on shorter engineering time scale because of its impact on, e.g., navigation channels, on hydraulic structures and, on agricultural resources (Ahmed and Louters, 1997).

Tide and current:

For bays and estuaries which are open to the outer ocean like the Bay of Bengal and the Meghna Estuary residual currents can be strongly influenced by the tidal currents primarily due to the asymmetry created by the carioles effect as well as bathymetric configurations. At the same time, residual currents may differ under barotropic and baroclinic conditions and also the effect of asymmetry between spring and neap tide may generate residual currents at the inner bay.

The 'fluvial' and the 'fluvio-tidal' sub-units as described above act as a **tidal river** with very high river discharges in the monsoon whereas the 'tidal' unit behaves as a **tidal** estuary without significant fresh water discharge from the Feni river. The tide is semidiurnal in nature with two tidal cycles per lunar day of 24 hours 50 minutes duration - each cycle having a period of 12 hours 25 minutes. The interaction between the tidal river and the tidal estuary is induced by the open sea connection with the Bay of Bengal south of the Sandwip Island and by the two channels between the north of Sandwip island and the Noakhali main land (Ahmed and Louters, 1997).

Fresh Water Inflow:

Although several large and tiny rivers discharge into the Bay of Bengal, discharge from the lower Meghna River dominates all other rivers by its enormous volume as well as its large influence on the hydrological and morphological processes of the northern Bay of Bengal. Lower Meghna conveys the rainwater from the enormous catchments of the Ganges and Brahmaputra, combined in the Padma River, and from the Upper Meghna catchment. The river flow in the Lower Meghna has a distinct seasonal characteristic, and varies between approximately 10,000 m^3/s during the dry period and 100,000 m^3/s during the monsoon months (June – September) (Sokolewics and Louters, 2007).

Physico-chemical features:

Salinity distribution in the northern part of the bay of Bengal is strongly influenced by the seasonal changes in the fresh water discharge from the Lower Meghna River. During monsoon, the salinity drops considerably and the water becomes almost completely fresh. After the monsoon, the salinity rises again and the seawater intrudes into the estuary. However, even during the period with low river discharges the salinity in the area never approaches normal seawater salinity (34 g/l) but always remains distinctly lower (Sokolewics and Louters, 2007).

According to Hossain *et al*., (1986) the seasonal variations in surface water temperature and catch rate (kg/boat/day) of hilsa fishery is evident in Chandpur and there seems to be a direct relationship between temperature and the landings -the rise and fall in temperature coinciding with the rise and fall in the landings. At Cox’s Bazar and Chittagong, the peak value of temperature in October coincides with the peak catch rate in that month but such a situation does not obtain for the other temperature peak in May. The same study also detected that in Chittagong a significant inverse relationship was observed between salinity and catch rate. During winter high salinity was recorded when the catches were low. However, Cox’s Bazar data do not illustrate such a tendency.

Morphological features:

Meghna Estuary region of the Northern Bay of Bengal experiences the most dynamic morphological changes like development of new islands and erosion of coastal areas under significant sediment supply from the rivers. Nearly a billion tons of sediment enters into the northern Bay of Bengal through the Brahmaputra/Jamuna, Ganges and Upper Meghna rivers. Compared to other two rivers sediment input in the estuary through the Upper Meghna River is relatively small. A part of the sediment forms new land in the estuary, another sets off lateral and vertical accretion of the shelf area, and the rest is lost forever through the canyons in the ocean floor (Goodbred and Kuehl, 1999).

The availability of suitable freshwater spawning habitat is considered to be a major factor limiting the natural recruitment of anadromous Hilsa shad (*Tenualosa ilisha*) in the coastal waters of Bangladesh (Hossain, M.S., *et al*., 2014). The broods of Hilsa migrate from saline water to estuaries and rivers for spawning where the eggs hatch to larvae. Their spawning phase is closely synchronized with the lunar cycle and a spontaneous spawning is noticed during the new and full moon (Rahman and Cowx, 2006) at monsoon wet season (March–September) characterized with high turbidity, strong freshwater flow, low salinity (0–5‰) and large tidal variation (Blaber et al., 1997, 2003a; Haroon, 1998; Milton and Chenery, 2003). However, the rivers, estuaries and coastal waters of Bangladesh are reported to be favorable for brood Hilsa (Shafi *et al*., 1978; Quddus *et al*., 1984).

Existing threats to coastal ecosystem

Estuaries are the meeting place of freshwater from rivers and saltwater from the sea and, as such, are dynamic environments characterized by large fluctuations in environmental conditions (James et al., 2007). Importance of estuaries is well understood in many parts of the world as breeding and nursery grounds for a wide variety of fishes. Meghna river estuary is the largest estuarine ecosystem of Bangladesh and support diverse fisheries communities compared to others. Coastal regions of Bangladesh are considered to be the most vulnerable areas in the world due to upcoming climate change scenario, especially due to possible sea level rise and recurrent storm surges. The management of coastal and marine biodiversity in Bangladesh is its responsibility and also an exclusive task of the whole neighboring nations of Bay of Bengal and Indian Ocean rim countries (Quader, 2010). Meghna river estuary is the largest estuarine ecosystem of Bangladesh which is still unknown, unmanaged and unmonitored. The main reason behind this is the complexity and high variability at different temporal and spatial scales with lack of reference on previous conditions of ecosystem (Hossain, et al., 2012). Some identified threats of coastal ecosystem are:

1. Frequent river bank erosion (RBE)
2. Indiscriminate and over fishing
3. Shrinkage of open water fish habitats
4. Obstruction to feeding and spawning migration due to inadequate migration routes
5. Use of agrochemicals and pesticides in riverside agriculture fields
6. Open water dumping in rivers causes acute harm to pelagic and benthic organisms of river
7. Spilled oil from heavy water vessels

The threats to global freshwater biodiversity can be grouped under five interacting categories: overexploitation, water pollution, flow modification, destruction or degradation of habitat and invasion by exotic species (Dudgeon, D. et al., 2006).

Estuaries are areas of physical and biological transition between the land, freshwaters, and the sea (Chowdhury et al., 2009). Almost 25% of the global vertebrate diversity is accounted by fish and fish species threatened in Bangladesh was last measured at 18 in 2013 by the World Bank. IUCN (2004) listed 13 threatened fish species in our coast including Sundarbans. Moreover, the Swatch of No Ground has now been identified as a cetacean hotspot for globally endangered Ganges River and Irrawaddy dolphins, and very recently government has declared its first marine protected area in the Bay of Bengal. Despite the country has number of strong policies and plans to protect environmental and biological resources, it is continuously losing its biodiversity because of their poor implementation and also due to human ignorance. We failed to recognize biodiversity as a rich and essential source of our nutrition and livelihood (Hoq, 2014).

It is believed that out of 61,259 species of vertebrates recognized world over, 32,300 are fish species; of which 16,764 are marine (William *et al.* 2010). A number of coastal areas and ecosystems in Bangladesh are under stress due to growing aquaculture, agriculture activities and other anthropological activities. Natural causes affecting coastal biodiversity have also been of concern in recent years.

Benthic habitat quality (nutrients, organic carbon, micro invertebrates)

The primary result of the dredging is the change in bottom topography (deepening of the channel bed) and the temporary suspension of large clouds of sedimentary material (increased turbidity). There are a number of related impacts affecting chemical and physical conditions, and biological parameters. The extent of the impacts depends partially on the equipment used, the quantities dredged per time unit and the quality of the dredged material.

Dredging causes increased turbidity in water. This reduces light penetration, thereby interfering with the photosynthetic process. Dredging disturbs the thin layer of oxidised sediments at the channel bottom; it will expose and disturb the deeper un-oxidised layers. The removal of this material may result in high values for chemical and biological oxygen demand in the surrounding waters. Nutrients (nitrogen and phosphorous compounds) present in the bed material will be released. This in itself can be considered as a positive impact, rendering nutrients from the bottom sediment available for aquatic biota.

Benthos is among the most important components of an estuarine ecosystem and may represent the largest standing stock of organic carbon in the system (Rao and Misra, 1988). Many benthic organisms, such as hard clams, soft-shell clams and prawns are the basis of the estuarine commercial fisheries. Other bottom-dwelling organisms, such as polychaete worms and small crustaceans, contribute significantly to the diets of economically important fish. Benthic communities' vary considerably according to environmental conditions (McLusky, 1989). Most benthic macroinvertebrates have highly aggregated small-scale distribution induced by several environmental variables, such as substratum type, food availability and predation (Cummins, 1962). Meghna is the biggest estuary in Bangladesh. The joined flow of the three mighty rivers forms the estuary.

Hossain et al. 2009 found significant seasonal difference among the benthos species composition and density in the Meghna estuary .

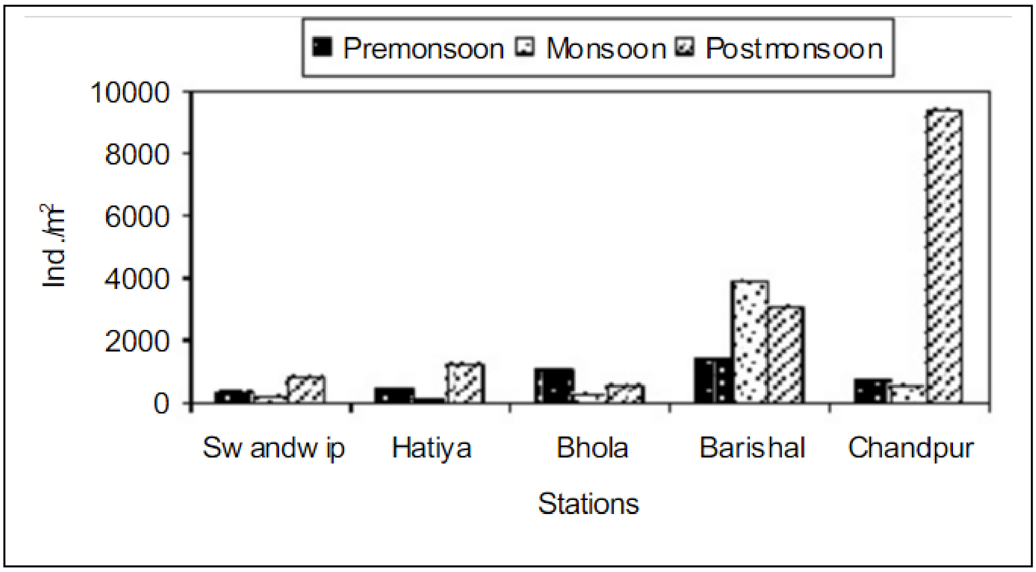


Figure 5.53: Total macrobenthos counted during three at Sandwip, Hatita, Bhola, Barisal and Chandpur (after Hossain et al. 2009)

Table 5.42: Taxonomic groups of benthic fauna, their percentage and rank of abundance in the Lower Meghna (Chandpur, Barisal) and Meghna Estuary (Sandwip, Hatiya, Bhola) (Source: Hossain et al. 2009)

SL. No.	Taxonomic Groups	Ind./m^2	% of total number	Rank of abundance
1	Ciliopora	20	0.085	15
2	Polychaetea	7871	33.30	2
3	Oligochaeta	12701	53.73	1
4	Nematoda	519	2.20	3
5	Cyclopoid Copepoda	57	0.24	9
6	Calanoid Copepoda	176	0.74	5
7	Harpecticoid Copepoda	9	0.04	18
8	Amphipoda	416	1.76	4
9	Ostracoda	23	0.10	14
10	Branchiopoda	52	0.23	10
11	Mysidacea	16	0.07	17
12	Crab	72	0.30	7
13	Cladocera	21	0.09	16
14	Isopoda	52	0.22	11
15	Coleoptera	68	0.29	8
16	Hymenoptera	32	0.14	13
17	Hemiptera	38	0.17	12
18	Diptera	135	0.58	6

Considering the overall faunal composition in the 5 stations together, oligochaetes were the most dominant group which constituted 53.73% followed by polychaetes (33.30%), mesogastropods (4.94%), nematodes (2.2%) and amphipods (1.76%). Other groups present in small numbers (<1%) were ciliophora, copepods, ostracods, branchiopods, mysids, crab megalopa, isopods, cladocera, insects and bivalvia constituting 4% of the total population (Hossain et al. 2009). Maximum population density was found during postmonsoon and minimum during the monsoon. Diversity and density was higher in both Barisal and Chandpur was higher than the sampling stations located in the estuary. It is established that benthos is rich in the stable environment and increasing depth reduces their abundance.Abundance and composition of benthos vary due to prevailing abiotic and biotic factors. Biotic factors that affects the living organisms in the intertidal zone such as competition for space and food, predation, reproduction substrate settlement preference, osmoregulation (Ramamurthy 1953). Abiotic factors that affect the living organisms in the intertidal area such as salinity, temperature, air and light exposure, tidal flow, waves and current action, substrate, wind direction and strength, dissolved oxygen, storms, natural disasters (Weyl & Peter 1970). In another study in the Meghna Estuary 10 major groups/taxa were identified during premonsoon from all stations. The maximum density (4511 individual /m) was found at Nijhum Dweep Namar Bazar and the minimum (4332 individual /m) at Nalchira Ghat. The macrobenthos included polychaetes (45.03 %), oligochaetes (16.65 %), 2 shrimp larvae (13.93 %), crab (9.63 %), gastropods (3.56 %), isopods (1.15 %), bivalves (1.15 %), copepods (0.73 %), annelids (0.42 %), amphipods (0.63 %) and others (7.12 %). Polychaetea, oligochaetea, shrimp larvae and crab contributed 85.24 % of total population. Polychaete was dominant by contributing 45.03 % of total macrobenthos (Asadujjaman et al. 2012).

Data on fish and shellfish catches and trends

Meghna estuary and its tributaries possess a widespread system of aquatic ecosystem which supports massive amount of species of plants, fish and other organisms. Of all these living organisms, fish are the most important element and is the major source of dietary protein for the national sector (Hossain et al., 2012). Species-wise annual fish catch of Meghna River for 2013-14 is available in Table 2. The population of Bangladesh depends on wild fish for food and the generation of income. A large portion rural family are engaged in part time fish capture from the rivers and beels (Hughes et al., 1994). For fishing, different types of crafts, gears and traps are used. Different types of fishing method used from primitive times and now fishing methods had been modified (Mia *et al.*, 2015).

Sanctuaries and protected areas (existing or proposed) (also See Section 5.3.1 Sensitive/ Protected Areas)

Fisheries sector of Bangladesh represent a remarkable natural resource, with an intimate connection with the life and well-being of the country and its people. This sector is playing a major role to ensure food security and economic growth of Bangladesh. In 2013-14, Bangladesh has produced 3548115MT fish of which 83.22% % and

16.78%comes from inland and marine fisheries respectively (FRSS, 2014). Hilsa shad, *Tenualosa ilisha* (Hamilton-Buchanan, 1822), which is the national fish of Bangladesh and commonly known as Ilish, is the largest and single most valuable species with annual catch of 340,000 Metric Tons (MT) (DoF, 2013). Total catch of hilsa in Bangladesh ranged between 194,981 and 280,328 tons with an average of 217,681 tons per year from 1987to 2007 and the total production increased approximately 48% during this period (Mome and Arnason, 2007). Also the hilsa catch in2011 in Bangladesh was 313,753 tons (BBS, 2012). In the year 2003, the estimated standing stock size and MSY (maximum sustainable yield) were 218,000 tons and 235,000 tons, respectively (DOF, 2005). This indicates the over-fishing of the hilsa stock existed earlier.

Table 5.43: Hilsa spawning grounds boundary

Hilsa spawning ground periphery/demarcation		GPS Point
1	Mayani Point, Mirsarai, Chittagong in the Northeast	91^{0}32.15’E and 22^{0}42.59’N
2	Paschim Syed Awlia Point, Tajimuddin, Bhola in the northeast	90^{0}40.58’E and 22^{0}31.16’N
3	North Kutubdia Point, Kutubdia, Cox’s Bazar in the Southeast	90^{0}52.51’E and 21^{0}55.19’N
4	Lata Chapali Point, Kalapara, Patuakhali in the southeast	90^{0}12.59’E and 21^{0}47.56’N

Source: GoB, 2011

Table 5.44: No HilsaCatch Zone and Peak Spawning Period of Hilsa

Position Peak	Area	Spawning Period (Ban Period of Hilsa catch)
North-East	Shaher Khali/Haithkandi point, Mirershárai	15-24 October
North-West	North Tajumuddin/West Syed Awlia point	15-24 October
South-East	North Kutubdia/Gandamara point	15-24 October
South-West	Lata Chapili point/Kalapara	15-24 October

Source: DoF, 2011

The government is going to make an addition to the existing list of five sanctuaries for Ilish (Hilsa) fish, one of the major foreign revenue earning natural resources of Bangladesh.Bangladesh Fisheries Research Institute (BFRI) proposed new sanctuary, located in three tributaries of the Meghna River, somewhere between Hijla and Mehendiganj in Barisal district. At present, the five sanctuaries cover a total riverine area of 350 sq-km; the upcoming one is about 60 sq-km in size.(Dhaka Tribune, 2015).Whereas The Daily Star (2011),stated that the government is soon going to declare a 20-kilometre stretch of the Padma in Shariatpur a new sanctuary for hilsa to increase the production of the kingly fish.

Table 5.45: Hilsa fish sanctuary area, their boundary and ban fishing period

S. N.	Hilsa Sanctuary	Demarcation	All fishing ban period
1	100 km stretch of Lower Meghna river	From Shatnol of Chandpur district to Char Alexander of Laxmipur district Shatnol point (90^{0}37.12'E and 23^{0}28.19'N) Char Alexander Point (90^{0}49.30'E and 22^{0}40.92'N)	March to April= 2 months
2	90 km stretch of Shahbazpur channel, a tributary of Meghna river	Char Ilisha to Char Pial of Bhola District Char Ilisha Mosque Point (90^{0}38.85'E and 22^{0}47.30'N) Char Pial Point (90^{0}44.81'E and 22^{0}5.10'N)	March to April= 2 months
3	100 km stretch of Tetulia river	Bheduria of Bhola district to Char Rustam of Patuakhali district Bheduria Ferry ghat Mosque Point (90^{0}33.89'E and 22^{0}42.31'N) Mandolbazar (Char Rustam) (90^{0}31.40'E and 21^{0}56.32'N)	March to April= 2 months
4	40 km stretch of Andermanik river in Kalapara Upazilla of	Kalapara Upazilla of Patuakhali District Golbunia Point (90^{0}19.20'E and 21^{0}57.68'N)	November to January= 3 months

	Patuakhali district	Confluence of Bay of Bengal and Andhermanik river (90^{0}3.91'E and 21^{0}49.43'N)	
5	20 km stretch of Lower Padma river, the confluence of Padma and Meghna river	Naria-Bhedorganj Upazilla of Shariatpur in the north and Matlab Upazilla of Chandpur and Bhedorganj upazilla of Shariatpur in the south Kachikata point of Bhedorganj upazilla of Shariatpur district in the northeast (90^{0}32.6'E and 23^{0}19.8'N) Bhomkara point of Naria upazilla of district Shariatpur district in the northeast (90^{0}28.8'E and 23^{0}18.4'N) Beparipara Point of Matlab upazilla of Chandpur district in the southeast (90^{0}37.7'E and 23^{0}15.9'N) Tarabunia point of Bhedorganj upazilla of Shariatpur district in the southwest (90^{0}35.1'E and 23^{0}13.5'N)	March to April= 2 months

Source: GoB, 2011

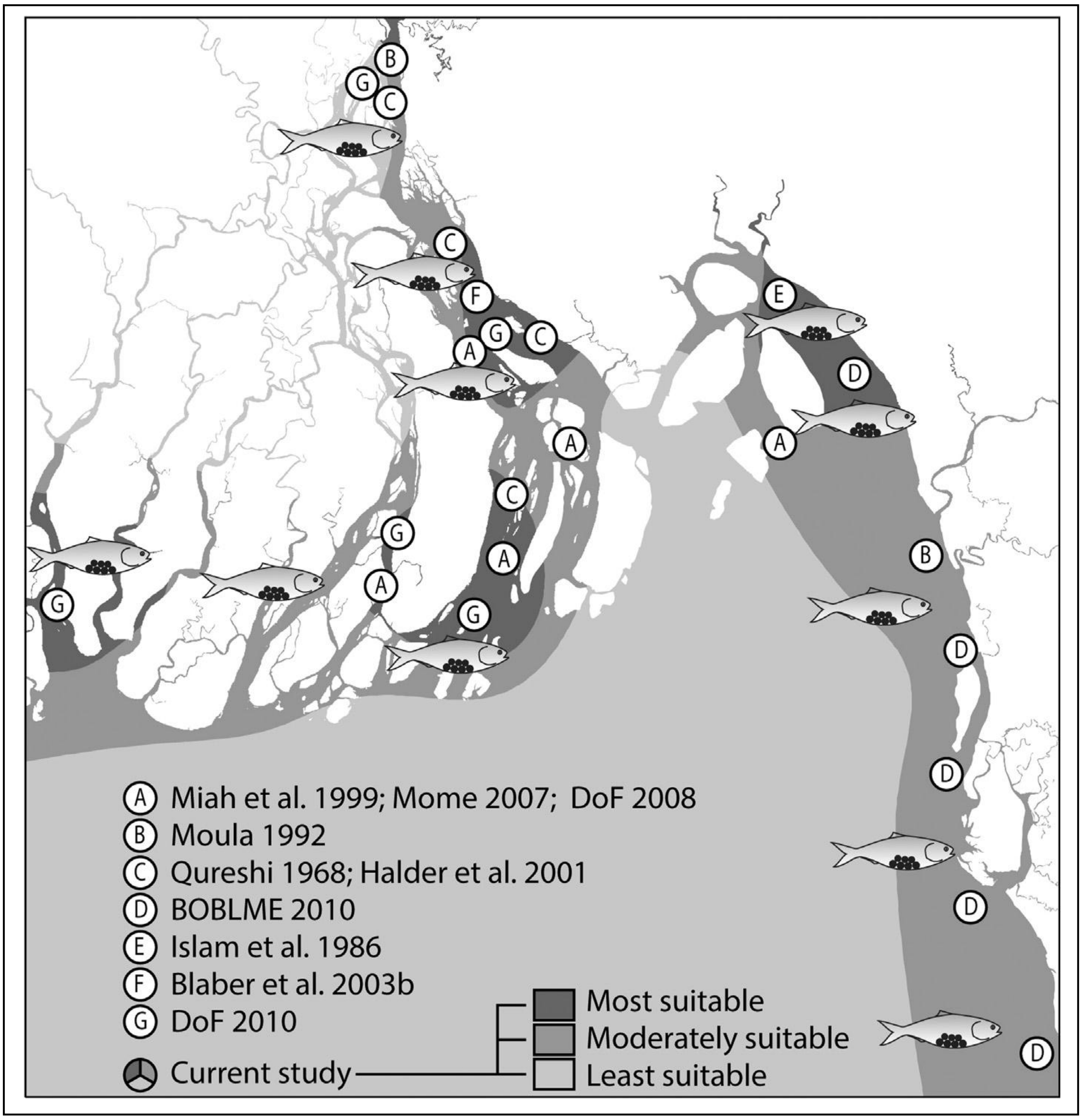
Table 5.46: Hilsa sanctuary in the lower Padma River (Newly proposed)

Position	**Sanctuary area with GPS point**	**Ban period**
North-East	Kasikata, Vedorgonj, Shariatpur (23°19.8' N, 90°32.6'E)	March to April every year
North-West	Vomkora, Noria, Shariatpur (23°18.4' N, 90°28.8' E)	
South-East	Beparipara, Matlab, Chandpur (23°15.9' N, 90°37.7' E)	
South-West	Tarabunia, Vedorgonj, Shariatpur (23°13.5' N, 90°35.1' E)	

Source: *BOBLME, 2010*

If the new proposed hilsa sanctuaries are finally approved as Hilsa Sanctuary and necessary conservation measures are taken, it can result in the sustainable management of not only Hilsa but also other viable species of Meghna river and its tributaries.

The overall situation of hilsa fishery is under severe stress in Bangladesh and vulnerable to over exploitation. Simulation results show that increased harvesting of the adults entering the rivers and the juveniles in the rivers cause gradual decline in hilsa fish population and even may cause to disappear this valuable resource within a short period of time (Bala, B.K., *et al*., 2014). For sustainable production of hilsa fish as well as increase in production sound development policy and management strategies are urgently needed (Bala, B.K., *et al*., 2014).



Source:M.S. Hossain et al. 2014

Figure 5.54: Geo-spatial spawning habitats modeling for Hilsa overlap with many authors in the coastal waters of Bangladesh.

Existing threats to coastal ecosystem

Coastal areas are commonly defined as the interface or transition areas between land and sea, including large inland lakes. Coastal areas are diverse in function and form, dynamic and do not lend themselves well to definition by strict spatial boundaries. Unlike watersheds, there are no exact natural boundaries that unambiguously delineate coastal areas. Coastal zone means the coastal waters (including the land therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands and beaches.

The hydrological cycles; rivers and distributaries from the lands and the ocean currents and waves accumulate huge organic and geochemical substances; thus make highly productive zones with important sources of food and raw materials, energy, minerals, recreation, transport, and trade. Coasts also host an impressive array of valuable habitats with an equally extraordinary collection of species. Excellent landscapes are found on sea shores. They are the best natural defense for keeping the shoreline intact from abrasions. However, coastal zones face serious problems of habitat destruction, pollution, erosion and resource depletion due to human economic activities and probably climate change effects. A combination of human activities like over-fishing, pollution of estuaries and the coastal ocean, and the destruction of habitat, especially wetlands and sea-grasses etc., currently exerts a far more powerful effect on marine fisheries than is expected from climate change.

However, some problems often create disasters and make the lives hard and the whole coastal ecosystem is being disturbed. Among them, tropical cyclones and tornados, tidal surges and floods, erosion, heavy siltation and pollution, especially from the mega-cities and ports, shrimp hatchery and shrimp farms. Deforestation, over fishing and salt fields, overexploitation, and hill cutting for unplanned construction, ships breaking industries and tourism have accelerated ecosystem damages.

The government has developed the Bangladesh National Programme of Action (NPA) for the Protection of the Marine Environment from Land – based Activities under the aegis of the Global Programme of Action (GPA) of the UNEP. This national document, signify the needs and opportunities for the protection of the coastal environment and associated lives and livelihoods.

5.3.4 Floodplain and Char Land Ecology

A floodplain is a flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current.

Lateral connectivity by means of floodplain inundation has been described as a major factor affecting the biodiversity and biocomplexity of floodplain systems. With decrease in connectivity after flood recession the influence of the river on floodplain waterbodies diminishes and floodplain habitats develop their own limnological features. Knowledge of the effects of dry spells and drought on aquatic systems comes primarily from intermittent and arid-zone streams, and the implications of extended dry periods for floodplain waterbodies are still poorly known.

The extended dry period resulted in continuous morphological changes in non-flooded sites as opposed to more drastic changes in sites subject to flooding. Even though habitat characteristics varied through time, most variation occurred between flooded and non-flooded waterholes, as the latter sites presented significantly lower proportions of habitat elements, such as aquatic and overhanging vegetation, algae, debris, leaf litter and root masses. Flooded waterholes showed greater indication of temporal changes, given that many of these habitat elements increased in proportion during the wet season, after flooding.

Flooded sites showed lower pH, conductivity and dissolved oxygen values and higher water temperatures. Inundation decreased turbidity in waterhole sites and increased this parameter at the river site. Flooding, although minor, was an important factor structuring the physical habitat and water quality characteristics of waterholes, whereas the absence of flooding led to more continuous low-magnitude changes. These processes can be expected to influence resources available for consumers such as fish, as well as the habitats available for colonization by the aquatic fauna.

The large rivers characterized by extensive floodplains and the river-floodplain systems are regulated by the flood pulse regime and the hydrological connectivity, which determine high habitat heterogeneity and a wide spectrum of resources for benthic invertebrates. The floodplain environments range from secondary channels of different discharge and flowing regime (intermittent flow, permanent flow) and connectivity degree and fluvial or lacustrine wetlands. The connectivity degree, macrophytes cover, riparian leaf litter, availability of detritus in the bottom sediments determine high habitat heterogeneity at different temporal and spatial scales in the Meghna River floodplain.

The high spatial variability (patches, mesohabitat, regional/landscape scales) and the temporal fluctuations of the system (flood pulses magnitude, duration and frequency, seasonality, etc.), determine a high taxonomic and functional diversity of benthic invertebrates and large amounts of available benthic resources for aquatic and aquatic-terrestrial food webs. Lateral gradients are found among mesohabitats with increasing richness, abundance, biomass and secondary production from the main channel to secondary channels, lakes with different connectivity degree and wetlands. The secondary channels show differences in the benthic invertebrate assemblages among the central strip and the banks, in relation to detritus inputs, granulometry and hydraulic stability degree. The floodplains offer a high heterogeneity in relation to their connectivity degree (mainly at the landscape level). Besides high levels of environmental complexity and significant differences in the benthos assemblages may be found at the patches scale in relation to their area and shore development (embayment, irregularities, debris dams, etc.).

A gradient from the permanent water bodies to the terrestrial zones may be observed in the marginal wetlands in terms of physical and chemical microhabitats and vertebrate and invertebrate assemblages. Moreover, the taxa found in the marginal wetlands can develop desiccation strategies to survive during the drought phase. Despite the importance of floodplain habitats and their natural dynamics for the biodiversity of the system and for the human economic activities, the rivers have been greatly disturbed by engineering and regulating water flow, resulting in a degradation of floodplain-river function and connectivity.

Floodplains and Charlands are two major important biota of river biome. Charlands are low-lying islands whether temporary and permanent land mass within river channel resulted from sedimentation and accretion , while the floodplains are perennial wetlands along the bank of river course comprising of seasonally flooded land, low-lying depression, ox-bow lakes, canals, ponds and ditches. The project influence and study areas cover a wide array of water ecosystems e.g., islands, chars, shoals in the river channels, riverbed and banks, the river basin/catchments upstream & downstream of the watercourse, floodplains & drainage area and patterns, areas of potential influence of existing and planned river ports, landing, terminals, vessel shelters, ferry crossing and dredge spoil dumping sites, areas of ecological important, irrigation and roads.

Natural Vegetation

The char lands support the natural successions of grass and reed lands. At the estuary the char lands re-colonized the mangrove swamps naturally. The charlands are temporary waterscapes in the rivers houses perennial vegetation comprising of grass and reedlnds plan communities. This seasonal succession of charland vegetation is unique evolutionary phenomena which produces highest biomass productivity on earth within a short span of time. During winter season these biomasses are consumed by livestock and wildlife in various forms. People in these delta are from time immemorial are being harvesting grass and reeds as fodder for their livestock, using the sungrass and typha for thatching their houses, use the charlands as foraging and grazing grounds for livestock. The phragmites and Saccarum are used as special fodder for cattle. The aquatic vegetation especially the weeds are used as bio-fertilizer after composting those. Huge quantity of aquatic weeds are using as fire fuel after sun drying.

The Charlands are very fertile land for agriculture. People are cultivating different type of crops including cereal, species, vegetables, sesame, peanuts and mustard.

During monsoon all these biomass from the charland vegetation are the main nutrient to fish and other riverine life. The vegetation when got submerged during flooding becomes decomposed and dispersed naturally into the river course and supplied dissolved nutrient materials to water and soil. The Economic value of charlands agriculture, fisheries and other NTFPs need to be assessed and consider its role in the livelihoods of the charland community. The charlands is also an important gene bank of indigenous aquatic vegetation, wild paddies and indigenous livestock, poultry and duckery.

These are eternal dynamic natural nutrient cycle/process in the river delta which the charlands are performing to keep the riverine natural ecosystem functions intact and sustaining the richness in diversity of aquatic biodiversity. Charlands are also acts as an important natural carbon sink to a greater extent.

But these values and functions of charlands are never been taken into account as such during the multifarious intervention in the forms of water development projects.

Ninety seven species have so far been recorded from the Charlands surveyed. The most common well adapted species of charlands are *Saccharumspontaneum,Saccharumravennae, Typha elephantine, Vetiveria ziznoides, Tilanthera philoxeroides, Rottboelia exaltata, Lippia nodifolia, Echinochloa colonum, Alternanthera sessilis, Phragmites karka, Aeschynomene* *indica, Imperata cylindrica, Leersia hexandra, Fimbristylis dichotoma , Polygonum hydropiper, Eclipta prostate and Xanthium indicum*. The rare presence of some tree species also noticed in the charlands. These are *Baringtonia acutagula* (hijol) *Trewia polycarpa* (pidali), *Salix tetrasperma* (willow), *Ziziphus mauritiana* (boroi) and *Tamarix gallica* (nonajao). The most common ground cover of charlands is *Cynodon dactylon (*durba), *Hemarthia portens* (chailla), box grass, *Colonum crusghali* (shamagrass), *Cyperus rotundus* (bhaduli), and *Leersia hexandra* (arali grass). In the wet area of charlands a member aquatics very are very common. These are *Eichhornia crssipes* (kachuripana), *Pistia stratiodes* (topafana), *Ipomoea aquatic* (kolmi), *Nympaea pubescens* (shampla), *Nymphoides indicum* (chandmala), *Utricularia exoloeata* (jaji), *Ludwigia repens* (mulsi), *Tilanthera phylloxeroides* (helencha), *Hygrorrhiza aritrata* (hygrorhiza), *Monochoria hastata* (Nukha), *Sagitteria sagittifolia* (sagitteria), *Hydrolea zeylanica* (hydrolea) etc.

Mammals

Mammalian fauna of Bangladesh is comprised of 124 species including 5 species of marine mammals. Among these species 10 primates, 30 carnivores, 34 bats, 7 artiodactyls, 9 dolphins and whales and one species of elephant is notable (Khan 2010). Among the 30 species of carnivores, 8 species are felids *viz.* Bengal Tiger (*Panthera tigris*), leopard (*Panthera padrus*), Clouded Leopard (*Neofelis nebuosa*), Fishing Cat (*Felis viverina*), Asiatic Golden Cat (*Felis temminckii*), Marbled Cat (*Felis marmorata*), Jungle Cat (*Felis chaus*) and Leopard Cat (*Felis bengalensis*). Three species of bears, *viz. Ursus thibetanus* (Asiatic Black Bear), *Melursus ursinus* (Sloth Bear) and *Helarctos malayanus* (Sun Bear) are found in the forests of the country.Among the 19 species of primates of South Asia, Bangladesh supports 10 species. Among these primates 5 species of monkeys, 3 species of Langurs, 1 species of Gibbon and 1 species of Loris inhabits here. Four species of deer *viz. Axis axis* (Spotted deer), *Axis porcinus* (Hog deer), *Cervus unicolor* (Samber deer) and *Muntiacus muntjak* (Barking deer) are found in Bangladesh. Bangladesh is the home of Asian Elephant (*Elephas maximus*) - the largest land mammals of the country. Bangladesh supports a good number of bats (34 species). Among these bats 29 species are insectivores, 4 fruit bats and 1 carnivore (Khan 2008).

On the basis of both primary and secondary data, a total of 26 mammalian species is reported from the study area. The relative abundance of the mammalian species, Critically Endangered was 09 (36%), Common individuals are 3 (12%), Uncommon 04 (16%), Vulnerable 05 (25%) and 02 (8%) species are Rare (See Annex – Mammals).

Terrestrial habitats: include forests, grasslands, reed forest and agriculture lands. They are typically defined by factors such as plant structure, leaf types (eg. broadleaf and needleleaf), plant spacing and climate. Grasslands include a variety of upland grass-dominated habitats. In general, grasslands occur on dry slopes and have well-drained sandy or loamy soils. Terrestrial means living and moving 'on land'. Terrestrial fauna viability is dependent upon maintaining a mix of vegetation quantity, quality and distribution. Maximum number of mammalian species used different vegetative and structural stages for feeding, breeding and cover. The vegetation also changes, both natural and human-caused, the major influences on terrestrial wildlife.

Most mammalian species today are terrestrial. Some mammalian today remain aquatic (Gangetic Dolphin, *Platanista gangetica*), semi-aquatic (Otters), living the first stage of their lives as fish-like tadpoles. Some special habitats are used by special types of wild animals.

Riparian Habitats: A good number of mammalian fauna uses riparian habitats for nesting. These types of habitats are believed to support potential mammalian species (rats, moles, mices, jackals, civits, etc) at risk. These habitats are those adjacent to rivers and streams or occurring on nearby floodplains and terraces. Riparian habitats are shaped and maintained through seasonal flooding, scour, and soil deposition. Riparian habitats occur along rivers and streams at all elevations, from valley bottom floodplains. Riparian habitats also include springs, seeps, and intermittent streams, and many low elevation alluvial floodplains.

Arboreal habitat is the area of "animal movement" in trees. In every habitat in which trees are present, animals have evolved to move in them. Some animals may only scale trees occasionally, while others are exclusively arboreal. A good number of mammals are adapted in arboreal habitat i.e. False Vampire Bat,*Megaderma lyra;* Leschenaults Fruit Bat, *Rousettus leschenaulti;* Indian Flying Fox, *Pteropus giganteus;* Lesser Rat-tailed Bat, *Rhinopoma hardwickei*, Kelaart's Pipistrelle, *Pipistrellus ceylonicus, etc*.

Arboreal environments pose many functional challenges for animal locomotion including fitting within narrow spaces, balancing on cylindrical surfaces, moving on inclines and moving around branches that obstruct a straight path. Many species of mammals are arboreal and their flexible bodies appear well-suited to meet many of these demands.

Forest Habitat is a large area of land where many plants and trees grow. There are different kinds of forests throughout the study areas and each has its own special characteristics. Climate, soil, and water determine the kinds of plants and animals that can live in a place. In the forest, there are several layers of plants they provides food and shelter for many kinds of mammalian species, etc.

Flagship mammalian species: The keystone species plays a unique and crucial role in the way an ecosystem functions. Many other species rely upon keystone species for some critical aspects of their life history and survival. These species play a vital role in maintaining the structure of an ecological community and help to determine the types and numbers of various other species in the community.

On the other hand, Flagship species are popular, charismatic species that serve as symbols and rallying points to stimulate conservation awareness and action. Flagships are viewed as ambassadors or icons of an ecosystem. Each of the particular habitat types of the country has some keystone or flagship species those are very crucial for that particular region, like, Irrawaddy Dolphin, Gangetic Dolphin, Golden Jackal, Fulvous Fruit Bat, Fishing Cat, etc.

Birds

Central Coast of Bangladesh is the cross-road of East Asia -Australasian and Central Asian -Indian Flyways. Central Coast of Bangladesh particularly the NijhumDweep is possibly the best place for the wintering of shore birds in Bangladesh. This site supports more than 200, 000 migratory birds either as their wintering ground or as staging ground during winter quarter. This is mainly because of its pristine habitat and a huge foraging and roosting ground. A total of about 98 species of shorebirds has so far been recorded. Important sites at the central coasts are NijhumDweep, Char Bahauddin, Dhal Char, Char Jonak, Char Nogila, Patar Char and Kalkeniy Char. Highest number of birds arrived in the central coasts are belongs to waders (50000) gulls, terns and egrets (80,000) , ducks and geese (50000).

Some of the rare species of birds those who visit the regularly are: Bar-headed Geese, Grey Lag Geese, Eurasian Spoonbill, Black-headed Ibis, Goliath Heron, Asian Dowitcher, Spotted Green Shank, Spotted Red Shank, Spoon-billed Sandpiper and Indian Skimmer. These birds start visiting the site from October and return in the month of April. The early migrants are Common Sandpiper, Wagtail, lesser Sandplover, Brown-headed gull.

Bangladesh has 628 species of birds (16 orders and 67 families; 276 passerine and 352 non-passerine), of which 388 are resident (16 orders and 60 families; 171 passerine and 217 non-passerine), and 240 are migratory (10 orders and 33 families; 105 passerine and 135 non-passerine). Sarus Crane (*Grus antigone*) is the largest (standing about 1.75 m tall) bird in the subcontinent, but it is now a rare occurrence in Bangladesh.

A few flowerpeckers and sunbirds, smaller than the sparrow, are perhaps the smallest. The bird population is shrinking every day. One of every nine species of birds is now threatened with extinction. Today 41 species (out of 388 species of resident birds) are threatened in Bangladesh, of which 19 are critically endangered, 18 endangered and 4 are vulnerable. Of the 388 resident species, the status of 158 could not be evaluated due to paucity of data. The ecological alterations obviously affected the composition of the avifauna. Birds associated with forests of some sort or with a swampy habitat have declined, and their places taken over by other birds.

All members of the family Scolopacidae are migratory. Common among these are 2 spp. of Curlews (Gulinda), Numenius; 2 spp. of Godwit (Jurali), Limosa, 13-14 spp. of Sandpipers (Chapakhi Pi-oo), etc., Tringa; 5-6 spp. of Snipes (Chaha or Kadakhucha), Gallinago; Woodcock (Bara or Buno Chaga), Scolopax rusticola; 3-4 spp. of Stints and Dunlins (Baman Chapakhi), Calidris, and Ruff Philomachus pugnax. Of these snipes and woodcock usually occur singly and the others are usually found in flocks of several individuals to several thousands. Most are restricted to the coastal areas, estuaries, charlands, beels, baors, haors, mountainous streams, ponds and lakes. Larger flocks are restricted to the larger water bodies. The list of birds in the project area is given in Annex.

Reptiles

There are 157 reptilian species had so far recorded in Bangladesh (Khan, 2010). One species of crocodile, *Crocodylus porosus* and one Ghorial, *Gavialis gangeticus*, belongs to the

Family Crocodylidae and Family Gavialidae. 28species are turtle and tortoise belongs to 5 families. A total of 31 lizard species represents 6 families and 97 snake species are recorded belongs to 8 families under the order Serpenteria.

A total of 34 species of reptiles are recorded from the study area. The relative abundance of the reptilian species, Critically Endangered was 12(37.5%), Common individuals are 4 (12.5%), Uncommon 03 (9.38%) and 02 (6.25%) species are Rare (Annex).

Gharial: Gharial, *Gavialis gangeticus,* rarely occurs in the Padma; the species is Critically Endangered (CR) nationally and globally. Some scientist assumes that it is extinct in the wild in Bangladesh. Habitat shrinkage, food scarcity, breeding ground destruction and poaching of eggs and young are the main threats for this species. There are past sighting reports of this rare croc in the river and charlands between Shariatpur and Harina

Turtle and Tortoise: Turtles and Tortoises have a great commercial value as food and ecological services (such as scavengers) at the local level, and they are valued nationally and internationally for food, medicinal products and the pet trade (Das, 1987). There are 28 turtle and tortoise species in Bangladesh. At present most of the species of turtles and tortoises are threatened. River Terrapin, *Batagur baska* and Cantor's Softshell turtle, *Pelochelys cantorii* these species are critically endangered and occurs in brackish water and large water bodies of Bangladesh. Asiatic soft-shell turtle, *Chitra indica* found in deep water of big rivers and it occursin study area in good abundance in Padma, althoughthe turtle is categorizedas critically endangered in IUCN-Red Data Book (Bangladesh).

A total of 12 species of both freshwater and marine turtles are recorded from the study area. Turtles are usually found to inhabit in ponds, ditches, pools, canals, rivers and estuaries in the study area. During winter season turtles are seen basking on the bank of the waterbeds, vegetation, semi-submerged bamboo poles, floating material or erected objects in the water. The spotted flap-shell turtle was found in paddy fields under straw in burrowing condition.

Poisonous and non-poisonous snakes: In Bangladesh among the 82 species of snakes 28 are venomous, 12 species of them are sea snake (Faiz*et al.* 2008). Venomous snakes belong to the families Viperidae, Elapidae (including cobras, kraits, coral snakes), Hydrophiidae (sea snakes and Colubridae (a large family, of which most species are non-venomous and only a few are dangerously toxic to humans) (Paul *et al.* 2008).There are 5 medically important groups of snake in our country, these are- Cobras, Krait, Russell's viper, Green pit viper and sea snake. Among this majority of venomous bites in our country are cobras and kraits. They are mainly neurotoxic, and respiratory failure is the main cause of death following venomation. Snakes bite defensively or when agitated.

The common snakes in the present study area are: Checkered Keelback (*Xenochropis piscator),* Striped Keelback (*Amphiesma stolata),* Banded Wolf Snake (*Lycodon aulicus),* Black-barred Kukri Snake (*Oligodon cinereus),* Smooth Water Snake (*Enhydris enhydris),* Rat Snake (*Ptyas* spp.), Cobra (*Naja* spp.), Kraits (*Bungarus* spp.) and others.

Snakes are found in grassland habitats. This habitat, with its vegetation, attracts rodents and insects, which the snakes prey upon. The high grass also provides protective cover for the snakes. Reed forests are also important habitats for reptiles. Rat snakes (Elaphidae) are found in the jungles, crop fields and backyards of homesteadsin good numbers.

Habitats typically contain many niches and support many different species. Habitat is an ecological area that is inhabited by a particular species of animal or other type of organism. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food and the presence of predators. A variety of stable habitats are vital for the long term welfare of reptile species. Some species of reptilianfauna live in the same type of habitat all the years, while others spend the summer in one type of habitat and winter in different habitats. In addition, habitats are quite different for different types of species. Large, wide-ranging species like snake and monitor lizards can travel large distances and use many different types of places or vegetation types. Smaller species, like Wall lizards, Calotes, Mabuya, Gecko, etc. can spend much of their lives near a single fallen log.

A suitable habitat for any given organism will possess the resources required for its survival. Habitats with better resources, including adequate food supplies and safer shelter, may give an individual a selective advantage and improved fitness over others. Differences in habitat use are thought to develop as a result of physiological, morphological interspecific differences, adaptation to a habitat based on independent evolution in different areas, or specialization to optimal habitats because of competition within or between species.

Selection of a habitat can be ordered at the macro and micro levels. First, a physical or geographical location in which to inhabit will be selected as a macro-habitat. Then the animal will secure a home range, limiting their movement spatially. Further selection will occur as an animal makes use of the different habitat components, or microhabitats, in the home range. Habitat availability, relative to the proportions at the macro level, may decrease at the micro level because an animal is selecting for an area where its habitat of preference dominates. Usage by the animal at the micro level can therefore increase relative to the total availability of habitat types.

There are only two types of ecosystems: terrestrial and aquatic ecosystems. However, these ecosystems can be broken down into a variety of smaller, more regional and specialized ecosystems, which are sometimes referred to as biomes.

Aquatic Habitats: Large number of reptile species uses the aquatic habitats which cover lakes, ponds, canals, marshy areas, streams, rivers and intertidal zones. Below is a description of these various aquatic habitats.

Freshwater habitats: Include bogs, ponds, rivers, reservoirs. Freshwater aquatic habitats typically contain water year-round, while wetlands may dry out through the season. Most reservoirs (Marsh, Ponds and other natural water bodies) also are included in these habitats and land cover type, as they represent man-made versions of dishes and ponds, which are difficult to distinguish with imagery. Eventually, when the lakes and reservoir coverage for the state is completed, reservoirs might be separated from natural water bodies. These habitats feature standing water and believed to support turtles, monitor lizards and some snake species. Marsh, lakes and ponds that have not had their hydrologic regime modified provide the best habitat. Rivers and streams are the habitats of aquatic vegetation and animals which ensures food and shelters of turtles, snakes, crocodiles, etc.

Wetland habitat is a place where the water controls the environment and the plant and animal life. They are some places where the ground is wet or covered with water for most of the year. The wetlands are rich in animal life. Since these areas are covered with water, many reptiles like Roofed Turtle (*Pangshura tecta*), Median Roofed Turtle (*Pangshura tentoria),* Three-striped Roofed Turtle (*Kachuga dhongoka),*Yellow Turtle (*Morenia petersi),* Spotted Flapshell Turtle (*Lissemys punctata*), Monitor lizards (*Varanus* spp*).*, Seibold's Smooth Water Snake (*Enhydra seiboldii*), Dark-bellied Marsh Snake (*Gerarda prevostiana), etc.* Wetlands are covered with water during all or part of the year. Wetland habitats are highly diverse and include the following different types:

Swamps and shrub lands are located in depressions, around lakes or ponds or on river terraces. They generally flood seasonally with nutrient-rich waters and are dominated by woody vegetation. Many species of monitor lizards, turtles are frequently found in these habitats. Marshes occur in depressions (ponds), fringes around lakes and along slow-flowing streams. Marshes are seasonally or continually flooded and have water-adapted plants such as sedges, bulrush and floating vegetation. Marshes can have mucky soils resulting in water with high mineral content and dominated by herbaceous species, often including wildflowers. Different types of reptiles like Indian Roofed Turtle, Yellow Turtle, Three-striped Roofed Turtle,Spotted Flapshell Turtle, Peacock softshell Turtle, Black Pond turtle, Ckeckered Keelback watersnake, Striped keelback snake, Monitor lizards, etc. lives in marshes.

Seasonal ponds and vernal pools hold water during the winter and spring but typically dry up during the dry summer months. Vernal pools occur in complexes of networked depressions that are seasonally-filled with rainwater. They host a variety of reptilian species with unique adaptations.

Terrestrial Habitats used by reptilian fauna: Terrestrial habitats include forests, grasslands, agriculture land and pastures. They are typically defined by factors such as plant structure, leaf types, plant spacing and climate. Grasslands include a variety of upland grass-dominated habitats. In general, grasslands occur on dry slopes and have well-drained sandy or loamy soils.

Terrestrial means living and moving 'on land'. Terrestrial reptiles, lizards, snakes, tortoises, gharials, etc viability is dependent upon maintaining a mix of vegetation quantity, quality and distribution. A substantial number of snakes use different vegetative and structural stages for feeding, breeding and cover. The vegetation also changes, both natural and human-caused, the major influences on terrestrial wildlife.

Riparian Habitats- A good number of reptilianfauna uses riparian habitats for nesting. These types of habitats are believed to support potential reptiles’ species at risk. These habitats are those adjacent to rivers and streams or occurring on nearby floodplains and terraces. Riparian habitats are shaped and maintained through seasonal flooding, scour, and soil deposition. Riparian habitats occur along rivers and streams at all elevations, from valley bottom floodplains. Riparian habitats also include springs, seeps, and intermittent streams, and many low elevation alluvial floodplains.

Arboreal habitat- is the area of "animal movement" in trees. In every habitat in which trees are present, animals have evolved to move in them. Some animals may only scale trees occasionally, while others are exclusively arboreal. Arboreal that lives and move 'Above' the ground". A good number of reptiles are adapted in arboreal habitat i.e. Short- nosed Vine Snakes (*Ahaetullaprasina*), Common Vine Snakes (*Ahaetulla nasutus*), Tokey Gecko (Gecko gecko), Flat-tailed Gecko (*Hemidactylus platyurus*), Common Garden Lizard (*Calotes versicolor*), Jerdon's Forest Lizard (*C. jerdoni),* Green Fanthroated Lizard *(Ptyctolaemus gularis),* etc.

Arboreal environments pose many functional challenges for animal locomotion including fitting within narrow spaces, balancing on cylindrical surfaces, moving on inclines and moving around branches that obstruct a straight path. Many species of snakes are arboreal and their elongate, flexible bodies appear well-suited to meet many of these demands, but the effects of arboreal habitat structure on the locomotion of snakes are not well understood.

Amphibians

Present Status of Amphibian species: There are 42 species of amphibian fauna are reported from Bangladesh (Khan 2010), of which order Anura covers all the 42 species belonging to 07 families [Bufonidae = 04, Dicroglossidae =12, Hylidae = 01, Megophrydae =03, Microhylidae =09, Ranidae =12, Rhacophoridae =11]. In the present study only 10 species were identified in the PMBP impact area. Of which, Common toad, *Duttapharynusmelanostictus*, is very common and widely distributed. Of the frog species Bull frog, *Hoplobatrachustigerinus; Common skittering frog, Euphlyctiscyanophlyctis;* and Cricket frog, *Fejervaryalimnocharis* is common and widely distributed in the study area (Table 1). Green Frog, *Euphlyctis hexadactylus;* Two-striped Grass Frog, *Sylvirana taipehensis* are endangered species in the PMBP area. Of the recorded amphibian species, the relative abundance of the species, Critically Endangered species were 02(20%), Common individuals were 3 (30%), Uncommon 5 (50%) species.

Table 5.47: List of Amphibian species identified in the study areas.

No	Order	Family	Species	English Name	Local Name	IUCN	Local
1	Anura	Bufonidae	*Duttaphrynusmelanostictus*	CommonToad	Kuno Bang		CR
2		Dicroglossidae	*Euphlyctiscyanophylctis*	Skipper Frog	Kotkoti Bang		C
3			*Euphlyctishexadactylus*	Green Frog	Sabuj Bang	EN	UR
4			*Fejervaryalimnocharis*	Cricket Frog	Jhijhi Bang		C

No	Order	Family	Species	English Name	Local Name	IUCN	Local
5			*Hoplobactrachustigerinus*	Indian BullFrog	Sona Bang		C
6		Ranidae	*Nasiranaalticola*	Pointed-headed Frog	Pana Bang	VU	UR
7			*Sylviranataipehensis*	Two-striped Grass Frog	Kaad Bang	EN	UR
8			*Hylaranatytleri*	Leaping Frog	Pana Bang		UR
9		Rhacophoridae	*Polypedatesleucomystax*	Asian Brown Tree Frog	Gecho Bang		CR
10			*Polypedatesmaculatus*	Indian Tree Frog	Gecho Bang		UR

Notes: IUCN Status (Local): VU = Vulnerable; EN = Endangered; CR = Critically Endangered.
CITES Status: I=Threatened with Extinction; II=Trade to be Controlled to Help Survival; III=Protected in at Least One Country
Local Status (Occurrence/abundance): CR = Common Resident; C = Common; UR = Uncommon Resident; RR = Rare Resident

Terrestrial habitats used by amphibian fauna

Terrestrial habitats- include forests, grasslands, reeds and agriculture lands. They are typically defined by factors such as plant structure (trees and grasses), leaf types (eg. broadleaf and needleleaf), plant spacing (forest) and climate. Grasslands include a variety of upland grass-dominated habitats. In general, grasslands occur on dry slopes and have well-drained sandy or loamy soils.

Terrestrial means living and moving 'on land'. Terrestrial fauna (toads and frogs) viability is dependent upon maintaining a mix of vegetation quantity, quality and distribution. A substantial number of amphibian species used different vegetative and structural stages for feeding, breeding and cover. The vegetation also changes, both natural and human-caused, the major influences on terrestrial wildlife.

Riparian Habitats- A good number of amphibian fauna uses riparian habitats for nesting. These types of habitats are believed to support potential amphibian species at risk. These habitats are those adjacent to rivers and streams or occurring on nearby floodplains and terraces. Riparian habitats are shaped and maintained through seasonal flooding, scour, and soil deposition. Floods replenish nutrients, recharge groundwater, and reset succession processes. Riparian habitats occur along rivers and streams at all elevations, from valley bottom floodplains. Riparian habitats also include springs, seeps, and intermittent streams, and many low elevation alluvial floodplains.

Arboreal habitat- is the area of "animal movement" in trees. In every habitat in which trees are present, animals have evolved to move in them. Some animals may only scale trees occasionally, while others are exclusively arboreal. Arboreal that lives and move 'Above' the ground". A good number of amphibians are adapted in arboreal habitat i.e. Asian Brown Tree

Frog (*Polypedatesleucomystax*), Jerdon's Tree Frog(*Hylaannectans*), Striped Asian Tree Frog (*C. vittatus),* Large Tree Frogs (*Rhacophorus* spp.), etc.

Arboreal environments pose many functional challenges for animal locomotion including fitting within narrow spaces, balancing on cylindrical surfaces, moving on inclines and moving around branches that obstruct a straight path. Many species of frogs are arboreal and their flexible bodies appear well-suited to meet many of these demands.

Forest Habitat- is a large area of land where many plants and trees grow. There are different kinds of forests throughout the study areas and each has its own special characteristics. Climate, soil, and water determine the kinds of plants and animals that can live in a place. In the forest, there are several layers of plants they provides food and shelter for many kinds of frogs (*Rachophorus* spp., *Hyla* sp., *Chiromantis* spp., *Philautus* sp., *Polypedetes* sp.), etc.

Invertebrates

Bangladesh is a host of wide range of invertebrate diversity. The Table 4reflects a partial state of species diversity of invertebrate fauna shows the recorded species of insect fauna.

Among the fauna, Insects play a vital role in regulating the ecosystem and contribute to sustainability of the biodiversity. Das (2009) estimated the total number of insect species as 2,444 in Bangladesh. Feeroz, et al. (2011) recorded 43 Butterfly species and 11 species of other groups of insects from Rema-Kalenga Wildlife Sanctuary in Shatchari, Sylhet. Forty four species of butterflies were recorded from Butterfly Research park in Bhawal National Park in 2012 (Anonymous and Bashar, 2012). In 2012 these researchers made a report on Dudpukuria-Dhopachari Wildlife Sanctuary of Bandarban and reported more than 100 species of insects of various groups including Butterflies, dragonflies, Damselflies, Bees, Wasps, Beetles, Mantids, Grasshoppers and others. They also listed 70 butterflies, 25 dragonflies & damselflies, and 10 species of grasshoppers from Teknaf Wildlife Sanctuary in 2013. Bhuiya (1983-2014) recorded nearly 450 species of parasitic Hymenoptera from Bangladesh.

Bangladesh represents a good diversity in its butterfly species. IUCN (2004) reported a total of 311 species. However, the number of new species reports has increased during 2013 and 2014 by 12 more species in the records making the current total upto 323 species (Khandaker M. et al. 2013, Neogi et al. 2014, Khan M.K. et al. 2014 and Shahadat et al. 2014). Notably, Torben B. Larsen (2004) reported 236 in the whole of Bangladeshwhereas the rest 75 was done by previous researchers (Alam 1962a, 1962b, Ameen and Chowdhury 1968, Begum and Begum 1986, Alam and Ullah 1995 in IUCN 2014).

Invertebrates constitute the major group of wild fauna in the study area. Table-6 shows the species of invertebrates recorded from the study area. The charlands are good abode of invertebrates in general and the insects in particular. In the shallow water shoals are seen having high density of mollusks. These are important feeds of carnivorous fish, Storks, Ibises, Geese, Great Egrets, Birds of prey and monitor lizards. People collect mollusks in bulk to feed theirs ducks. Mollusks shells are also burned to make edible lime.

Insects like the grass hoppers and crickets are seen in superabundance which attracts huge flocks of insectivorous birds like drongo, swallow and other flycatchers.Butterfly and moths are also very important groups ofarthropods seen in all most all char areas nectaring on flowers of herbs.Bees and wasps are seen in the sesame fields in good populations. These groups are good pollinators of flowers. Beetles, bugs and fireflies are a group of insects found in the backyards of homesteads in good abundance. The list of terrestrial insects is given in Annex.

Threats to floodplain and charland ecosystem

The floodplains and charlands in the Upper Meghnarivers are all most all lost its natural features as result of human-induced changes. These areas are either under cultivation of fish culture. Flood control, Drainage and Irrigation (FCDI) projects controls the natural connectivity of river flow to and from floodplains which disconnects the migration path of aquatic life between beels and rivers. Thus it destroyed the natural habitats of floodplain capture fisheries. The charlands in the region mostly harbour villages where human population is very high and the natural features of the charlands are damaged. Major part of flood plains cultivable land and beels are land filled for housing, bazaars and other development structures. Water is polluted due to waterlogging in the low-lying areas and the municipal wastes dumped directly to the water.

Over fishing in the Lower Meghna is seen as one of the main threat to the floodplains biodiversity. The rate of erosion is also high in the charlands and river banks in these region which posing threats to the homesteads biodiversity.

The reedlands are being converted to agri-lands which damaging the reelands habitat for a great number of reedland birds.

Hunting, shooting and trapping of migratory birds in the charlands is an important threat to the migratory bird populations.

Shrip fry collection by mosquito nets posing threats to the plactonic life of more than hundred species of coastal and marine fishes.

Pollution from ships and accidental oil spill from capsized oil tanker are also threats to the aquatic and charland biodiversity

Over-exploitation: A very small areas of swamp forests are now present due to extensive exploitation over the past decades. Natural regeneration of the forest species is not happening anywhere in the wetlands. The reed beds are also significantly reduced from over-harvesting for fuel and converting land into agricultural fields.

Destructuve fishing methods: Harvesting the last fish, dewatering of key areas, repeated fish harvest on an annual basis, and leaving only a few fish for breeding are the most unsustainable fishing methods used. As a result, reduction of fish diversity has been happening in this once highly diversed wetland.

Soil erosion: Given a dynamic system, soil and river bank erosion is a major concern in charland and riverine areas respectively.

Water pollution: Excessive use of chemical in agricultural field and Industrial pollution are the major reasons of water pollution which in turn impacts the aquatic ecosystem negatively.

Predicted threats and suggested mitigation measures

To enhance the inland navigation different types of physical intervention has taken place along the river banks. Under this project, construction of Vessel shelter, Launch and Ferry terminal are such structural intervention to be carried out which have far reaching environmental impacts are predicted. From the historical and past experiences it is noticed that growth centers, business hub, bazaars and other development activities are being established by the community centering the Launch and Ferry terminal.

Although the terminal and station itself are not detrimental to environment as such but the associated development activities have adequate negative environmental impacts on the rivers and waters. All the existing terminal and ferry stations are visible examples of such environmental degradations which are resulted from the activities mentioned below.

- Filling river banks, water bodies and crop fields around the terminals for construction of shops/bazaars/bus stands/truck stands
- Illegal encroachment of Khas lands
- Dumping all most all solid/liquid wastes on site and rivers directly
- Air pollution from rice and brick clines
- Waste discharge directly from the factories without treatment
- Waste materials from abattoir , open slaughter house , hotels, restaurants and kitchen are dumped in the water
- Absence of sewerage and drainage systems
- Dumping and discharging toilet waste directly to river from all water vessels ply along the terminal
- Plastic bags/containers consumed by the passengers are thrown to the rivers
- Waste generated from hawkers are thrown all around
- Oils and mobiles slicked from the water vessels to the water
- Noise pollution from loudspeakers used in the ghats for various purposes

There should be an environmental management plan to mitigate the negative environmental impacts specifically the water pollution. Local government authority/bazaar committee/boat operators association under BIWTA should have “Local Environment Safety Protocol” developed, implemented and monitored.

Otherwise all the stations and terminals in near future will make river polluted like that of “Buriganga” in an irreversible state.

There should be an environmental management plan to mitigate the negative environmental impacts specifically the water pollution. Local government authority/bazaar committee/boat operators association under BIWTA should have "Local Environment Safety Protocol" developed, implemented and monitored.

- Prefer degraded habitat for dredge spoil dump at char and avoid dump at chars having high biodiversity and ecological value
- Prepare DO's and DON'TS ,use those at hoardings and orient the people engaged in the operation
- Keep the birds roost, feeding and nesting ground free from such operation
- Avoid dumping on reedlands
- Avoid Breeding and wintering season
- Translocate the rare wildlife including turtles, izards, frogs, snakes and mammals
- Relocate and transplant the rare vegetation
- No hunting, shooting, trapping and disturbing birds
- Minimize noise level
- Avoid anchoring boats/barges and other vessel in the mudflats
- Regulate oil slick of the vessel/dredger/carrier
- Restrict workers movement/ activities in the charlands
- No disposal of waste from the vessels operating in the water
- Dredge spoil has high demand for land fill and other uses for construction industry, thus *ex-situ* translocation is suggested
- Use boom/barriers/buoys to demarcate no go zones /restricted ecological area/reserves

5.3.5 Land Resources

Agro-Ecological Regions

Bangladesh has been divided into thirty agro-ecological regions and 88 sub-regions (Figure 5.55). The regions have been identified on the physical environments which are relevant for land use and assessing agricultural potential. These layers are: (i) Physiography (land forms and parent materials); (ii) Soils and their characteristics; (iii) Depth and duration of seasonal flooding; (iv) Length of the rain fed Kharif and Rabi growing periods; (v) Length of the pre-Kharif period of unreliable rainfall; (vi) Length of the cool winter period and frequency of occurrence of extremely low (below 0.4^0C) winter temperature; (vii) Frequency of occurrence of extremely high (> 40^0C) summer temperature.
Geo-morphological and ESIA study of river routes dredging, construction and maintenance of vessel shelters and construction/maintenance of launch/cargo terminals mainly located at Demra under Dhaka district, Narayanganjsadar under Narayanganj district, Gajariaupazila under Munshiganjdistrict, Polash(Ghorashal) upazila under Norsindi district, Brahmanariasadar and Ashuganjupazila under Brahmanbaria district, Bhedorganjupazila under Sariatpur district, Shandipupazila under Chittagong district, Raipur upazila under Lakshmipur district, Matlab Uttar, Chandpursadar and Haimcharupazila under Chandpurdistict, Hatyaupazila under Noakhali district, Sandwipupazila under Chittagong district, Bholasadar and Daulatkhanupazila, Tozumuddinupazila, Monpuraupazila under Bhola district, HijlaMehendiganj and Sadarupazila under Barisal district.

Agro-ecological zones and sub-regions are very broad units. Fertility status of these regions varies considerably. For detailed information about physical and chemical properties of soils, respective UpazilaNirdeshika of SRDI and Land Zoning Report of Ministry of land consulted. However, for fertility data of a specific area soil samples have been collected for detailed analysis.

The total study area (route) has been estimated about 150,700 ha and comprises of seven agro-ecological regions, namely (i) Old Brahmaputra Floodplain (AEZ-9), (ii) Active Ganges Floodplain (Aez-10), (iii) Ganges Tidal Floodplain (AEZ-13),(iv) Middle Meghna River Floodplain (AEZ-16), (v) Lower Meghna River Floodplain (AEZ-17), (vi) Young Meghna Estuarine Floodplain (AEZ-18), (vii) and Old Meghna Estuarine Floodplain (AEZ:19). The locations of agro-ecological regions are comprises with some physic-chemical properties of soil of AEZs have shown according to land type (in Table-5.48 to Table 5.54)

Table 5.48***:*** Some physic-chemical properties of soils of AEZ-9

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
High land	3.8-6.5	L-M	VL-L	VL-L	L	VL-L	M-Opt	M-Opt	L-M	VL-L	Opt
Medium highland	4.5-7.2	L-M	VL-L	VL-L	L-M	VL-L	M-Opt	M-Opt	VL-L	VL-L	Opt
Medium lowland	4.5-7.2	L-M	VL-L	VL-L	L	VL-L	M-Opt	M-Opt	L-M	VL-L	Opt

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum

Table 5.49***:*** Some physic-chemical properties of soils of AEZ-10

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
High land	6.7-8.1	L-M	VL-L	VL-L	L-M	L-M	M-Opt	H	L	VL-L	M
Medium highland	6-7-8.4	L-M	VL-L	VL-L	L-M	L-M	M-Opt	H	L	VL-L	M
Medium lowland	6.6-8.0	L-M	VL-L	VL-L	L-M	L-M	M-Opt	H	L-M	VL-L	M

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum, H=High.

Table 5.50***:*** Some physic-chemical properties of soils of AEZ-13

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Medium highland	4.5-8.4	L-M	L	VL-L	M-Opt.	M-Opt.	Opt-H	M-Opt.	L-M	M-Opt.	Opt.

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum, H=High.

Table 5.51***:*** Some physico-chemical properties of soils of AEZ-16

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Medium Lowland	4.8-6.9	L-M	VL-L	L-M	L-M	L-M	M-Opt	M-Opt	L-M	VL-L	Opt
Lowland	4.0-6.7	L-M	VL-L	L-M	L-M	L-M	M-Opt	M-Opt	L-M	L	Opt
Very Lowland	4.5-5.4	L-M	VL-L	VL	L-M	L-M	M-Opt	M-Opt	Opt	VL	Opt

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum, H=High.

Table 5.52***:*** Some physic-chemical properties of soils of AEZ-17

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
High land	5.5-6.5	M	VL-L	L	L-M	L-M	M-Opt	Opt-H	M-Opt	L	M
Medium highland	4.7-7.6	L-M	VL-L	VL-L	L-M	L-M	M-Opt	Opt-H	M-Opt	L-M	M
Medium Lowland	5.1-7.8	L-M	VL-L	VL-L	L-M	L-M	M-Opt	Opt-H	M-Opt	L-M	M

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum, H=High.

Table 5.53***:*** Some physic-chemical properties of soils of AEZ-18

Major land type	Soil pH	Soil OM	Nutrients status								
			N	P	K	S	Ca	Mg	Zn	B	Mo
Medium highland	4.5-8.4	M-Opt	VL-L	L-M	L-M	M-H	M-H	M-H	L-M	L-M	Opt

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum, H=High.

Table 5.54***:*** Some physico-chemical properties of soils of AEZ-17 (Old Meghna Estuarine Floodplain)

Major land type	**Soil pH**	**Soil OM**	**Nutrients status**								
			N	**P**	**K**	**S**	**Ca**	**Mg**	**Zn**	**B**	**Mo**
Medium high land	4.5-7.8	L-M	VL-L	VL-L	L-Opt	L-M	Opt	Opt	L-M	L-Opt	Opt
Medium lowland	5.4-7.6	L-M	VL-L	VL-L	L-Opt	L-M	Opt	Opt	L-M	L-Opt	Opt
Lowland	5.6-6.7	L-M	VL-L	VL-L	L-Opt	L-M	Opt	Opt	L-M	L-Opt	Opt

OM=Organic matter; VL=Very low, L=Low; M=Medium; Opt=Optimum.

Source: Fertilizer Recommendation Guide-2012, BARC.

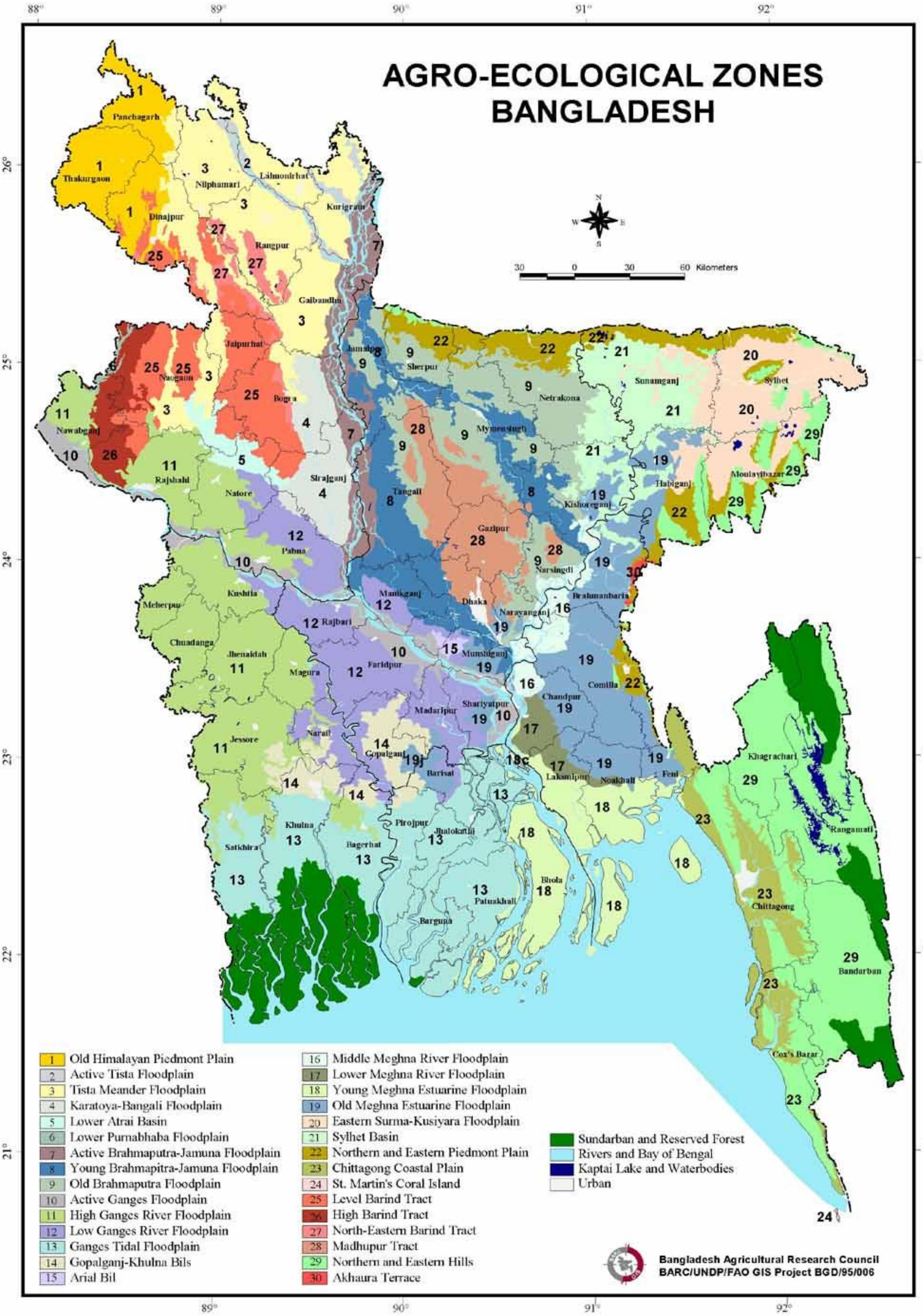


Figure 5.55: Agro-Ecological Zones in Bangladesh

Land Types

Land type classifications are based on depth of inundation during monsoon due to normal flooding on agriculture land. According to Soil Resource Development Institute (SRDI), five land types have been classified in terms of depth of flooding.

The distribution of land types of the study area is presented in Table-8. Maximum (59%) area of the project is covered with medium highland (F_1) which is followed by medium lowland (29%). The coverage of low land and very low land are about 9% and 2% of the Net Cultivable Area (NCA). The land type is classified only based on agriculture land which represented as Net Cultivable Area (NCA). Detailed distribution of land type of the study area is presented in (Table -5.55).

Table 5.55**:** Distribution of land type in the study area (Main land)

Land type	Flooding depth	Depth of Inundation	Flooding characteristics	Area (ha) of NCA	% of NCA
Highland (F_0)	0-30 cm	Flood free	Non flooded to intermittent	432.9	1
Medium Highland (F_1)	30-90 cm.	Less than 30 cm	Seasonal	25,539.9	59
Medium Lowland (F_2)	90-180 cm	30 to 90 cm	Seasonal	12,553.5	29
Lowland (F_3)	180-275 cm	90 to 180 cm	Seasonal, but remains wet in early dry season	3,895.9	9
Very Lowland (F_4)	> 275 cm	More than 180 cm	Seasonal but remains wet in most of the dry season	865.8	2
Total				**43,288.0**	**100**

Sources: GIS estimation, SRDI and Field Survey'2015

Soil Texture

Soil texture is the relative proportions of sand, silt and clay. It is very important for agriculture crop production. The sandy loam soil texture of the project area is about 46% which is followed by clay loam (25%). The clayloam soil texture is favored for growing dry land crops in the Rabi/dry season and also rice and jute. Detailed soil texture is presented in Table-5.56

Table 5.56***:*** Detailed soil texture of the Top- soil (0-15 cm) in the study area (Composition (%) in riverbank site permanent Village land)

Texture	Area (ha) of NCA	Percentage of NCA
Clay	3,463	8
Clay Loam	10,822	25
Loam	6,926	16
Sand	2164.4	5
Sandy Loam	19912.5	46
Total	**43,288.0**	**100**

Sources: GIS estimation, SRDI and Field Survey'2015

Land Use

Main land (village land)

The dredging work would be done in both sides of the river bed. The total corridor (study area) is about 150,700 ha of which about 28.7% is net cultivable area (NCA). Settlements with industries and water bodies constitute about 6.5% and water bodies 64.7% respectively of the total area of the project. Detailed land use of the area is presented in (Table-5.57).

Table 5.57**:** Present land use of the study area

Land use	Area (ha)	Percent of total area
Total Area	150,700	-
Net Cultivable Area (NCA)	43,288	28.7
Settlements, Industries, Roads bushes, trees etc.	9,868	6.5
Rivers, Khals, channels, ponds, and Water bodies	97,544	64.7
Total	**150,700**	**100.0**

Sources: GIS estimation, Google map and Field survey'2015

Char land

There are two types of Char is found in the study area. The char land is included with the River areas which are about 19,180 ha. Detailed of land use of char land area is presented in Table-5.58.

Table 5.58**:** Present land use of Char land

Land use	Area (ha)	Percent of total area
Char land	**19,180**	-
(i) Old accredited land	14960.4	78
(ii) Newly accredited land	4219.6	22
Total	**19,180.0**	**100**

Sources: GIS estimation, Google map and Field survey'2015.

5.3.6 Agriculture Resources

Farming practices

Farming practices in the study area are largely controlled by physical, biological, climatological and socio-economic factors. Agricultural crops are grown by cropping seasons. There are two distinct cropping seasons in a year, Kharif and Rabi seasons. The Kharif season starts from March and ends in October while the Rabi season starts from November and ends in February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into Kharif-1 (March-June) and Kharif-II (July-October) season.

Kharif-I is characterized by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. In this season, mainly HYVAus, B.Aus rice, Jute are grown. The Kharif-II season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Rice (Aman) is the predominant crop grown during this season due to the submergence of soils. Excessive soil moisture also restricts other crops suitable for a high temperature regime. B.Aman and High Yielding Varieties of Transplanted Aman (HYV Aman) rice are grown in Kharif-II season in the study area.

The Rabi season starts from mid November and ends in March. During this season, crops are favored with high solar radiation, low humidity and temperatures, but lacks of adequate soil moisture depresses the crop yield because of very low or even no rainfall throughout the season. Wide ranges of crops can be grown in this season. Major crops grown in this season of the study area are HYV (Boro), Pulses, Wheat, Mustard, Potato and Vegetables. However, there are occasional overlaps such that Kharif-II season crops (Aman rice) are harvested in Rabi season and Rabi season crop (Boro, Wheat, Oilseeds, Groundnut, Watermelon, Potato and vegetables) are harvested in Kharif-I season and Jute is harvested in Kharif-II season. In the study area, the practice of B Aus and Watermelon, Chili and Pulses are common especially in Char land.

Cropping Pattern (existing) and Cropping Intensity

Mainland

Both country sides (Main land), cropping pattern is defined as the sequence of crops grown in Kharif-I, Kharif-II and Rabi crops in a plot of land in any one year. In the study area, different cropping pattern in different location based on land type, soil fertility, soil texture and monsoon period are practiced. The existing major cropping patterns practiced in different land types in the study area are presented in table-3. The dominant cropping patterns in high land type of annual crops are Betel nut/leaf. In the medium highland, prominent cropping patterns are Fallow-HYV. Aman-HYV Boro. In medium lowland, the dominant cropping patterns are Fallow-HYVAman-HYVBoro. HYV Boro and Local Boro are grown as single crop in low land and very low land respectively (Table-17).

Total cropped area is about 95,233.6 ha. The single, double and triple cropped area are about 3,679.5 ha(8.5%), 52,811.4 ha (61.5%) and 38959.2 ha (29.5%) respectively and about 0.5% cultivable land remain fallow due to flood and water logging. The net cultivable area is 43,288 ha. The cropping intensity of the project is about 220 %(Table-5.59).

Table 5.59 **:** Existing major cropping pattern by land type (Main land)

Land type	**Kharif-I (March-June)**	**Khartif-II (July-Oct)**	**Rabi (Nov-Feb)**	**Area (Ha)**	**% of NCA**
F_0	Betel nut/leaf	Betel nut/leaf	Betel nut/leaf	432.9	1
Sub-total				**432.9**	**1**
F_1	Fallow	Aman(HYV)	Pulse	2,597.3	6
	Fallow	Aman(HYV)	Mustard-Boro(HYV)	1,298.6	3
	Vegetables	Aman(HYV)	Boro(HYV)	432.9	1
	Fallow	Aman(HYV)	Boro(HYV)	12,986.4	30
	Jute	Aman(HYV)	Potato	1,082.2	2.5
	Aus(HYV)	Fallow	Watermelon	865.8	2
	Aus(HYV)	Aman(HYV)	Wheat	1,731.5	4
	Aus(HYV)	Aman(HYV)	Groundnut	3,030.2	7

	Fallow	Aman(HYV)	Vegetables	1,515.1	3.5
Sub-total				**25,539.9**	**59**
F_2	Fallow	Aman(HYV)	Boro(HYV)	7,359.0	17
	Jute	B.Aman	Soyabean	1,731.5	4
	B.Aus	Aman(HYV)	Pulse	3,463.0	8
Sub-total				**12,553.5**	**29**
F_3	B.Aus	Fallow	Boro(HYV)	1,298.6	3
	Fallow	Fallow	Boro(HYV)	2,597.3	6
Sub-total				**3,895.9**	**9**
F_4	Fallow	Fallow	Boro (local)	649.3	1.5
	Fallow	Fallow	Fallow	216.4	0.5
Sub-total				**865.8**	**2**
Total				**43,288**	**100**
Cropping Intensity (%)				**220**	

Source: Field survey'2015 and secondary data from Upazila Agricultural Offices of the study area.

Cropping Pattern (existing) and Cropping Intensity

Char land

In char land, cropping pattern is defined as the sequence of crops grown in Kharif-I, Kharif-II and Rabi crops in a plot of land in any one year. In char land area, different cropping pattern in different location. The dominant cropping patterns in char lands are B.Aus-Fallow-Watermelon.

Total cropped area in char land is about 19,180 ha. The single, double and triple cropped area are about 956.0(5%)ha 8,631.0(45%)ha and 3,836 (20%)ha respectively. The net cultivable area is 19,180 ha. The cropping intensity of the char area is about 155 %(Table5.60).

Table 5.60**:** Existing cropping Patterns in Char area

Kharif-I(March-June)	Khartif-II(July-Oct)	Rabi(Nov-Feb)	Area (Ha)	% of NCA
Aus (HYV)	HYVAman	Chili	3,836	20
B.Aus	Fallow	Watermelon	5,178.6	27
Fallow	Aman (Local)	Maize	3,452.4	18
Fallow	Fallow	HYV(Boro)	959	5
Fallow	Fallow	Fallow	5,754	30
Total			**19,180**	**100**
Cropping Intensity (%)			**155**	

Source: IWM field survey, 2015 and secondary data from Upazila Agricultural Offices of the study area.

Cropped Area

Mainland

Total cropped area is 95,233.6 ha of which 74,238.94ha is under rice crop and non-rice crop is about 20,994.7 ha. About 78% and 22% cropped area are covered with rice and non-rice crop respectively. Among the rice crops, Aus, Aman and Boro are covered about 14%, 50% and 35.9% respectively. About 90.4% of the area is occupied by high yielding varietiesand about 9.6% area is covered by local varieties of rice crop. The non-rice crops include Jute, Pulses, wheat, Potato, Mustard, Soybean, watermelon, groundnut, betel leaf/nut and Vegetables etc.

Char land

Total cropped area is 29,729ha of which 17,262ha is under rice crop and non-rice crop is about 12,467 ha. About 58.1 % cropped area is covered with rice crop. Among the rice crops, Aus, Aman and Aman are covered about 52.2 %, 42.2 % and 5.6% respectively. About 41.9% of the area is occupied by non- rice crop. The non-rice crops include Chili, maize, watermelon etc.

Crop production

The total crop production has calculated on the basis of damage-free area and damaged area. In the damage-free area, the normal yield of crops has considered. In the damaged area, damaged yield against the damaged area has considered. This may be expressed as: *Total crop production = damage free area × normal yield -+ damaged area x damaged yield. There is no main agriculture crop considering production in the study area.*

a) **Main Land:** The total annual crop production is about 281,685.6metric tons of which rice production is about 158,650.5metric tons and non-rice production is about 123,035.1metric tons. Among the rice crops, (HYV Boro, localBoro, B.Aman, HYV Aman, B.Ausand HYV Aus) are contributing about 56.3%, and non-rice43.7% of the total production.

Crop Damage

Main land

Crop production loss has been calculated using the formula: *Crop production loss = Total cropped area × normal yield - (damaged area ×damaged yield+ damage-free area × normal yield).*Total loss of cleaned rice production is about 27,682.7 metric tons in 19,458 ha of land and total non-rice production loss is about 532.5 metric tons in 541.1 ha of land

6 SOCIOECONOMIC BASELINE

This section provides an overview of demographic trends, sources of livelihood, land use, agriculture, fisheries, public health, communications, social infrastructure, gender issues, cultural resources, demand for dredged material, and other relevant issues. The study route has been divided in terms of the river route and launch terminals, proposed 06 storm vessel shelters and 03 ferry crossing routes. The river routes include Dhaka and surrounding to Bhairab Bazaar, Chandpur, Barisal and to Chittagong. Dhaka and Chittagong are the major urban centers for business development, urbanization, export-import and industrialization of the country. Shadarghat, Bhairab, Ashuganj and Chandpur are the most important and busiest business and river transport routes of the country. The baseline information indicates that regions nearer to the main land enjoy better privilege in terms of education and medical services, employment opportunity and other advantages. On the other hand, some Char and Islands in the coastal area along the proposed river routes are still facing lack of basic civic amenities i.e. education, health services, electricity, road communication, gas connection, etc. This is an obstacle to industrialization of these regions. This section will scrutinize baseline information of project area more elaborately. The Table 6.1 below presents the total sample population (2793) from the study area with average HH size (4.77) and sex ratio.

Table 6.1: Sample population, HH information and sex ratio;

HH	Population						Ave. HH size	Sex ratio
	Male		Female		Total			
No.	No.	%	No.	%	No.	%		
585	1529	54.74	1264	45.26	2793	100	4.77	121:100

Source: ESIA study, September-October 2015;

6.1 Overview of the project

The Dhaka-Chittagong inland waterway has been used as a vital river way for many decades. At present, the people of this area are fundamentally using this river route for their necessity. But the present condition is very pitiable of this overall route. That is the genesis of this project for improvement of navigation and river route simultaneously. And time has come to modify it to keep pace with the many other transportations of our country. The interior issue is how to develop the river way and it is one of the claims of all walks of people of this region. If the proposed river way project is implemented, the people can get a positive touch to adjust their lives and livelihoods in pace with this developing world. Now-a-days a large number of people is traveling throughout the country by river way.

Not only human being but also a massive numbers of raw materials and other goods are transported from one place to another. For example Ashuganj, Mozu Chaudhuri Ghat etc. play a major role in transporting structure materials and receiving international merchandise. People are using boats (without engine), launches, trawlers, steamers, ships etc. to maintain the daily necessaries. There are many types of vessels in terms of size. River transport related workers basically the people of this area, launch captain, local BIWTA officials and people of the passenger terminals warmly received the project. They also advised the project to include river traffic system by inclusive development of signaling across the river routes to reduce hazards across the routes, reduce accidents, save time and improve security across river routes. Some ghats contain the commercial importance in the perspective of transforming goods and raw materials. Here carries the most important ghats are Shadarghat, Chaudhuri Ghat, Munshigang Sadar launch ghat, Chandpur Sadar launch ghat etc. After implementation the proposition of the business will run in a very smooth way. And mass people will enjoy a safe journey throughout the river way and total length of way will decrease after proper dredging and completion of the project.

On the other hand, some people especially those who are students and office staff of government and non-government sectors and tourists; they are entertaining by travelling through river. They seem that travelling through river route is comparatively safe, cheap and way of proper refreshment and amusement. And people are coming to take the real taste of travelling through the river way. The people basically riverside people can easily use almost cent percent of the river related transports in some specific area of proposed river way. People who are very enthusiastic to travel one place to another can get a proper river related transport services through the proposed routes. At present Boro Station Mul Head (Dakatia Mohana) is a tourist spot and it would be more attractive spot after modifying the transport system. It is hoped that a large number of people will satisfy their recreational demand to visit the spot.

River side population along the project routes face river erosion, flood or other natural disasters that damage their lives, assets, domestic animals, vegetables, residences, business structure etc. For this reason, they face a lot of financial losses more or less every year through all over the proposed river area. Some fishermen suspected that it is an oversize construction especially in the proposed vessel shelters and they will not get sufficient fishes after finishing the project intervention. Because, reverberation hampers the flow of all type of fishes and it would be affecting these people in the long run. Nevertheless, all of the survey and consultation participants opined that when improvement of the proposed river route is done, more or less people of this locale will be benefitted with many facilities. For example they can easily travel, will reduce the time of travelling and will get many opportunities in technological advancement. As a result, 100% of the population is looking forward to the project as a key to their socio-economic development.

6.2 Demography

Demography is the scientific study of the number of population, especially with reference of their size, structure, sex distribution, population density, literacy rate etc. The core point is the 10 Districts basically the people of specific 17 Upazilas (Sub-district), through which the project will pass through. Here the number of population is given along with some major related topics which are very relevant to demography.

Dhaka, the capital of Bangladesh is the largest city in Bangladesh and highest densely populated which has experienced an extremely rapid population growth after the independence, from only 1.6 million in 1974 to about 15.4 million in 2011. Dhaka grew strongly between 2001 and 2011 and is by far the most densely populated urban area in the world. Dhaka's density is estimated at 115,000 per square mile or 44,000 per square kilometer, with slum (informal dwelling) densities reported as 4,210 per acre, or 2.7 million per square mile (1 million per square kilometer). At this density, all of the world's 3.7 billion urban residents could be accommodated in an area approximately equal to that of the Washington (DC-MD-VA) urban area. All of Dhaka's urban population of 15.4 million fits into a land area equal to that of the city (municipality) of Portland (population less than 600,000). Nonetheless, analysts have referred to this example of the ultimate of urban density to be “sprawling”.

Although only the southern part; near the launch terminals will be included as project sites and area of influence, as no discrete information were found from secondary sources for the southern part, the demographic information demonstrates information on the whole metropolitan.

Again, the number of population of Keranigong Upazila is 794,360 and it is the highest in the perspective of Upazilas in study area. On the other hand, Monpura Upazila of Bhola District carries the lowest number of population that is 17,080. Population density is the highest and lowest respectively in Dhaka (30551) and Monpura (205). The average household size is plus or minus 4.72 except Dhaka Metropolitan. The largest household size is 8.42 in Dhaka Metropolitan. Again, Tozumuddin and Keranigong Upazilas carry the 4.42 house hold size. These two Upazilas are the lowest number of house hold size in the total study area. It indicates that Dhaka city being the capital; people from all parts of the country migrate to Dhaka in search of employment, education and all other facilities. The city is growing at a rate of 6% every year. On the contrary Monpura and other char Upazilas offer less opportunity and people migrate out of these places to area with better opportunity. The project might play a role in decentralizing some facilities to some remote river surrounded areas with better communication and transport opportunity.

The percentage of male is the highest and lowest in respectively Keranigong (113) and Sandwip (86) in Chittagong. Among the ten districts, literacy is top in Dhaka (74.6) and Barisal Sadar Upazila that is 69.3% and the bottom Upazila is Monpura under Bhola District that is 32.1%.

The social study team has identified and surveyed for baseline information in 26 adjacent sites throughout the proposed river route and the consultation team has conducted 24 community level stakeholder consultation meetings. The team has not come across any small ethnic community to be noted as indigenous population. Therefore, the World Bank policy OP 4.10 will not be triggered in this project. Nevertheless, further studies will be carried out prior and during implementation of the project.. Table 6.2 underneath demonstrates some key demographic information and literacy rates across impact Upazilas based on secondary sources (BBS, GOB Web portal, etc).

Table 6.2: Demographic information and literacy rates across proposed route

District	Upazila	Population	HH size	Sex ratio	Population density	Literacy rate
Kishoreganj	Bhairab	298309	5.01	97	2141	42.7%
Narsingdi	Roypura	535796	4.82	94	1713	40.5%
B.baria	Ashuganj	180000	5.37	96	2673	51.2%
Dhaka	Metropolitan	8906039	8.42	125	30551	74.6%
	Keraniganj	794360	4.42	113	4760	58.5%
Chandpur	Chadpur Sadar	465919	4.69	95	1509	56.1%
	Haimchar	109575	4.43	96	817	48.1%
	Matlab South	210050	4.6	87	1624	56.7%
	Matlab North	292053	4.6	93	1122	54.4%
Laksmipur	Laksmipur Sadar	684000	4.71	91	1425	51.9%
Noakhali	Hatiya	453000	4.98	98	300	34.2%
Bhola	Bhola Sadar	430520	4.85	99	1042	45.2%
	Doulatkha	168537	4.86	98	532	41.6%
	Tojumuddin	126940	4.42	105	247	42.9%
	Monpura	17080	4.48	102	205	32.1%
Chittagong	Sandwip	278605	4.9	86	365	51.5%
Barishal	Barishal Sadar	198739	4.49	97	1625	69.3%

(Source: Bangladesh Government Web Portal)

The Table 6.3 represents age-sex distribution of the sample population. It indicates that majority of the respondents are in the age group of 5-24. The number of population below the age of 04 and more than 60 years of age is very low compared to the other age groups. Percentage of female population is 45.26%.

Table 6.3: Age-sex distribution of sample population;

Age Group	**Male**	%	**Female**	%	**Total**	%
Up to 4	113	4.05	96	3.44	209	7.48
5 to 14	322	11.53	293	10.49	615	22.02
15 to 24	319	11.42	236	8.45	555	19.87
25 to 34	247	8.84	175	6.27	422	15.11
35 to 44	162	5.80	183	6.55	345	12.35
45 to 59	218	7.81	183	6.55	401	14.36
60 & above	148	5.30	98	3.51	246	8.81
Total	1529	54.74	1264	45.26	2793	100.00

Source: ESIA study September-October 2015;

Marital status of the sample population has been furnished in Table 6.4 below. It indicates that married population is more than the unmarried population. The percentage of unmarried men is higher than unmarried women. The number of widows is high compared to the abandoned or divorced population.

Table 6.4: Marital status of sample population;

Marital Status	Male	%	Female		Total	%
Married	715	25.60	722	25.85	1437	51.45
Unmarried	803	28.75	499	17.87	1302	46.62
Widow/widower	8	0.29	35	1.25	43	1.54
Abandoned	3	0.11	7	0.25	10	0.36
Divorced	0	0.00	1	0.04	1	0.04
Total	1529	54.74	1264	45.26	2793	100.00

Source: ESIA study September-October 2015;

Table 6.5: Religious distribution of the population;

Religion	%
Islam	97.61
Hinduism	2.39
Total	100

Table 6.5 describes religious distribution of the sample population. Large majority of the population are followers of Muslim religion. A few Hindu participants were found among the respondents. But no small ethnic community was identified during the study.

Education level of the sample population is lower than that of the advanced area of Bangladesh. Only 0.45% of the sampled population found post graduate whereas 1.49% of the people obtained graduation degree. More than 25% of the people read up to class four. Among the total population male are more educated than female as there is religious and social obstacles in free movement of the female students. Yet, dropout rate is high especially in case of female students. The

Table 6.6 below shows a decreasing tendency of the female students compared to male.

Table 6.6: Education level of population;

Education level	**Male**	**Female**	**Total**
	%	%	%
Up to Class 4	12.92	12.88	25.81
Primary School Certificates (PCS)	7.80	6.85	14.66
Six to Seven	5.41	5.12	10.53
Junior School Certificate (JSC)	4.75	3.67	8.42
Nine to Ten	3.88	2.73	6.61
Secondary School Certificate (SSC)	3.14	1.73	4.87
Higher Secondary School Certificate (HSC_	2.52	1.03	3.55
Bachelor of Arts (BA)	1.11	0.37	1.49

Masters of Arts (MA)	0.33	0.12	0.45
Higher Education/Advanced Degree/PhD	0.17	0.04	0.21
Hafez-E Quran	0.41	0.00	0.41
Can sign only	6.40	5.37	11.77
Illiterate	6.32	4.91	11.23
Total	55.16	44.84	100.00

Source: ESIA study September-October 2015;

6.3 Livelihood Sources in various locations

Livelihood means a supporting of one's existence, especially in terms of financial support. It encompasses people's capability, assets, income, etc. Most of the people near river side depend on their sources of livelihood by river correlated activities. In most cases businessmen, ferry ghat users, passengers, vessel operators will get benefit from the developed ferry terminals/launch ghats. The people living in the surrounded areas of the ferry ghat and launch terminals are also dependent on the ghats for their daily livelihoods. Livelihood sources of the various categories of people in various Ghats/terminals are described below-

Shadarghat (in Dhaka); It provides livelihood support to about 300-400 boatmen, who are depending on river related transports. There are also a large number of laborers in this ghat those who are working hard heartedly. Here the major sources of livelihood are carrying people and goods by boat, day laboring, selling of vegetables and other raw materials, selling clothes, rickshaw or van pulling, whole and retail selling of fruits, begging, etc. Most of the laborers are male and a few are female particularly small traders, vegetable sellers and beggars. More or less all types of daily necessaries are available in this populous and busy ghat. There is a huge number of hotel and/ or restaurant in this ghat area. People are leading their livelihoods from various sources in this ghat.

Aganagar ghat: On the opposite side of Shadarghat, the Aganagar ghat is located where there is a little mark of terminals or ghat. People of this area usually cross the river by boat and they carry local handicrafts to a greater extent. The people of Zinzira (where there are full of small-scale industries) are using this ghat for crossing the Buriganga river to go to Dhaka city. Again, the ghat of Keraniganj (Aganagar) has developed employment opportunities for various categories of people including male and female.

Munshiganj Sadar launch ghat: A large number of people are engaged in Munshiganj Sadar launch ghat as small and medium businessmen, mobile vendors, day labourers, etc.. Again fruits and vegetables sellers and other business men are leading their livelihood at Munshiganj Sadar launch ghat. There has been a possibility to generate more livelihoods for particular labour groups and floating labourers.

Bhairab Bazar Launch Ghat: There is a big market at Bhairab Bazar launch ghat where there are about 700 business units/shops in the nearby area of this ghat. A huge number of people (more or less 10, 000) cross the river through this ghat for their daily livelihood including business, job, day laboring, etc.

Ashuganj Ghat: The Ashuganj ghat is now playing a major role as international transit route and cargo terminl for transporting materials from India and other various districts of Bangladesh especially Sylhet regions. There are thousands of large, medium and small scale business enterprises at or near Ashuganj ghat. Boatmen, water vessel workers, small traders, sand businessmen, daily wage laborers, etc. are earning livelihoods from the ghat areas,

Harina ferry ghat: At Harina ferry ghat, approximately 500 fishermen are leading their lives by catching fishes from the river traditionally. Apart from this, small traders, vendors, wage laborers are also leading their livelihood from the Harina ferry ghat area.

Chairman ghat: At Chairman ghat (Boyar char) and sounding area there are about 15000-20000 fishermen who are directly or indirectly dependent on the launch ghat at Chairman ghat. The most interesting and important issue is that the highest numbers of fishermen earning livelihoods from the river at or near the Chairman Ghat all along the proposed river routes.

Chandpur Sadar launch ghat: A large market is established at Chandpur Sadar launch ghat area with some businesses units of vegetables, fishes, fruits and other necessary goods. There are more or less 1,000 shops are located here. These goods especially vegetables are mostly brought by boat from adjacent Chars.

Mozu Choudhuri ghat: Mozu Choudhuri ghat itself has 500-600 shops focusing on the inbounds and transport facilities of the ghat. Therefore, developing the terminals by extending its capacity and efficiency will directly enhance local economy in each case. There are 600-700 shops according to field survey result of the social survey team at Harina. But it is very needed to extend more shops to facilitate the local large population. So a number of people can clear up their occupation as shopkeeper and other related business.

Dakatia Mohana at Chandpur Sadar is a recognised tourist spot at present and has a glorious future for the local people, labourers, entrepreneurs and the small traders for livelihood. The river-based Chandpur provides livelihood to a large number of peoples as fishermen, fish sellers, vegetables vendors etc. The people who are living in the bank of river all over the route are collecting fishes as the sources of livelihood. Some boatmen are running their occupation as '*majhi*'.

The beneath table shows that 16.31%of total population of Dhaka, Munshigong, Gagaria and Chandpur launch route are business men, 5.70% are catching fishes, 8.21% are working as day labour, 1.14% operating boat (boatman) etc. The major issue is that about 8.67% people are more or less unemployed. It is mentionable that there are also all types of common professions are available here. And like to the vessel shelters locations, here women are mostly housewives (33.87%).

The table represents findings on proposed vessel shelter spots indicating that 13.22% people are leading their livelihood by business, 1.99% by rickshaw or van puller, 7.25% by catching fishes (fisherman), of them 0.54% are female in six proposed vessel shelters. The most interesting issue is that almost all of the sampled female population (33.15%) are housewife in nearby location of the proposed storm vessels shelters except 0.18% teacher and 0.54% fishermen.

Table 6.7 refers that 19.23% of the sampled population are businessmen, 7.07% are rickshaw or van pullers, 1.11% are boatmen, 7.22% are fishermen and many other common occupational groups in and around ferry ghats. There are also 34.07% women are housewife which is very similar to the vessel shelters and launch route. It is mentionable that 8.89% of people are unemployed in the spots.

Table 6.7: Primary Occupation across proposed project route;

Occupation	Rivet Route & launch terminals			06 vessel shelters			Ferry Crossing Route		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Agriculture	1.03	0.11	1.14	4.53	0.00	4.53	3.70	0.00	3.70
Teacher	0.11	0.23	0.34	0.18	0.18	0.36	0.37	0.00	0.37
Overseas jobs	0.68	0.00	0.68	0.54	0.00	0.54	0.74	0.00	0.74
Service	3.08	0.23	3.31	2.54	0.00	2.54	2.59	0.19	2.78
Housewife	0.00	33.87	33.87	0.00	33.15	33.15	0.00	34.07	34.07
Fisherman	5.70	0.00	5.70	6.70	0.54	7.25	7.22	0.00	7.22
Business	15.51	0.80	16.31	11.78	0.00	11.78	19.26	0.00	19.26
Day Labor	7.98	0.23	8.21	3.44	0.00	3.44	2.04	0.37	2.41
Driver	1.60	0.00	1.60	2.17	0.00	2.17	0.56	0.00	0.56
Mason	0.23	0.00	0.23	0.18	0.00	0.18	0.37	0.00	0.37
Carpenter	0.23	0.00	0.23	0.72	0.00	0.72	0.19	0.00	0.19
Unemployed	6.27	2.39	8.67	5.80	1.81	7.61	7.41	1.48	8.89
Tailor	0.11	0.00	0.11	0.18	0.00	0.18			
Doctor	0.11	0.00	0.11	-	-	-			
Herbalists	0.00	0.11	0.11	-	-	-			
Boatman	1.14	0.00	1.14	2.17	0.00	2.17	1.11	0.00	1.11
Student	7.30	3.42	10.72	7.79	5.43	13.22	7.96	2.78	10.74
Rickshaw/Van Puller	1.25	0.11	1.37	1.81	0.18	1.99	3.52	3.52	7.04
Aged People	2.05	2.96	5.02	3.08	4.71	7.79			
Servant	0.34	0.23	0.57	-	-	-			
Shoemaker	0.11	0.00	0.11	-	-	-			
Mechanic	0.23	0.00	0.23	-	-	-	0.19	0.00	0.19
Launch Master	0.23	0.00	0.23	-	-	-			
Barber	-	-	-	0.36	0.00	0.36	0.37	0.00	0.37
Total	55.30	44.70	100.00	53.99	46.01	100.00	57.59	42.41	100.00

(Source: ESIA study, September-October 2015)

The income and expenditure are very closely related to well being of the population. If the expenditure is more than one's income, he or she will fall in the trap of poverty. Here, it is noticeable that the income should be in a standard figure to match the way of life. Table 6.8 beneath demonstrates that the yearly expenditure is more than the income of this locale people in specially six proposed vessel shelters. So it would be a common phenomenon that the poverty level will be high if the interrelated other query are firmed. It is due to dependency of the people on the agriculture in most cases and fishing. There are no other alternative major sources of income as reported. Therefore, people living along the river cannot come out of the poverty circle. According to BBS, lower poverty line is considered to be BDT 60,000 per year. The study represents that the incidence of poverty is higher among river route compared to the vessel shelter and ferry route locations.

Table 6.8: Yearly Income and expenditure level of households through the route;

River route and Launch Ghats				
Income and expenditure Ranges (Yearly)	**Yearly Income**		**Yearly expenditure**	
	No.	**%**	**No.**	**%**
Up to 60,000	16	5.95	18	6.69
60,001 – 90000	30	11.15	38	14.13
90001-120,000	59	21.93	71	26.39
Above 120,000	164	60.97	142	52.79
Total	269	100.00	269	100.00
06 Vessel Shelters				
Income and expenditure Ranges (Yearly)	**Yearly Income**		**Yearly expenditure**	
	No.	**%**	**No.**	**%**
Up to 60,000	4	2.42	6	3.64
60,001 – 90000	22	13.33	29	17.58
90001-120,000	39	23.64	51	30.91
Above 120,000	100	60.61	79	47.88
Total	165	100.00	165	100.00
Ferry crossing				
Income and expenditure Ranges (Yearly)	**Yearly Income**		**Yearly expenditure**	
	No.	**%**	**No.**	**%**
Up to 60,000	3	1.99	6	3.97
60,001 – 90000	12	7.95	22	14.57
90001-120,000	45	29.80	50	33.11
Above 120,000	91	60.26	73	48.34
Total	151	100.00	151	100.00

(Source: ESIA study, September-October 2015)

6.4 Land use

Dhaka to Chittagong river route used the land of government from the very beginning of its origin. As a result, ghats, terminals, jetties etc. are all established on government land mostly

BIWTA or DC Khash land. The proposed 06 vessel shelters are also planned to be constructed mostly on public land to avoid private land acquisition, displacement, etc. and any other negative impacts on the community/ population at or near project sites. Yet, extension of launch and ferry terminals may imply some land acquisition. The project will consider all possible options to avoid, minimize and mitigate resettlement impacts. For the situation, where impact on land, structure, trees or any other properties irrespective of title to the land is unavoidable, a resettlement action plan will be prepared following the World Bank operation policy (OP) 4.12 and GoB land acquisition (LA) law which has been described in the resettlement policy matrix of the RPF of the project.

Land use pattern adjacent to the river route has two different scenarios for rural and urban sites. Terminals are established in urban or semi urban areas that have developed the Ghat areas as commercial centers of the region with shops and markets. These terminals generate sources of livelihoods for thousands of HHs. On the contrary, the terminals in rural regions with minimal transportation facilities are mostly surrounded by fellow land, cultivable land, ponds, ditches and canals. For example, Doulotkhan (Bhola), Sandwip, Tojumuddin, Laharhat, etc. have fewer shops and commercial entities compared to other terminals. Almost 65% of the private lands around the Ferry Ghats a Launch Ghats are found to be used for agricultural production.

Land ownership pattern has been identified during field level survey. Table 6.9 indicates that majority of the participants use their land for mostly commercial purpose. Other than land owners, majority of the participants are using GoB land for business and other purposes.

Table 6.9: Land ownership pattern;

Land ownership pattern	River route	06 vessel shelters	Ferry crossing
	%	%	%
Owner of land	70.26	80.61	94.70
Structure Owner with land	0.00	1.21	0.00
Sharecroppers	0.74	0.61	0.66
Lessee	7.06	1.82	1.99
Non-Titled (Squatters)	21.93	15.76	2.65
Total	100	100.00	100.00

(Source: ESIA study, September-October 2015)

6.5 Fisheries

The population of Bangladesh depends on wild fish for food and the generation of income. A large portion rural family are engaged in part time fish capture from the rivers and beels. Until 70s, there was an abundance of fish in the natural waters of the country to well-satisfy the demand. In recent years, however, capture fish production has declined to about 50%, with a negative trend of 1.24 % per year (Ahmed, 1995). In spite of these in 2013-14, Bangladesh has produced 3548115 MT fish of which 83.22% and 16.78% comes from inland and marine fisheries respectively (FRSS, 2015).

Fishermen comprise a major portion of the inhabitants by the riverside in this project area. They catch fish all the year round. Although they have some modes of established system of their product transportation, this project will add a new dimension in the fish trade as it will develop the navigation as well as port management through vessel shelter construction. However, agriculture (excessive removal of surface water and abstraction of groundwater for irrigation), pollution (domestic and industrial), and unregulated discharge of untreated industrial and farm effluents, habitat destruction also have significant impact, as does the regular over flooding and lack of flooding rain in the last few decades (Hossain, 2014).

The present study has identified an ethnic community named *Bede* in Dakatia river (a tributary of Meghna river in Chandpur). They are living here for round 100-150 years following their ancestors. Their daily income is about 300-500 BDT. Their main occupations are fish capture and selling. No proper sanitation system has been developed for them. Their children get no schooling facility. They drink river water by mixing with Alum. There is several floating net culture's evidence in the Dakatia river. Though it is under culture practice, some people are still making money out of it. Tilapia and carp species are mainly cultured in this system.

In Horinaghat, fishermen stated that, they usually eat the small fishes (Bacha, Dain etc.) of the net and sell the big fishes (Hilsa, Pangus etc.). Another important living source among the fishing communities is the net sewing. A consultation meeting with local residents of Choumohuni, Barisal revealed that, if vessel shelter is made here, a lot of people will earn money for their livelihood and will contribute in this area's economic status. Most of the fishermen near this area are in debt from different loan providers (ASA, Grameen Bank, BRAC, Podokkhep etc). This same situation was observed in Daulatkhan, Bhola where some families were recorded to leave their home and fishing boat to escape from the loan supplier's reminder. This has become a common phenomenon in the fishermen's village. Katha fishery (a special type of fishing, practiced in Bangladesh to aggregate fish in a certain place of open water) is also a temporary subsistence option for some people around the area. This practices were quite familiar in Dakatia river, Koroitola Khal (a tributary of Kirtonkhola river, Barisal), Shitalakkha river (less common than the previous two). One of the main problems was lack of capital for buying fishing gears and craft. Most of the fishermen are Muslim in religion but Hundu are another significant group. Fishermen are engaged in fish catching in the Meghna River throughout the year. January, February, March, April are almost dry season. At that time water level was very low and riverine environment is not suitable for the growth of fish. So, during this period fish were not available (Mia *et al.*, 2015). Fishermen basically change their income source then; to labor based other works at their locality. Almost all fishermen community is disadvantaged in social capital such as the networks, groups, trust, access to institutions etc. There was poor existence of social organizations in the surveyed areas. Lack of social capital has affected socio-economic condition of poor people in fishing communities (Mia *et al.*, 2015).

The government of Bangladesh has adopted a programme to protect *jatka* in 2003-04 to ensure sustainable *Hilsa* production. By this programme, *jatka* catch, sell, carry and transport has been prohibited during 1st November to 31st May (7 months). It is not unlikely that *jatka* fishers earn their livelihood by selling jatka and they do not have any alternate source of income. That's why the government has given special importance this year for alternate sources of income for *jatka* fishermen so that they can earn their livelihoods by some other means during the 'no catch period' of *jatka*. For the rehabilitation of *jatka* fishers there was a programme named '*Jatka* Protection and Jatka Fishers Rehabilitation Programe'. A total of Tk.2.00 crores/year has been allocated for rehabilitation of *jatka* fishermen during the years 2008-2010. Beside this programme a project named "*Jatka* Conservation, Alternate Income Generation for the *Jatka* Fishers and Research Project" has been implemented within jatka available and sanctuary surrounding upazilas for giving alternate income generation activities during the ban period. As this rehabilitation programme was implemented and it helped their livelihood, this made it comparatively easy to keep the fishermen away from catching jatka. This project covers 21 upazilas of 4 districts. Through this project the Government has allocated 10,000 Tk for each *jatka* fisheries to maintain their family during the *jatka* catch ban period since the project started.

The Government initiated to help the fishers affected by *Hilsa* ban which includes rice provision through VGF (vulnerable group feeding) per household for four months during the ban period in order to mitigate the sufferings of the fishermen. This programme has started since 2004-05. Programme has covered 85 upazilas of 15 districts for each year (Ahsan *et al*., 2014).

According to Mondal et al. (2013) in Lakshmipur (Ramgati upazilla) of Lower Meghna a total of 82% of fishermen are professional and 18% are seasonal where 25500 fishermen in this area are dependent on the riverine fish for their livelihood and protein supply. The study also states that, two types of fish marketing channel exist in the study area. In first type (84%) involving fishermen to directly consumers and 2nd type (16%) involving three intermediaries (*aratdar*, wholesaler and retailer). During the peak season, the monthly incomes of fishermen were adequate and the range was 5000 to 30000 BDT. But during the lean period their income became low and even zero. 80% fishermen are fishing with boats (Consider as one unit) and the rest without boats. This underprivileged group of people of our society is the basement of our national protein demand.

6.6 Public Health

According to investigation, partial places of the project influenced area are rural areas whilst some are towns. Sanitary conditions in towns are good. Residents drink tap water and live in good houses. Sanitation and epidemic prevention achieve good effects. People are in good health status. However, sanitary conditions in rural area are much poorer than that in towns. Collective water supply is realized only in some towns. Most rural residents drink water in the well. Due to limitation of sanitary conditions and impact of living habits, drinking water quality is hard to be ensured.

The main water related diseases in the project influence area include dysentery, hepatitis, typhoid, paratyphoid fever and arsenicosis etc.

Dysentery- Dysentery is featured with bacillary dysentery. The patients and carriers are sources of infection. Disease germ is excreted to the outside of the body with the feces of the patients. Hand touch and mouth infection through drinking water lead to occurrence of disease. The peak is in summer and winter. It often occurs in areas with poor sanitary conditions.

Hepatitis- Hepatitis has many types. Hepatitis B is infected through blood and daily contact while hepatitis A is infected through mouth. Hepatitis A easily causes outbreak. (Outbreak means that three persons are infected in a unit). Such disease seldom occurs in evaluation area.

Typhoid fever and paratyphoid- Healthy carriers, drinking water and food that are polluted by soil of the patients are infection resources of typhoid fever and paratyphoid. The diseases come on when people drink and eat the polluted water and food. Typhoid fever often occurs in the project area. This disease can be controlled through vaccination. Paratyphoid, similar to typhoid fever, is not so serious.

Arsenicosis- Arsenicosis is caused by exposure over a period of time to arsenic in drinking water. Arsenic contamination in water may also be due to industrial processes such as those involved in mining, metal refining, and timber treatment. Drinking arsenic-rich water over a long period results in various health effects including skin problems (such as color changes on the skin, and hard patches on the palms and soles of the feet), skin cancer, cancers of the bladder, kidney and lung, and diseases of the blood vessels of the legs and feet, and possibly also diabetes, high blood pressure and reproductive disorders.

Survey on 269 respondents in the project influence area revealed that 74.35 percent is sought treatment from the drug store attendants who are trained healers and 8.55 percent received treatment from private clinic while 7.43 percent took it from government hospital for the normal disease (Table 6.10). On the other hand, in case of critical disease, most of them received treatment from government hospital and upazila health complex which are 76.95 percent and 18.22 percent respectively (Table 6.11).

Table 6.10: Health seeking behavior in case of normal diseases

Health Service providing institutions	No. of People Reported	Percent (%) of People Reported
Government Hospital	20	7.43
Upazila Health Complex	15	5.58
Private clinic	23	8.55
Rural Dispensary	200	74.35
Family welfare centre	5	1.86
Community Clinic	6	2.23
Total	269	100.00

Table 6.11: Health seeking behavior in case of critical diseases

Name of Health Service providing institutions	No. of People Reported	Percent (%) of People Reported
Government Hospital	207	76.95
Upazila Health Complex	49	18.22
Private clinic	8	2.97
Rural Dispensary	3	1.12
Family welfare centre	2	0.74
Community Clinic	0	0.00
Total	269	100.00

6.7 Communications

Currently the communication practice of BIWTA is to circulate information through websites and stakeholder's consultation at field level. BIWTA also publishes all necessary documents in print media. The main stakeholders of BIWTA are dredging community, traders, owners of ships and cargos and port authorities.

The purpose of this project is to effectively operate Dhaka-Chittagong Inland Water Transport Corridor by establishing water structures and dredging the river channels to popularise water transportation in the country with a view to cut pressure on road and rail communications.

It is recognised that to achieve this outcome, a broad range of potential audience groups are required to be targeted, each with differing communication activities and approaches. However to be effective each target audience needs to have a different communication strategy and approach. The priority audience groups have been identified for communication activities are shown in Table 6.12.

Table 6.12: The priority audience groups for communication activities

Stakeholders/Audiences	
INTERNAL	EXTRNAL
The Ministry of Shipping - BIWTA - Bangladesh Inland Water Transport Corporation (BIWTC)	**Aid Agencies and Donors** - World Bank
Project staff - Dhaka office - Local staff	**Local Government** - Upazila Parishad - Union Parishad

Stakeholders/Audiences	
INTERNAL	EXTRNAL
Government agencies - Bangladesh Water Development Board (BWDB) - Department of Agricultural Extension (DAE) - Department of Fisheries (DoF) -Department of Environment (DoE) - Land Ministry - Ministry of Commerce - Ministry of Industries - Department of Fisheries - Department of Hydrology - Chittagong Port Authority (CPA) - Mongla Port Authority (MPA) - Land Port Authority	**Local communities** - Women - Community leaders - Fishermen - Farmers - School teachers - Opinion leaders - Community-based organisations
	NGOs/Research organisations - Bangladesh Center for Advance Studies (BCAS) - Bangladesh Environmental Lawyers Association (BELA) - BRAC - Center for Sustainable Development Center for Natural Resource Studies - Coastal Area Resource Development and Management Association - Centre for Coastal Environmental Conservation - Center for Environmental and Geographic Information System (CEGIS) - Development of Biotechnology and Environmental Conservation Centre - Environment and Social Development Organisation - Wildteam - Forum of Environmental Journalists of Bangladesh
	Media - Print media (newspapers) - Broadcast Media (Television and Radio) - Online
	Development practitioners - Institute of Governance Studies (IGS) - BRAC University

	Private sector - Bangladesh Cargo Vessel Owners' Association - Bangladesh Launch Owners' Association - Bangladesh Inland Waterways Passenger Carrier Association - Dhaka Chamber of Commerce and Industry (DCC) - Federation of Bangladesh Chambers of Commerce and Industries (FBCCI)

6.8 Social Infrastructure

The project routes will navigate through 17 Upazilas of 10 districts in Bangladesh. Upazila wise existing health care facilities, educational centers have been collected from secondary sources. On the other hand, location wise distances of nearest health and educational facilities have been tabulated from survey findings. Table 6.13 underneath indicate that on an average that the communities have the benefits of having rural dispensary, community clinics and welfare centers, yet, health complex hospitals have been mostly identified further from their convenience. This distribution has developed into a trend of depending on local unauthorized medication from local pharmacies or dependency on herbal or other medication (Kabiraji, homeopathy, etc).

Table 6.13: Distance of Health Service providing institutions

Name of Health Service providing institutions	**Launch Ghat**					**Vessel Shelter**					**Ferry Ghat**				
	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total
Government Hospital	34.9	8.7	5.6	50.8	100	15.3	7.6	0.6	76.4	100	2.1	5.7	5.0	87.1	100
Upazila Health Complex	49.1	16.2	6.0	28.6	100	14.8	9.7	15.5	60.0	100	4.4	16.1	16.8	62.8	100
Private clinic	67.1	12.3	4.1	16.4	100	41.4	21.4	17.9	19.3	100	43.3	23.6	13.4	19.7	100
Rural Dispensary (RD)	95.2	4.4	0.4	0.0	100	95.7	3.1	1.2	0.0	100	97.3	2.0	0.7	0.0	100

Name of Health Service providing institutions	Launch Ghat					Vessel Shelter					Ferry Ghat				
	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total
Family welfare centre (FWC)	77.4	18.3	1.0	3.4	100	69.9	23.5	2.2	4.4	100	65.9	22.8	10.6	0.8	100
Community Clinic	81.3	17.2	1.0	0.5	100	73.5	22.0	3.0	1.5	100	55.3	39.8	4.1	0.8	100
Others	80.0	20.0	0.0	0.0	100	66.7	33.3	0.0	0.0	100	0.0	100.0	0.0	0.0	100

(Source: ESIA study, September-October 2015)

The numbers of educational institutes have been listed in the project impact Upazilas that are demonstrated in the table underneath (Table 6.14). Unfortunately no authentic list for total number of educational institutions was found in Dhaka Metropolitan city. Yet, being the capital and the most developed cities of the country, Dhaka metropolitan has uncountable number of public and private educational institutions including universities. On the other hand, the list indicates that the area has a number of primary educational institutes, with fewer colleges and not many institutions for higher education.

Table 6.14: Educational institutes;

Upazilas	Total No. primary schools	Total No. High schools	Total No. colleges	Total No. Universities	Others (Madrasas)
Bhairab	93	19	6	-	8
Roypura/Raipura	147	30	3	-	8
Ashuganj	48	13	6	-	13
Dhaka Metropolitan	Not listed				
Keraniganj	158	76	12	-	9
Chadpur Sadar	210	50	7	-	49
Haimchar	77	11	1	-	10

Upazilas	Total No. primary schools	Total No. High schools	Total No. colleges	Total No. Universities	Others (Madrasas)
Matlab South	136	30	4	-	17
Matlab North	168	37	7	-	10
Laksmipur Sadar	265	68	12	-	54
Hatiya	255	40	5	-	16
Bhola Sadar	198	65	13		177
Doulatkha	109	21	3	-	21
Tojumuddin	118	18	1	-	12
Monpura	38	7	2	-	7
Sandwip	149	32	5		19
Barishal Sadar	178	50	10	1	29

Source: Bangladesh Government Web Portal[4]

The ESIA study findings also indicate that there are quite large numbers of primary schools and other basic educational institutes at convenient locations but a few numbers of higher study institutions. It is found that primary schools are located within 1 km whereas most of the universities and colleges are beyond 5 km from their place of residence. It is reported that the inhabitants are getting more facilities when they are travelling more distance in terms of all educational institutions particularly for higher studies. Proposed navigation infrastructures distance from educational institutions is described in Table 6.15.

[4] Cited: 21.10.2015

Table 6.15: Distance of Educational Institutions;

Nam of educational and service providing institutions	Launch Ghat					Vessel Shelter					Ferry Ghat				
	Within 1 km	1 to 3 km	3 to 5 km	5 km+	Total	Within 1 km	to 3 km	to 5 km	5 km+	Total	Within 1 km	to 3 km	to 5 km	km+	Total
University	21.3	3.8	5.4	69.5	100	4.0	5.3	4.6	86.1	100	0.0	2.2	3.6	94.2	100
College	42.4	16.9	15.3	25.5	100	11.7	19.6	29.4	39.3	100	3.6	12.2	33.8	50.4	100
Secondary School	69.1	23.3	5.2	2.4	100	54.9	33.3	11.7	0.0	100	39.3	40.7	11.0	9.0	100
Primary School	94.6	5.4	0.0	0.0	100	95.1	4.3	0.6	0.0	100	90.8	8.6	0.0	0.7	100
Non-formal primary school	83.3	10.1	3.6	3.0	100	91.7	8.3	0.0	0.0	100	77.9	16.3	2.3	3.5	100
Moktob (Basic Islamic school)	89.5	9.2	1.3	0.0	100	93.4	6.6	0.0	0.0	100	88.1	11.2	0.7	0.0	100
Others	66.7	0.0	0.0	33.3	100	100.0	0.0	0.0	0.0	100	75.0	0.0	25.0	0.0	100

Source: ESIA study September-October 2015;

Safe drinking water is very necessary for all. Tube well water is highly used in study area. The highest number of sources of potable water in three components of the project is reported as tube well; such as in launch ghat (66.15%), vessel shelters (66.46) and ferry ghats (74.83%). On the other hand, 8.54% of people in vessel shelters are using river water for drinking after purification as they have limited access to the road communication and other civic amenities in most cases whereas 0.77% and 1.99% of the sampled population of launch ghat and ferry ghats are using river water for drinking. Although they are drinking river water after purification but still it is unhygienic and dangerous to health. Lsit of source of water for drinking purpose is mentioned in Table 6.16.

Table 6.16: Source of Water for drinking purpose;

Source of Water for drinking purpose in %	Dhaka, Munshigong, Gagaria, Chandpur Launch Ghat %	Vessel Shelter's Area %	Ferry Ghat %
Hand tube well	66.15	66.46	74.83
Deep Tube well	21.54	21.95	21.85
Pond	0.00	1.22	0.66
River	0.77	8.54	1.99
Supply water	8.08	1.83	0.66
Rain Water	3.46	0.00	0.00
Total	100	100.00	100.00

Source: ESIA study September-October 2015;

Water is being used for daily activities mostly for bathing, dish washing, and other household purposes. The highest numbers of households use river water (32.42%) throughout the proposed route and 57.42% in proposed vessel shelters. On the other hand, 74.83% (the highest) people use tube well water in ferry crossing routes for domestic use. All along the river routes it is common phenomenon that people are mostly dependent on the river. Although it is also reported that due government and non-government initiatives people are using tube well water for their daily activities. Source of Water for household purpose is mentioned in Table 6.17.

Table 6.17: Source of Water for household purpose;

Source of Water for household purpose in	Dhaka, Munshigong, Gagaria, Chandpur Launch Ghat (%)	Vessel Shelter's Area%	Ferry Ghat%
Hand tube well	25.57	14.84	74.83
Deep Tube well	6.39	1.94	21.85
Pond	26.48	25.16	0.66
River	32.42	57.42	1.99
Supply water	3.20	0.65	0.66
Rain Water	5.94	0.00	0.00
Total	100.00	100.00	100.00

Source: ESIA study September-October 2015;

The people of the river route area use 72.12% sanitary toilet, 12.64% use non-sanitary toilet, katcha toilet is 11.15% and open defecation is 4.09%. According to the national statistics only 3% of the people are still habituated in open defecation but in the river bank this number is a bit higher that national average. On the other hand at the Storm Vessels Shelters, 67.27% of the sampled population used sanitary toilet. Non-sanitary, Katcha and open space are used respectively 20%, 9.09% and 3.64%. Again, 67.55% people of ferry crossing route is used sanitary toilet. Non-sanitary and katcha toilet are used by 21.19% and 9.27% respectively. Here only 1.99% people use open space in terms of toilet. But overall toilet facilities in the launch and especially ferries are inadequate considering the passenger load. It is to be mentioned that the facilities need cleanliness support to maintain a hygienic condition. Types of required toylat facility is mention in Table 6.18.

Table 6.18: Type of Toilet;

Type	Dhaka-Munshiganj-Gajaria-Chandpur-river route (%)	Six Vessel Shelters (%)	Ferry crossing route (%)
Sanitary	72.12	67.27	67.55
Non-Sanitary	12.64	20.00	21.19
Katcha	11.15	9.09	9.27
Open Space	4.09	3.64	1.99
Total	100	100.00	100.00

Source: ESIA study September-October 2015;

The electricity facility of river route area is very underprivileged in the project districts. The shops, business and some other entities have managed other sources like solar panels, unauthorized electric connections, etc. Access to electricity has been illustrated below by Figure 6.1.

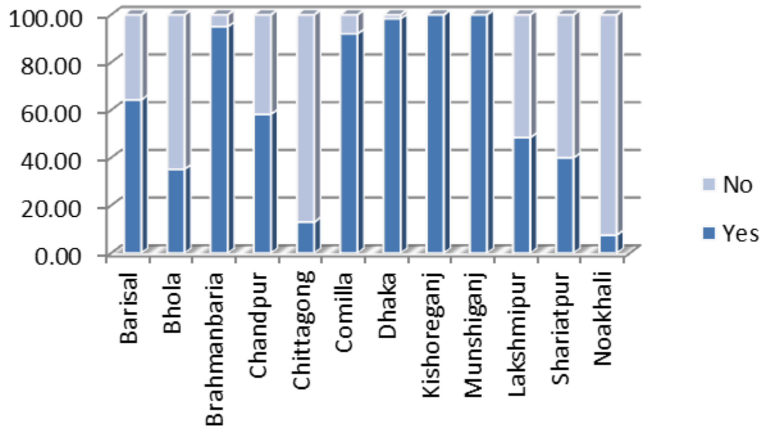


Figure 6.1: Access to electricity;

The figure represents a significant factor regarding access to electricity through the project area. It indicates that, the areas, where the project sites have been chosen from islands, access to national grid electricity is limited. On the contrary, access is better in the main land. The islands and char areas mostly rely on generators or solar panels.

The overall infrastructure of the river side area seems inadequate considering demand and activity in the surrounding. It is certain that there are immense opportunities and demand for improvement in the area.

6.9 Demand for dredged Materials

Bangladesh is a 'delta', formed by river sediments and being mostly plain land, a huge amount of sediments is delivered by the rivers that are brought by course of their travel. These sediments play a major role in cultivation and fertility of our land, but increasing amount of sediments cause barrier to navigation system through the rivers. Dredging is a key focus of this project to improve river navigation and therefore, dredging is very important for river related transport all over the route. In terms of previous knowledge of the respondents, they have experienced waste of previous dredging kept on the river bank or river side chars/cropping field. And finally it took place in the river during rainy season or caused river erosion in preceding places and also causes lack of fertility of land. Therefore, the first choices to the dredge materials have been to take them away from river. As means of keeping the spoil from the river bank, the first choice has been to sale the spoil sediments to willing buyers. In some sites near to polders, the participants advised to use the dredge spoils for maintenance and increasing heights of polders. Some suggested increasing heights of yard of community properties like school Eidgah, etc. During field study, the respondents near Dhaka, especially Shadarghat and Jinjira opined that the river bed is fully contaminated therefore dredged material near shadarghat in Buriganga river is not usable. They are not interested to buy the dredged materials at this location. On the other hand, dredged material from Ashuganj, Bhairab, Homna, Raipura and further downstream are very much welcomed by the sand traders. The local sand traders are willing to buy dredged materials. Apart from this, local people have also demand for the dredged materials for their community use such as filling up yard of the community properties (School, Madrasah, College) and rural roads, dyke, embankment.

6.10 Gender Issues

Gender related issues across river side population through project route will be an influential focus in Social Impact Assessment for ensuring socio-economic safeguard of the attached population. Similar to many other regions of this lower middle income country, the effort of women in socio-economic development and well being of their family and surrounding is rather invisible. The sample population in this assessment study has been chosen mostly from river terminals and bordering shops and business centers, where majority are male employers or workers. On the other hand, common passengers and other female stakeholders encountered during study have been impulsive and defiant to participate in the study, which has been a major challenge to overall learning in this project. However, the current river transport systems do not have any specific facility dedicated for women. There are no separate ticket counters, waiting rooms or rest rooms for women. This has made the female passengers more dependent on road transportation. The female respondents also complained about sanitation facilities in the terminals and in water transports and expected the project to mitigate these problems. Among the total HH population of the survey, 45% were female and the survey findings have been deliberated based on their circumstances. The study findings indicate that the project sites offer minimal opportunities to women for economically active participation. In addition to that, the study also reveals that decision making role of women in the HH is negligible with only 1.03% households being headed by women.

On the contrary, better communication and transport facility may convey additional facilities and introduce more choices for their pursuit. Figure 6.2 demonstrates such opportunities according to the survey respondents. Majority of the participants believed that the project will bring more employment opportunities to women in addition to education, which will play a role in gender balance and enhance better role in business for women. Other than that, some respondents also highlighted that with better transport and communication facility, women will be able to receive better medical facility and overall situation for women will be developed.

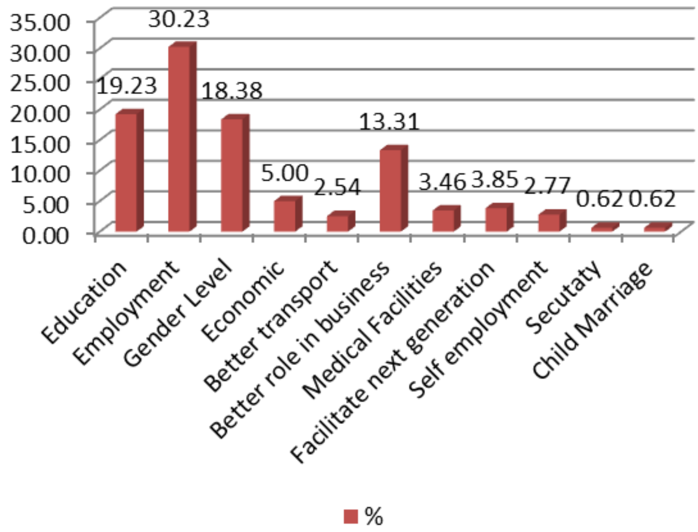


Figure 6.2: Project role in women empowerment;

The baseline information in the study area indicates that the project site lacks higher education as well as proper health service facilities. Special focus should be paid on sanitation facilities across river route. The constraint added to the women correspondents is that due to lack of transport facility, attaining service from distant sites is more inconvenient. In addition to that, Table 6.19 represents recreational preferences of various age and gender groups. It indicates that men and boys are enjoying the most of the facilities compared to women, girls and children. Again, women's movement is mostly induced by household work (by the river) and socialization (ceremonies in community centers).

Table 6.19: Recreation to different age and sex groups;

Recreational preference	Men	Women	Boys	Girls	Child
By the river	8.80	3.45	10.38	6.71	2.97
Common ground	5.00	1.55	9.71	3.77	5.58
Community centre	6.35	5.03	0.45	1.97	0.23
Club	8.03	0.26	1.81	0.29	0.10
Local Tea Stall	16.09	0.10	1.06	0.19	0.13
Total	44.28	10.38	23.41	12.93	9.00

Source: ESIA study September-October 2015;

The major limitations through project locations for women empowerment is employment opportunities to women. The business, transportation and all other opportunities are compact with male appearances. In addition to that, convenient transport facility to education facility is also a major requirement to gender balance. Some advancement in women empowerment and decision making has been noticed during ESIA study. It is presented in Figure 6.3.

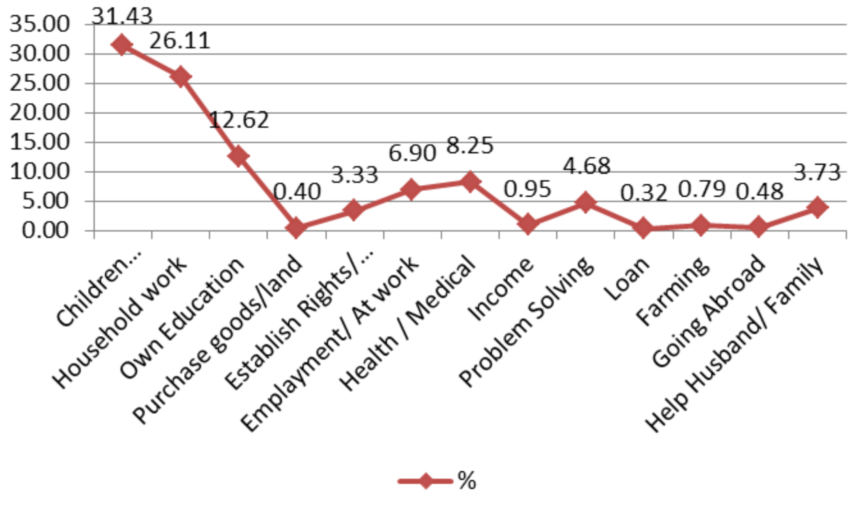


Figure 6.3: Women's' role in decision making;

The findings indicate that women enjoy the liberty of decision making about their children's study and well being, household work and their own facilities like education, medication, work, etc. to some extent.

But they have limited hold on expenditure, income, loan, moving abroad, etc external issues.

Majority of the project sites are considered remote in terms to transport and other service facilities. It can be expected that improvement of the river navigation routes and promoting transport facilities can improve overall gender balance and promote women empowerment to some extent.

6.11 Cultural Resources

Culture is one of the most important central concepts in any socio-economical issue. Basically it refers to the way of life. More than anything else, culture is that complex whole which includes knowledge, belief, arts, moral, laws and any other capabilities as a member of society. Natural sites, archaeological resources, cultural resources and historical sites carry an importance of a place.

A historical place also plays a major role to the proper development of a city. Dhaka is highly enriched to the historical places. All the districts (Chandpur, Bhola, Munshijonj, Lakshmipur, Noakhali and others) have a number of historical places. List of cultural resources/archeological places along the routes is given in Table 6.20.

Table 6.20: List of cultural resources/archeological places along the routes

Upazilas	Archaeological, cultural and historical spots
Bhairab	Syed Nazrul Islam bridge
Royapura/raipura	Panthaosala
Ashuganj	Ashugong fertilizer company limited, Bank of Meghna river
Metropolitan	No information
Keraniganj	Bashundhara park, Dhaleswari river
Chandpur Sadar	Chowdhury Bari
Haimchar	Bank of Meghna river(old college)
Matlab South	Boalia Jamider Bari, Dhonagoda river
Matlab North	Satnal tourist spot
Laksmipur Sadar	Dalan bazar Jamidar Bari, Charmanasha hawa park
Hatiya	Nijhum Dwip (island) is one of the most important tourist spots of the country. Sun rise and sun set can be viewed from the vast extended sea beaches located on the southern and western extremities of the island. Kazir Bazar, Surjomukhi are also another tourist spots
Bhola Sadar	Birsrasto Mostafa Kamal Museum
Doulatkhan	Bangla Bazar Hatam Khanom Complex Mosque
Tojumuddin	Char Mozemmal and Char Johiruddin
Monpura	Monpura landing station, Chowdhury project
Sandwip	Solar energy project, Shabus Char
Barisal Sadar	Korapur Mia Bari Mosque, Barisal river port, Banghabondhu Uddan

Source: GoB web portal

7 CLIMATE CHANGE AND ADAPTATION

7.1 IWT and Climate Change

Situated in the lower end of the three great rivers, the Brahmaputra, the Ganges and the Meghna, Bangladesh is one massive alluvial flood plain criss-crossed by a network of several rivers, their numerous tributaries and canals. Inland water transport (IWT) is a very important mode for maintaining transport link between the various remote parts of the country and at the same time a means for transporting export-import cargo as well. Bangladesh is recognized as one of the most vulnerable countries to climate change impacts in the world. It has a history of extreme climatic events claiming millions of lives and destroying past development interventions (DoE, 2007). The exposures to different risks get aggravated because of varying high population density, and concentration of economic activities in different parts of Bangladesh (Ahmed, 2006; DoE, 2007). Drought, flooding, cyclonic storm surge are frequent water borne disaster in Bangladesh, which will be worse under climate change effect. Numerous studies have been performed to characterize the effects of climate change. A combination of sea level rise, changes in monsoon rainfall and more extreme events will have large scale impacts on the country. Climate change is likely to increase flood and drought risks, increase monsoon river flows and increase salt water intrusion, intensification cyclonic storm surges. As a result climate change will have large impacts on water management and water related sectors such as inland navigation. Global warming with higher associated rainfall and relative sea level rise will also likely cause significant changes in sediment and erosion regimes. Consequently, rivers may be disturbed requiring long periods of adjustment in fluvial processes and morphological forms. Being subjected to upstream condition which is beyond control, changes in hydrological and climatic parameters would make the rivers of Bangladesh more vulnerable as well as unpredictable. The main issues of climate change that may affect River navigation i.e. sedimentation and erosion in the river are (a) changes in flood regime due to changes in precipitation pattern (b) changes in sediment load due to changes in precipitation and river flow (c) changes in water level due to sea level rise. Climate change is now a fact. It is also now widely accepted that human activities are playing a role in the increase of greenhouse gas emissions that have accelerated global warming during the last century, although the significance of the human contribution is still a matter of debate. IPCC has introduced several global climate change scenarios, from which projections are made, based on that projection impacts and responses can be identified. IPCC introduced new AR5 scenarios.

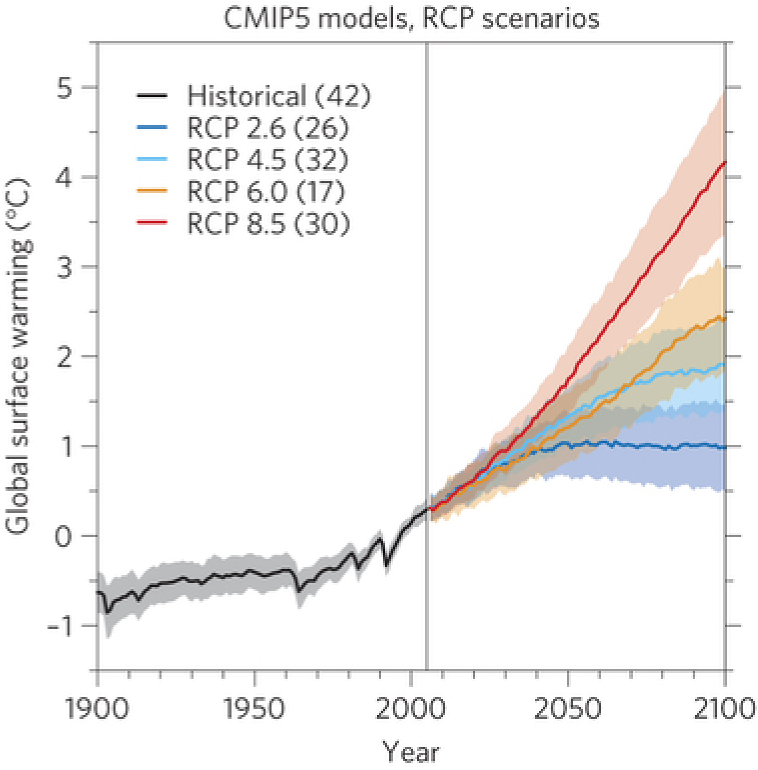


Figure 7.1: IPCC climate change scenarios and projection of global temperature change

AR5 scenarios are categorized according to the carbon emission which is briefly described the following Table 7.1.

Table 7.1: Main characteristics of each RCP

Scenario Component	RCP2.6	RCP4.5	RCP6	RCP8.5
Greenhouse gas emissions	Very low	Medium-low mitigation Very low baseline	Medium baseline; high mitigation	High baseline
Agricultural area	Medium for cropland	Very low for both cropland and pasture	Medium for cropland but very low for pasture (total low)	Medium for both cropland and pasture
Air pollution	Medium-Low	Medium	Medium	Medium-high

The recent climate change information in Bangladesh has been discussed based on information available in published sources and some updated knowledge has been generated based on the analysis of long-term historical data of some important climatic parameters.

The country average of minimum, maximum and mean temperature for the period 1948-2011 has been subjected to least square time regression analysis to estimate the trends for country average temperature. During the winter and pre-monsoon seasons the minimum temperature has increased more than the maximum temperature. The changes in winter temperature are significant while the trend for maximum temperature is not significant. However, for the monsoon and post-monsoon season the maximum temperature has increased more than for the minimum temperature. Increasing trends in both minimum, mean and maximum temperature are evident in the following Figure 7.2 & Figure 7.3

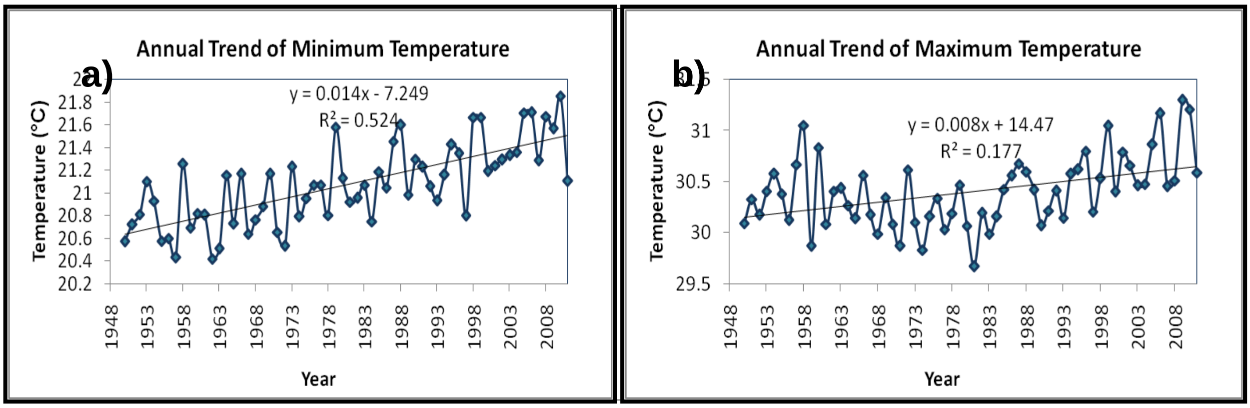


Figure 7.2: The time series plots of annual minimum (a) and maximum (b) temperature (source BDP2100)

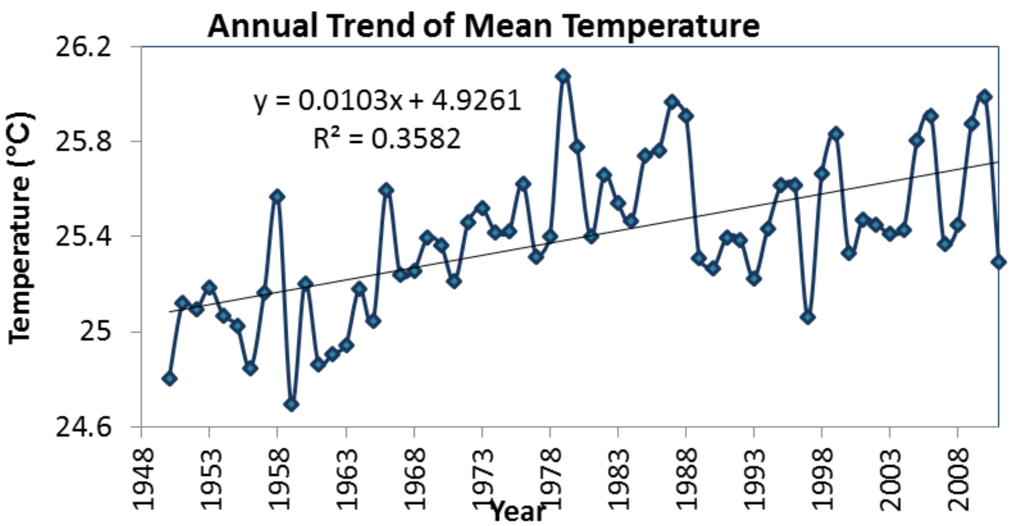


Figure 7.3: The time series plot of annual mean temperature (1948-2011). The thin straight line is the least square best fit line showing the trend of mean temperature (Source: BDP2100: Climate Change Baseline Study)

Trend analysis has been carried out based on the annual maximum, average and minimum of available water level data for selected tidal water level stations (Hironpoint at Pussur River, Khepupara in the Tentulia River and Rangadia in the Meghna estuary) by IWM to find the change in relative sea level rise.

Hiron Point

The available data at Hiron Point is from 1977 to 2013. The trend equation of yearly maximum water level at Hiron Point has been obtained y = 0.0078x - 12.916. The slope of this equation indicates the change of water level per year. Positive slope indicates the increasing trend and vice versa. The slope of trend equation of annual maximum water level at Hiron Point is 0.0078 which indicates that the rate of increase of water level at the surrounding region of Hiron Point is (i.e. Koyra Upazila, Khulna division, Sundarban) 7.8 mm/year. Similarly rate of increase of annual average water level is 6.8 mm/year (Figure 7.4). But Annual minimum water level does not show any significant trend.

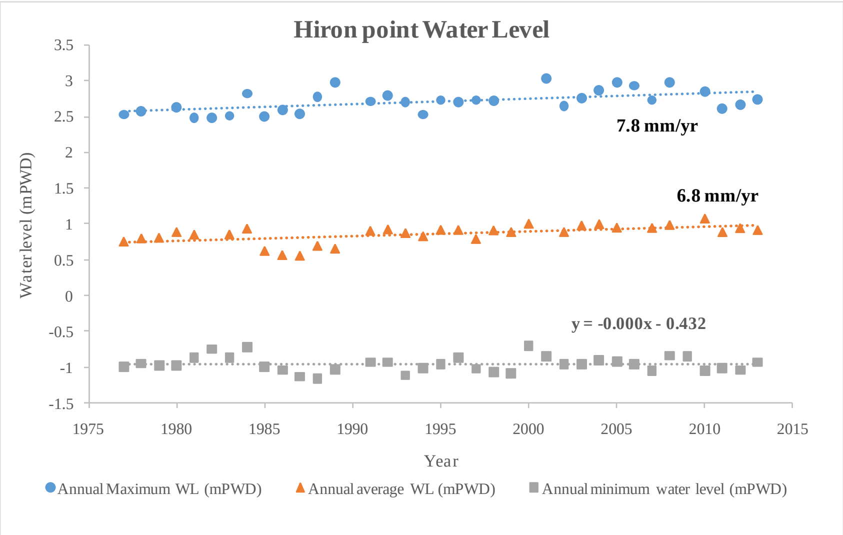


Figure 7.4: Trend analysis of annual maximum, annual minimum and annual average water level at Hiron Point

The trend analysis shows that water level has been increasing over the years, which is combination of global warming and local effects.

Khepupara

The available data at Khepupara in the Barisal area is from 1988 to 2012. The annual maximum, minimum and average water level has been calculated from this data set. The trend equation of yearly maximum water level at Khepupara has been obtained y = 0.0081x – 13.61, which indicates that the rate of increase of water level is 8.1 mm/yr at around Patuakhali. Similarly, the rate of increase of annual minimum water level is 0.6 mm/yr and rate of increase of annual average water level is 3.7 mm/yr as seen in Figure 7.5.

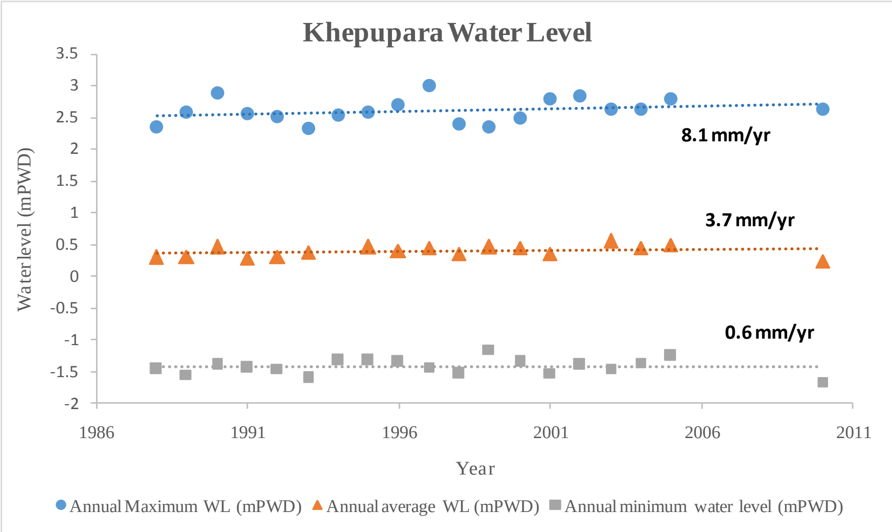


Figure 7.5: Trend analysis of annual maximum, annual minimum and annual average water level at Khepupara

Rangadia

The available water data at Rangadia (located in the Chittagong district at the outfall of the Karnafuli Rivers) from 1993 to 2012. The annual maximum, minimum and average water level data were calculated from this data set. It is seen that the trend of annual average water level is 4 mm/yr and significant trend is not found for annual minimum water level as seen in the Figure 7.6.

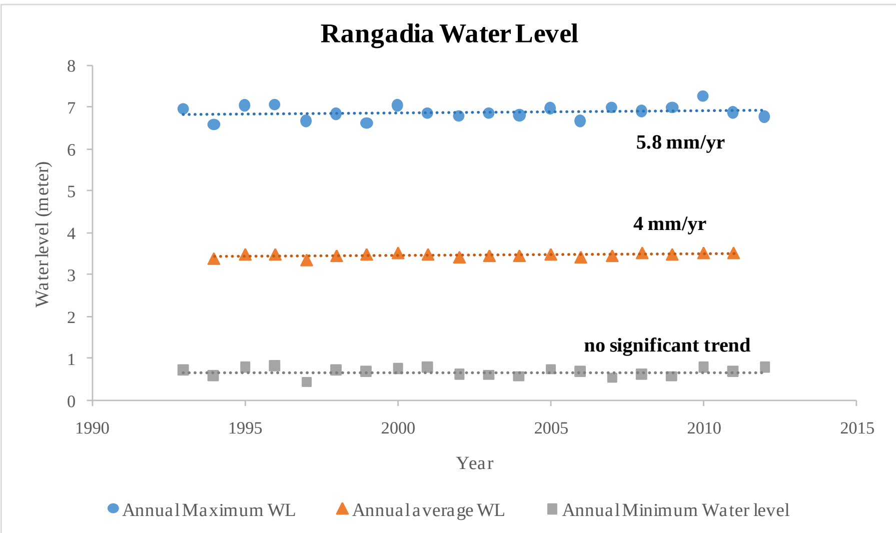


Figure 7.6: Trend analysis of annual maximum, annual minimum and annual average water level at Rangadia (Source IWM)

Assessment Report5 (WG1AR5, TS-5,2013) of IPCC stipulates that it is certain that Global Mean Surface Temperature (GMST) has increased since the late 19th century. Each of the past three decades has been warmer than all the previous decades in the instrumental record, and the decade of the 2000's has been the warmest. The global combined land and ocean temperature data show an increase of about 0.89°C [0.69–1.08] over the period 1901–2012 and about 0.72°C [0.49- 0.89] over the period 1951–2012 when described by a linear trend. Similar to the analyses above all the last IPCC (2013) report concluded that it is very likely that mean annual temperature has increased over the past century over most of the Asia region, but there are areas of the interior and at high latitudes where the monitoring coverage is insufficient for the assessment of trends (see IPCC 2013, Chapter 2, Figure 24-2). New analyses continue to support the AR4 and SRES conclusions that it is likely that the numbers of cold days and nights have decreased and the numbers of warm days and nights have increased across most of Asia since about 1950, and heat wave frequency has increased since the middle of the 20th century in large parts of Asia (see IPCC 2013, Section 2.6.1). Rainfall variability in Bangladesh is extremely high. There is a large difference between the different regions of the country and large differences between seasons. Also the inter-annual differences are large. This large variability makes it difficult to find significant trends in historical rainfall records.

Impacts and adaptations

In addition to trends for an ongoing rise in global temperature and associated sea level rise, it is anticipated there will be an increase in the frequency of such extreme events as storm surges floods and droughts. Climate change effects are also expected to increase in the coming decades, in part because of the relative lack of success to date in implementing mitigation measures (i.e. measures designed to reduce greenhouse gas emissions), and in part due to the thermal inertia of the oceans, the 'climate engine'. Clime change and sea level rise is very likely to cause the changes in the state variables or indicators of the river and estuary. The schematization of climate change influencing the use of waterways is presented in the Figure 7.7

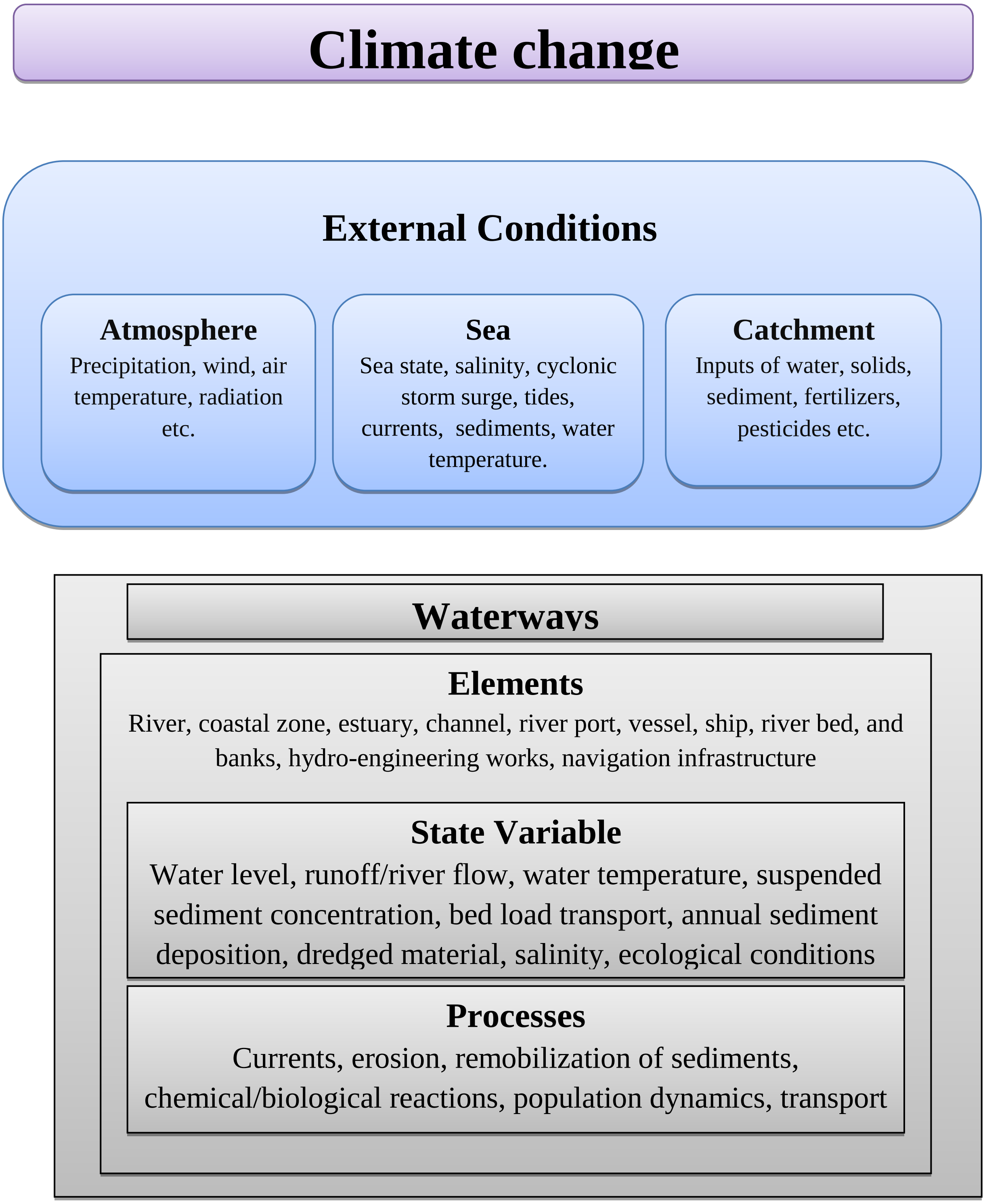


Figure 7.7: Flow chart of climate change and processes influencing the use of waterways

Projection on Climate Change

Assessment Report 5 of IPCC (IPCC, AR5, 2014) has provided the projections on temperature, precipitation, sea level rise and wind speed for the latest 4 climate change scenarios in global and regional scale. Table 7.2 presents the projection on temperature and precipitation for South Asia. The precipitation responses are first averaged for each model over the 1986–2005 period from the historical simulations and in the projected periods of the RCP8.5 experiments. (Source: IPCC chapter 14SM; Table 14.SM.1b)

Table 7.2: Precipitation change projections (at SOUTH ASIA) by the CMIP5 global models

Scenario	Region	Month	Year	Min	25%	50%	75%	100%
RCP 8.5	South Asia	DJF	2035	-13	-2	1	6	20
			2065	-16	-4	4	10	23
			2100	-17	-1	12	21	42
		JJA	2035	-3	1	3	5	16
			2065	-1	7	10	13	27
			2100	-9	13	17	23	57
		Annual	2035	-2	1	3	5	11
			2065	0	6	8	11	17
			2100	-7	11	18	21	45

This projection is in regional scale and is not wise to use for Bangladesh. Bangladesh Water Development Board (BWDB) is implementing the Coastal Embankment Improvement Project 1 (CEP1), a World Bank funded project, use the statistical downscaling results of GCMs for climate change scenario of RCP 8.5. Bangladesh Delta Plan 2100 (GOB, 2014) suggests that the climate change scenarios will be based on the analyses on a low (RCP4.5) and high emission scenarios (RCP8.5). Likely impacts on navigation would be insignificant under RCP4.5. However, there very likely that navigation routes will experience impacts under RCP 8.5 with higher increase of precipitation and sea level rise. The monthly projection for 2050 based on statistical downscaling results of 15 GCM is presented in the following Table 7.3 . The list of GCMs is presented in Table 7.4

Table 7.3: Monthly Rainfall Projection (at 2050's) for RCP 8.5 scenario at selected coastal zone of Bangladesh (calculated from selected 15 GCM's)

West coastal zone Rainfall			Central Coastal zone Rainfall		
Month	% change	Delta factor	Month	% change	Delta factor
January	-12.39	0.88	January	-14.53	0.85
February	4.68	1.05	February	3.24	1.03
March	-5.29	0.95	March	-0.4	1.00
April	-11.85	0.88	April	-10.7	0.89
May	3.06	1.03	May	6.46	1.06
June	1.05	1.01	June	3.55	1.04
July	15.75	1.16	July	16.71	1.17
August	16.08	1.16	August	19.6	1.20
September	22.47	1.22	September	26.99	1.27
October	14.46	1.14	October	16.09	1.16
November	-6.75	0.93	November	-11.53	0.88
December	12.26	1.12	December	-16.97	0.83

Table 7.4: List of Selected 15 GCM's are provided below:

SI No.	GCM (General Circulation Model)	SI No.	GCM (General Circulation Model)
1	ipsl-cm5a-lr	9	bcc-csm1-1
2	ipsl-cm5a-mr	10	bnu-esm
3	miroc-esm	11	canesm2
4	miroc-esm-chem	12	ccsm4
5	miroc5	13	cesm1-bgc
6	mpi-esm-lr	14	cnrm-cm5
7	mpi-esm-mr	15	gfdl-esm2g
8	mri-cgcm3		

Source: The calculations are performed from the output of Climate change group of World Bank Team. Source of data can be found at http://climatewizard.ciat.cgiar.org/wbclimateanalysistool/

The projection covers the Lower Meghna River, Meghna Estuary and Barisal area, which is shown in the figure 7.8

In accordance with the projection on precipitation the rainfall in the dry season will be decreased. It implies that the water flow/discharge is very likely to be decreased in the river during dry season causing decrease of navigation depth. The decrease of navigation depth might increase the maintenance dredging volume in the navigation routes. In the monsoon the precipitation is increases in accordance with the downscaling results of GCM. The increase of precipitation will increase the river flow during monsoon, which may lead river bank erosion in the navigation routes. In such situation the alignment of the dredging is very likely to be changed keeping adequate distance from the river bank to avoid dredging induced erosion.

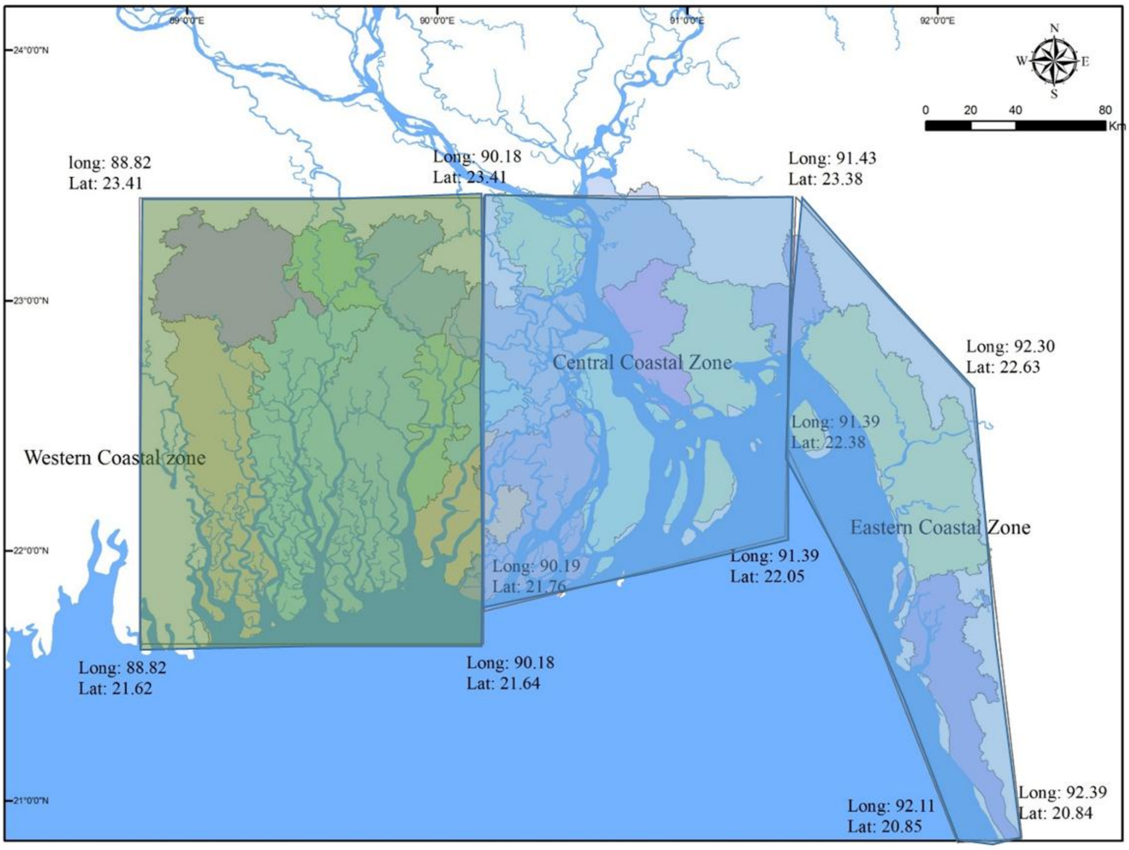


Figure 7.8: Coastal zones for downscaling results of GCMS

IUCN (2007) addressed following likely impacts on navigation in the changing climate;

- Loss of navigability due to increase in frequency and duration of dry spell (drought) may imply higher prices and losses; Increase in frequency in wet and stormy period may imply higher costs due to weatherdisturbances and safety;
- Gradual low flow conditions and resulting economic losses;
- Large variations and reduced water depth;
- Sharp increase in frequency of extreme costs;
- Damage from cyclone and storm surge to IWT infrastructures

Again it is worthy to mention that dredging activities for inland navigation improvement mostly will take place in rivers and Meghna estuary. The morphology of these areas is influenced by sediment supply, currents, waves, winds, water levels and tidal range. Changes in these conditions due to global warming may induce changes in erosion and sedimentation patterns, with potential consequences for both inland and in the estuary dredging requirements to maintain adequate navigation depth. Adaptation measures might be dredging of increased volumes sediment or locations, the type or number of dredging tools, or new dredging methodologies. Navigation interests could be affected through changes in the shape and depth of channels, formation of submerged shoals or a change in maintenance dredging frequency and volume. Changes in water quantity will cause changes in river discharge; especially, the probability of extreme hydrological events will increase such as floods and drought. This could cause changes in river channel erosion, sedimentation and sediment transport. The morphology reflects the supply and transport of sediments in rivers. In the event of climate change, both sediment supply and sediment transport are subject to change. Dredging technique and dredging method should be determined in a manner that can adapt to the erratic conditions of the rivers due to climate change. Through morphological and social studies dredge materials may be discharged to raise the river banks. For sustainable navigability river training work should also be carried out as well. Despite BIWTA's aid to navigation support along the channel, change of river course has become almost unpredictable. As a result, vessels are grounded often cause huge economic loss for the vessels operators, which is likely to be increased under climate change through channel shifting and that demand close monitoring of navigability. Changes in cyclonic storm duration and/or frequency may lead to decreased regularity of river ports, increased downtime and the requirement for more storage capacity at cargo and container terminals for use in times of closure specially in the Meghna estuary not in the rivers in the non-tidal area like Buriganga, Shitalakhya Rivers. The planning and design of passenger, cargo terminals and ferry ghats needs to be carried out considering flood level and storm surge height in the changing climate. Climate change adaptation measures need to be based on a well-informed, proactive and integrated approach; adequate monitoring and follow up programmes will be important. BIWTA also needs to consider adaptation to include strategies that adapt the current systems and infrastructure to account for changing climate.

7.2 Climate Change impacts and adaptation in the D-C IWT Project

7.2.1 Climate Change Impacts

Bangladesh is a disaster prone country due to its geographical location. On the other hand, geography of the country is mostly plain land and the height of southern region of the country is very close to sea level. This makes it more vulnerable to climate change impacts. The country suffers from storms and cyclones, the intensity of which is also about to increase due to climate change issues.

The proposed river route of the Dhaka-Chittagong inland water transport corridor project travels across southern river terminals of the country. Especially Bhola, Monpura, Hatiya, Sandwip, etc. char islands will suffer the consequences of climate change more intensely. Therefore, the vessel shelters and terminals to these sensitive regions should have hazard maps and locations of nearest cyclone shelters clearly marked in visible locations near the entrance of the terminals. In addition to that, an emergency Hotline number should be included in all the terminals to ensure safety and security of the passengers. A detailed investigation is required to find likely impacts on navigation routes and adaptive measures under climate change and sea level rise.

There are very limited researches and studies on assessment of effect of climate change on inland waterways.

Potential impact on navigation:

I. Change in river erosion and sedimentation
II. Increase of local sea level and storm surges
III. Decreasing flow during dry season causing reduced navigation depth
IV. Increase of wind conditions
V. Evolution of wave action
VI. Evolution of tidal propagation and range
VII. Changes in ocean coastal and estuarine morphology
VIII. Changes in storm events
IX. Relocation of designated environmentally protected areas
X. Change in navigation route alignment.

7.2.2 Climate change mitigation and adaptation

A Climate Change Unit will be established in the BIWTA for mainstreaming the climate change issues in the project planning and implementation. The following mitigation and adaptation measures will be pursued during implementation of the Project.

In parallel to the project implementation, the World Bank will provide technical assistance to MoS, BIWTA and other relevant agencies to develop a strategy and action nplan for “greening the waterways”, and will pilot select activities under the plan, to test approaches and generate lessons learned to enable scaling up in a future operation. This study will include a large focus on identifying mitigation measures to reduce carbon dioxide and other greenhouse gases emissions from ships, cargo handling equipment and related hinterland transport. Possible such activities to be included in the action plan are:

- Preparing GHG emissions inventory (from the current operations) and setting goals to reduce emissions. Also periodic reporting.
- Exploring the introduction of cleaner fuels such as CNG (comparatively less emissions) in the vessels owned by the ministry to set a good example for others to follow.
- Developing an incentive scheme to encourage vessel owners to upgrade vessel engines, such as conversion to CNG or installation of emissions control measures.
- Educational campaigns for users of the waterways to tackle behavioral aspects of reducing emissions and other forms of pollution.
- Improving efficiency within the logistic chains by streamlining the movement of cargo, truck traffic and inland navigation access
- Reduce energy dependence with in the ports by developing and using renewable energy sources

On the adaptation front, the project will foremost ensure that river terminals and landings are designed in consideration of maximum flood levels expected with climate change, as well as potential decreases in minimum flows during dry season.

In addition, in parallel to the project, the World Bank will provide technical assistance tosupport a detailed climate change vulnerability assessment and development of an adaptation/resilience strategy for the IWT sector as a whole. Potential adaptation measures to be explored at the sector level include:

- Climate change modeling and developing forecasts for river water levels and changing sedimentation patterns
- long term planning and design for new infrastructure in consideration of climate vulnerabilities
- Identify the vulnerabilities in the IWT sector and proactive actions
- Design of new wider vessels that could accommodate low drafts
- Planning for future upgrading / modification of additional BIWTA-owned facilities to account for future flood levels expected from climate change

8 POTENTIAL SIGNIFICANT ENVIRONMENTAL IMPACTS

8.1 Alternative Dredgers Types (Equipments/Techniques)

Potential types of dredgers and their functions

According to engineering design basically there are 3 kinds of dredgers; they are mechanical, pneumatic and hydraulic dredger. As known, though there are some mechanical dredgers are in use by BWDB, BIWTA (those are being used they are very old), being inefficient this type is not the preferred one.

Hydraulic type dredgers mainly of two types: *trailing suction hopper dredger* and *cutter suction dredger*.

Cutter Suction

Cutter suction dredger consists of a centrifugal pump and the suction tube that has cutting mechanism (rotary blade) at the end. The main technique is applied in dredging is that loosening the sand and cutting are done simultaneously, and the dredged material is sucked by the dredging pump and transported through a pipeline. Though can be used in sandy, clayey soil, due to the capacity of cutting it has preferred use in case of dredging on bedrock or very hard soil or gravel deposits. Usually, the distance of transportation pipe line by design could be 2-3 km. However, by adding booster pump to the pipeline the dredge-spoil can be transported/dumped to a further distance.

Trailing Suction Hopper Dredger

The *trailing suction hopper dredger* is practically a ship that by the use of dredging equipment can dredge desired location and discharge into the ship's container and can sail it in order for releasing the dredge elsewhere. A description of its functionality and uses are also given in **Section 3.3.2**.

In principle, its dragging technique is basically similar to a vacuum cleaner. That means sail-and-drag, sucking by creating vacuum and hence loading, then sailing to unload elsewhere. The hopper suction dredger has self-loading and unloading capacity. As an operation procedure, one or two suction pipes having trailing suction head connected to the end descend onto the river bed (desired dredging location). There are nozzles in the head that are connected to a high pressure installation that are capable of loosening the bed material (sand). With respect to limitation of its uses, since it prepare and collect dredge by loosening sediments and dragging and and also steel teeth are not so big, so it is capable of working on relatively loose and soft substance.

As to the components of equipments, apart from the ship with engine, it has rearward extending one or more suction pipes, one or more dredging pumps in order to create suction (under pressure) to extract dredged sediment inside the pipe, transportation pipes in order to send dredge into the hopper, an overflow device to get rid of the redundant water overboard, kind of degassing devices to remove any gas from the substance.

A comparative consideration

Where pumping is possible, hydraulic dredgers are much more efficient than mechanical dredgers. However, any situation that limits the uses of hydraulic dredging other types can be used. For example, due to hard rock, debris or narrow channel with a lot of passing traffic, which does not allow the floating pipeline. In such circumstances, grab dredgers can be used. Again, in such situation hopper barges would be required to convey the dredged spoil to the desired dumping sites. On the whole, choosing an appropriate dredger type is a matter of optimization between the issues - dredging project, constraints and dredging equipments. A good guidance on the suitability of types of dredging equipments depending on the soil condition can be seen in Table 8.1

Table 8.1: Suitable types of dredging equipments on the soil criteria

TYPE OF EQUIPMENT	SOIL				SITE		
	SILT	CLAY	GRAVEL	ROCK	OFF SHORE	IN SHORE	
						TRAFFIC	NO TRAFFIC
BUCKET DREDGER	G/R	R/G	R/G	R/G	NA/R	NA	G
PLAIN SUCTION DREDGER	R	NA	G	NA	R/G	NA	G
CUTTER SUCTION DREDGER	GOOD	G	G	R	R	NA	G
TRAILING SUCTION HOPPER DREDGER	GOOD	R	G	NA/R	G	G	G
GRAB DREDGER	R/G	R	G	NA	NA	NA/R	G
BACK HOE	R	G	G	R	R	R	G
BED LEVELLER	GOOD	NA/R	R	NA	NA	G	G

G = GOOD R = RESTRICTED NA = NO APPLICATION

[Courtesy: H van Muijen, IHC]

Feasibility under this project

In this project the dredging operation involves a number of rivers of hundreds of kilometers and they are well-wide, and most locations of dredging will be well inside the coastline. From efficiency consideration with respect to all aspects – technical, capacity, cost, the mechanical dredgers would not be feasible. Their use is diminishing day by day, when other robust and efficient devices are available. Using of hydraulic-type would be feasible due to the size of the river (long, wide), type of sediments (no bed rock, all navigation paths and routes pass through flood plains and estuaries, all are late holocene sediments, no debris etc). Therefore, cutter suction type dredger would be the feasible option from both technical and financial point of view. However, while dredging locations are the coastal area, for example downstream of Bhola, Lakshmipur hopper suction type dredger might be considered provided if costing favours in choosing such type. In no way hopper suction would be a viable option for inland rivers, since the sailing distance will surely be very long, the capacity, therefore, be low and hence the cost for each unit volume of sediment would be quite high. As known so far known from BIWTA, it will be using for dredging inside inland rivers 18-inch cutter suction dredger. And in the estuary area either hopper suction or 26-inch cutter suction dredger will be used.

8.2 Dredge Material Placement Locations

There are several suitable locations have been selected for disposal of dredged material. These locations are given in the below Figure 10.1 and illustrated in the Table 10.1.

8.3 Environmental, Health and Safety Impacts

8.3.1 Impact of Dredging on Benthic Habitat, Dolphin, River Turtles and Important Bird Area

The impacts of dredging on biological resources can be short term or long term, direct or indirect. There can be short-term impacts from the dredging, and long-term impacts associated with habitat modification. Short-term impacts could include local changes in species abundance or community diversity during or immediately after dredging. Long-term impacts could include permanent species abundance or community diversity changes caused by changes in hydrodynamics or sediment type, or a decline or erratic trend beyond the normal range of variability in the years following new dredging.

Direct impacts would be directly attributable to the dredging activity, such as a direct loss of mudflat habitat. Dredging involves the removal of substrate and benthic organisms at the dredging site, resulting in immediate localized effects on the bottom life. Besides the decimation of organisms at the dredging site, there is the removal of the existing natural or established community with widely varying survival of organisms during dredged material excavation. Aside from the initial physically disruptive effects, a long- term environmental concern is the recovery (repopulation) of bottom areas where dredging has occurred. Dredging thus opens the area for recolonization on a new substrate that may resemble the original substrate or be completely different in physical characteristics. Recolonization of the dredging site can begin quickly, although reestablishment of a more stable benthic community may take several months or years after the dredging operation has occurred. The effects of habitat loss or alteration at the dredge site may extend beyond the boundaries of the dredging operations. However, dredging-induced habitat alterations are minor compared to the large-scale disturbance of benthic habitat.

During all dredging operations, the removal of material from the riverbed also removes the animals living on and in the sediments (benthic animals). With the exception of some deep burrowing animals or mobile surface animals that may survive a dredging event through avoidance, dredging may initially result in the complete removal of animals from the excavation site.

Where the channel or berth has been subjected to continual maintenance dredging over many years, it is unlikely that well-developed benthic communities will occur in or around the area. It is therefore unlikely that their loss as a result of regular maintenance dredging will significantly affect the aquatic ecology. However, certain aquatic species and communities are more sensitive to disturbance from dredging than others.

Dredging activity removes the existing benthic community which is important in nutrient cycling and as a source of food. The rate of recovery for the benthic community is highly variable and depends on the type of sediment, system size, the composition of nearby communities, the amount of sediment removed, and salinity. For instance, recovery is reported as faster for benthic communities in low versus high salinity habitats, and those associated with finegrained sediments versus coarsegrained sediments.

Recurring physical disturbances (such as maintenance dredging) can alter the sediment chemistry and reduce recruitment of new benthic animals. Over time, a decrease in benthic community abundance and diversity is likely.

Human influences on benthic habitat include not only dredging and disposal, but also waste discharges, sediment deposition from hydraulic mining, filling of Bay margins, fresh water diversions, and introduction of exotic species. When the disturbance ceases, recolonization of the benthic substrate occurs; reestablishment of a more or less stable benthic community can take several months or years.

Assessing the recovery of benthic habitats disturbed by dredging and dredged material disposal operations is an important and growing management issue throughout the world. Although many projects have been monitored and a substantial literature on the subject exists, few generalizations can be made about typical recovery rates because biological responses are influenced by numerous factors, including site-specific bathymetry, hydrodynamics, depth of deposited sediments, and the spatial scale of the disturbance, sediment type, and the timing and frequency of the disturbance. Additionally, there is no accepted definition of what constitutes "recovery."

The dredging and disposal activities will also have impacts on the bird habitats such as reed lands and mudflats, and habitats of dolphin and dolphin and turtles etc. Detailed impact assessment on these species and their habitats are presented in Annex C: Biodiversity Management Plan. The impact on birds will be mainly from the noise pollution associated with the dredging and associated activities. The dredging activities and disposal activities if carried out any near the reed lands will disturb the habitats of the resident birds. Mud flats in the lower Meghna and Meghna Estuary is an Important Bird Area and is the winter destination for some migratory birds. They also act as foraging ground and essential stepping stone for others on longer migratory journeys. Changes in the mudflats caused by the disposal activities may affect the habitat quality of the migratory birds due to altered sediment concentration. January and February are the periods that migratory birds usually habitat these areas. Any dredging activities carried out during these periods near the mudflats might have an impact on the birds. Hunting of migratory birds by the construction workers associated with dredging activities will also be a major concern.

River turtles generally lay eggs in the chars and river banks in the Lower Meghna. 15 March to 15th April is generally breeding period for the critically endangered river turtle, *Batagur Baska*. Dredging and disposal activities in the chars and on the banks during these periods will have a significant impact on the turtle’s habitat. Noise generating from the dredging activities and movement of dredgers and associated vessels will also have impact on the reptiles. Underwater noise levels generated by the dredging will have impact on the dolphins, and turbidity and sediment dispersion associated with dredging activities may also affect the dolphins prey.

The impacts on the habitats of resident and migratory birds will be avoided by carrying out any dredging activities minimum 100 m away from the reed lands and mud flatswhich is possible becausethe reedlands and mudflats (mainly the IBAs) are located in sections of the rivers and estuary which has broad expanse and the navigation route maintains a distance from these sensitive areas. Special attention to be paid during the months of January and The dredged material will not be disposed in the reed lands, mudflats and other areas known for habitats of resident and migratory birds. A monitoring mechanism will be established under the biodiversity management plan to monitor the disposal and dredging activities. Similarly the dredging activities will also carried out minimum 100 m away from the chars and river banks in the lower Meghna area. Impacts on birds, turtles, dolphins and other species can be avoided by employing a ‘soft start’ approach by the dredger, in which the dredging speeds will be increased gradually to allow these species leave the dredging areas. Dolphins will also be chased by use of pingers.

Table 8.2 : Physical Factors Affecting Benthic Recovery

PHYSICAL FACTORS AFFECTING BENTHIC RECOVERY	
Depth of Overburden at Disposal Sites	Some benthic organisms such as burrowing polychaetes, amphipods and molluscs can colonize newly deposited sediments through vertical migration, therefore, if dredged material depths are limited to within the vertical migration capacity of these organisms (20-30 cm), recovery rates may be quicker than if colonization is dependent upon the lateral migration of juveniles and adults from adjacent areas and larval settlement.
Habitat Type (disturbance history)	Shallow benthic habitats (< 20 m depth, Hall 1994) experience relatively frequent wave, wind, and current induced disturbances and thus are typically inhabited by low-diversity, selected benthic assemblages that can readily re-establish themselves under conditions of high frequency disturbances (Dauer 1984, Clarke and Miller-Way 1992, Ray and Clarke 1999). These communities are naturally held in early successional stages and therefore, are able to recover more rapidly than communities in deeper, more stable environments (Newell et al. 1998, Bolam and Rees 2003).
Sediment Type	Rapid recolonization of soft-bottom benthic habitats is frequently associated with either unconsolidated fine grain sediments (Cruz-Motta and Collins 2004) or the rapid dispersion of fine-grained dredged material by currents (Van Dolah et al. 1984). Newell et al. (1998) characterized typical recovery times at 6-8 months for mud habitats and 2-3 years for sand and gravel substrata.
Spatial Scale of Disturbance	The spatial scale of the dredged or disposal area may be proportional to recovery times (Zajac et al. 1998, Guerra-Garcia et al. 2003). For small-scale disturbances, the edge/surface area ratio of the disturbed area is larger than for larger disturbances, therefore colonization through adult immigration from surrounding undisturbed areas may facilitate recovery. With larger disturbed areas, the central portion of the disturbed areas is reliant upon settlement from the water column for colonization, which is very dependent on seasonal recruitment patterns and local hydrodynamics.
Timing and Frequency of Disturbance	Avoiding dredging activities after seasonal larval recruitment periods is a common practice when possible. Deposition of sediments in several smaller units rather than one deep deposit also may be less detrimental to the benthos. In a microcosm study, sediment deposited in a single event caused more severe changes to nematode assemblages than the same amount of sediment deposited in smaller doses (Schratzberger et al. 2000).

Some of disposed material may accumulate as fine sediment over time along with new/fresh sediment brought in by the river. The sediment deposition rate and depth of sediment is difficult to estimate as it depends on various factors like sediment load, type of sediment, water current velocity, differences in the velocity at different locations, etc. The dredging depth varies at different locations. Since this is maintenance dredging project, the Class I routes have to maintain a depth of 4m during dry season. To maintain the required depth of the waterway, the estimated dredging depth is shown in the Table 8.3 below.

Table 8.3: Estimated average dredging depth in different sections of the rivers under different zones

Location/Zones	Average Dredging Depth (m)
Upper Meghna	1 – 1.5
Satnol	0.5
Sitalakhya	0.5
Lower Meghna	1 – 1.5
Barisal	1

Mitigation

- Excavation and dredging methods should be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation.
- As part of the daily/weekly inspection, examine the benthic communities and examine the level of Turbidity, pH, temperature, salinity, BOD, COD in excavation area and also in the outlet of the disposal area.
- Carry out dredging activities a minimum of 100m from reedlands, mudflats, and other areas of important bird habitat. The specific locations are shown in Figure 10.1.
- Do not dispose of dredge material on reed lands, mud flats, and other areas of important habitats of resident and migratory birds or turtles during nesting period in the areas shown on Figure 10.1 during the months in Table 10.1. In case such disposal cannot be avoided due to insufficient submerged discharge locations in proximity to the dredge site, the following rules shall be applied to minimize impacts to mudflats and riverbank areas of important habitat for migratory birds and turtles

- To compensate for possible unavoidable impacts to benthic communities as well as reedlands/mudflats and other riverbank areas of important habitats, a biodiversity conservation program will be developed and implemented to strengthen conservation efforts in key charlands, carry out mangrove, reedland and other habitat restoration, etc. (refer to the TORs presented in the Biodiversity management Plan presented in Annex)

8.3.2 Impact of Dredging on Water Quality and Fish

Water Quality

Water quality effects of dredging activities are variable depending on increases in turbidity, suspended solids, and noise; reduced light transmittance; changes in salinity, temperature, and pH; reduced dissolved oxygen (DO); and releases of nutrients, heavy metals and organic contaminants (Connor et al. 2004; US Navy 1990).

Short-term Water Quality Impacts

Conceptually, the water quality impact of dredging activities is two-fold: 1) suspended sediment plumes resulting from dredging or disposal activities, and associated water quality changes in the water column, and 2), sediment disturbance, and associated changes in the chemical properties of the dredged sediment. This overview addresses the first, short-term water quality impacts in the water column associated with plumes, which include chemical transformations, release of oxygen-demanding substances/reductions in DO, decreased pH, release of contaminants, and changes in bioavailability.

Chemical transformations: The most significant chemical transformation processes in dredging plumes are probably the releases of ferrous iron (Fe^{2+}) and sulfides from oxygen-depleted resuspended sediments and their subsequent oxidation with the DO in the aerated water column (Jones-Lee and Lee 2005). The oxidation of sulfides to sulfate and of Fe^{2+} to iron oxides/hydroxides is the primary chemical processes driving DO reductions in sediment plumes. In addition, they control the release of ionic metals and their short-term speciation and bioavailability during resuspension.

In anoxic (oxygen-free) sediments, sulfur occurs in the form of sulfide species (S^{2-}, S^{2-}/S^{-}, H_2S, and HS^{-}species), and iron occurs as Fe^{2+}. During resuspension of the anoxic sediment in the oxic water column, both Fe^{2+} and sulfides react with DO. Sulfides are oxidized by DO to form the highly acidic sulfate (SO_4^{2-}) species. Thus, the reaction of sulfides with oxygen can both reduce DO and also contribute to pH decreases in the water column. Fe^{2+} is oxidized by DO to form ferric (Fe^{3+}) hydroxide [$Fe(OH)_3$], which is exceedingly insoluble within the normal pH range of oxygenated waters and rapidly precipitates.

Heavy metals occur mostly as sulfides (CdS, CuS, PbS, etc) in anoxic sediments. The low solubility of metal sulfides results in low porewater concentrations. Upon resuspension of anoxic sediment into the oxic conditions of the overlying water, Fe and also Manganese (Mn) are rapidly oxidized (first few minutes following sediment resuspension) to insoluble oxides/hydroxides. The insoluble Fe and Mn oxides/hydroxides precipitate again from the water column and are subsequently deposited, thus contributing to the formation of fresh sediment layers. Compared to the rapid oxidation of iron sulfides (FeS) and manganese sulfides (MnS), the oxidation kinetics for heavy metal sulfides is much slower. Laboratory studies showed that oxidation of CuS, CdS, and PbS takes more than 8 hrs. Once oxidized, however, they are quickly scavenged by, or coprecipitated with, the iron and manganese hydroxides or complexed by organic matter.

Releases of oxygen-demanding substances/reductions in dissolved oxygen: DO in SW1 and SW12 exceeded the DoE guideline. Dissolved oxygen (DO) concentrations in the water column may be reduced when oxygen-demanding substances (for example, organic material) are mixed into the water column by dredging or disposal activities. Inorganic oxygen demand is caused by abiotic (non-biological—inorganic)-based reactions consuming DO in waterbodies. The most important inorganic constituents responsible for DO reductions in aquatic systems are sulfides and reduced iron. When released from the reducing anoxic sediments into the oxidative conditions of the water column, they will be oxidized in reactions with the oxygen present in the water column. Therefore, anoxic sediments containing reduced substances such as Fe^{2+} and sulfides that react with DO would cause the greatest temporary depression in DO at the disposal site.

Decreased pH: The extent of pH decreases during sediment resuspension is mainly a function of the oxidization of sulfides to highly acidic sulfate (SO_4^{2-}). The formation of sulfate depends on the amount of sulfide in the sediment and how much it is oxidized during the release.

pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity (Gupta 2009). The variations in pH are an important parameter in water body since most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes. However, seasonal variations of pH ranging from 6.73 to 7.28 are considered satisfactory for the production of biomass. (George 1997).

Release of sediment contaminants: Dredging and dredged material disposal can release sediment-associated metals and other pollutants by dispersion within the resulting sediment plume. The dispersion of pollutants can occur in the dissolved or in the particulate state. The release of contaminants into the water column is difficult to draw, because of the complex and specific nature of the physiochemical processes in each case. While the processes and mechanisms are well known, the exact results are dependent on numerous conditions that regulate them. Examples are the influence of ambient water concentrations on sorption and desorption from sediment particles, the role of dissolved organic carbon (DOC) and particulate organic carbon (POC) vs. mineral particles per se (e.g. bi- and tri-partite clay minerals), and how these processes are controlled by changes in redox potential and other factors.

Heavy Metals of concern of concern, due to their potential toxicity to fish, include cadmium (Cd), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), zinc (Zn), silver, (Ag), chromium (Cr), and arsenic (As). Research to date has investigated the effect of dredging-induced sediment resuspension on many potentially toxic metals. However, despite the many comprehensive studies, there is very little consensus on the release of metals and their effects. However, heavy metal test results indicate all test results are within the standards of DoE and EHS.

Effluent Guidelines (To be applicable at relevant wastewater stream: e.g., from FGD system, wet ash transport, washing boiler / air preheater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oil-separated water, site drainage, coal pile runoff, and cooling water)	
Parameter	**mg/L, except pH and temp**
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium - Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.
Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants.	

Figure 8.1 : WHO Effluent Guidelines

Overall, only a small fraction of the total amount of heavy metals is dissolved, because of their general tendency to be bound to Fe and Mn oxyhydroxides. In anoxic pore waters the dissolved heavy metal fraction that occur as single, positively charged ions in water (e.g., Cd, Cu, Hg, Ni, Pb, and Zn) is reduced further by precipitation with sulfide. Thus, the direct contribution of these metals from anoxic sediments is considered to be negligible.

Ammonia. There is a possibility of short-term changes in unionized ammonia in conjunction with near-bottom turbidity plumes caused by disposal. Ammonia toxicity is known as a confounding factor in toxicity tests with benthic organisms.

Organic contaminants are mostly particle-bound due to their hydrophobic ("oily") nature. Thus, direct contribution from pore water is low, unless it contains high concentrations of dissolved organic matter (DOM). In this case, pore water may contribute substantial amounts of DOM-bound pollutants: organic contaminants may adsorb to DOM, forming a complexed fraction which is included in the operationally defined dissolved state (particles <0.45 μm), although the micropollutants occur in bound form. Then, a substantial amount of apparently dissolved, yet DOM-bound pollutants may enter the water column during dredging.

During dredging, several changes occur when sedimentary material is dispersed into the water column:

1. the particulate organic matter (POM) concentration in the water increases;
2. DOM-bound pollutant concentration in the water column increases;
3. the total concentration of pollutant in the water increases;
4. and POM with different pollutant concentrations are mixed.

According to the partition theory, a new equilibrium will be established Figure 8.2. The concentrations in this newly equilibrated situation can be estimated using partition theory, which says that, for a given compound, the ratio of the concentration associated with POM (μg/g) and the dissolved concentration in the water (in μg/L) is a constant, characteristic for that compound. In many cases, the concentration on the sediment POM can be expected to be higher than the concentration on suspended POM already in the water column. In that case, mixing of sediment particles will cause desorption, according to the partition theory, to restore the equilibrium. However, for organic contaminants, desorption rates tend to be quite slow, and it may take months to years for these chemicals to desorb and reach equilibrium partitioning between the solid and dissolved phase (Figure 8.3)

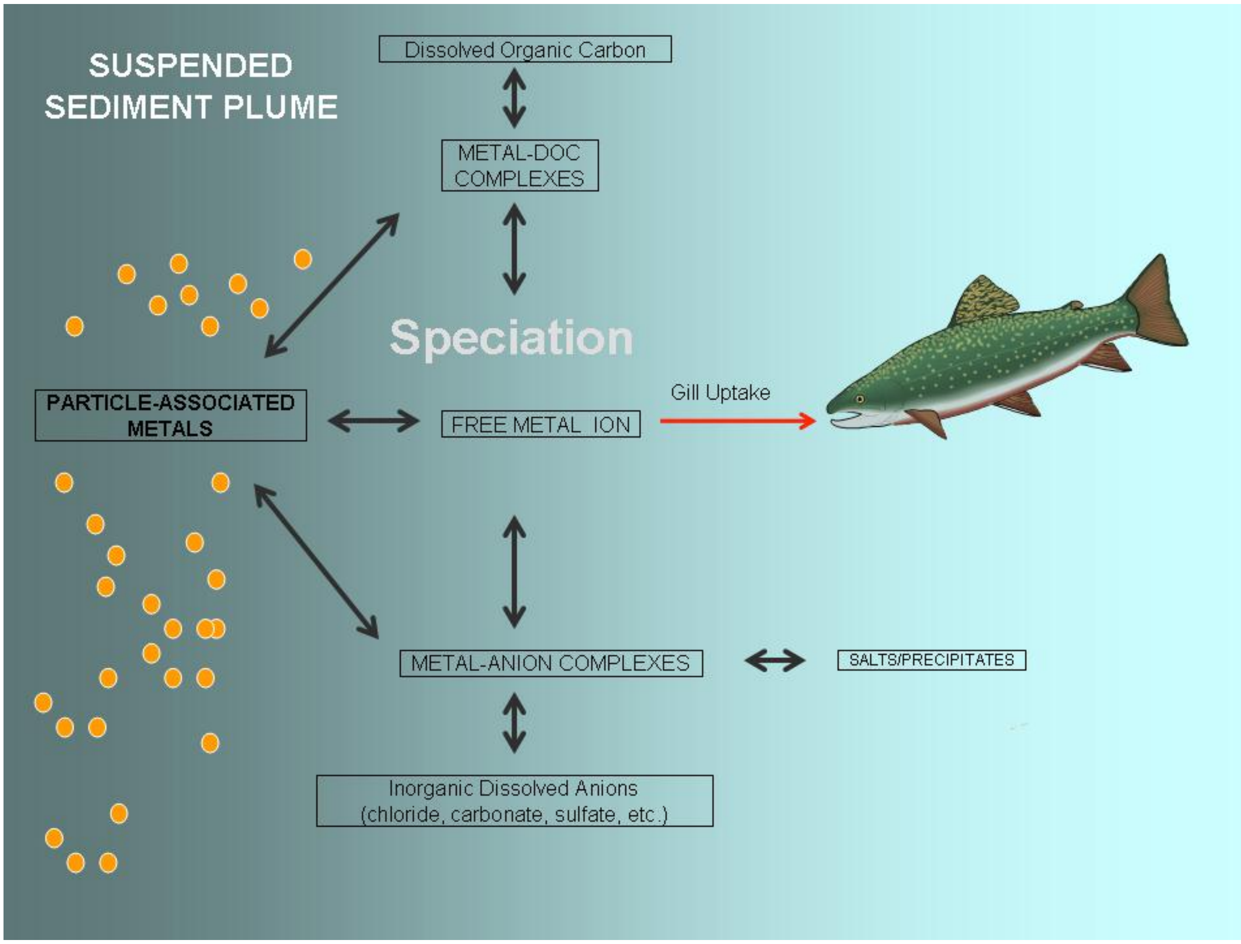


Figure 8.2: Bioavailability and toxicity of waterborne metals is very speciation dependent

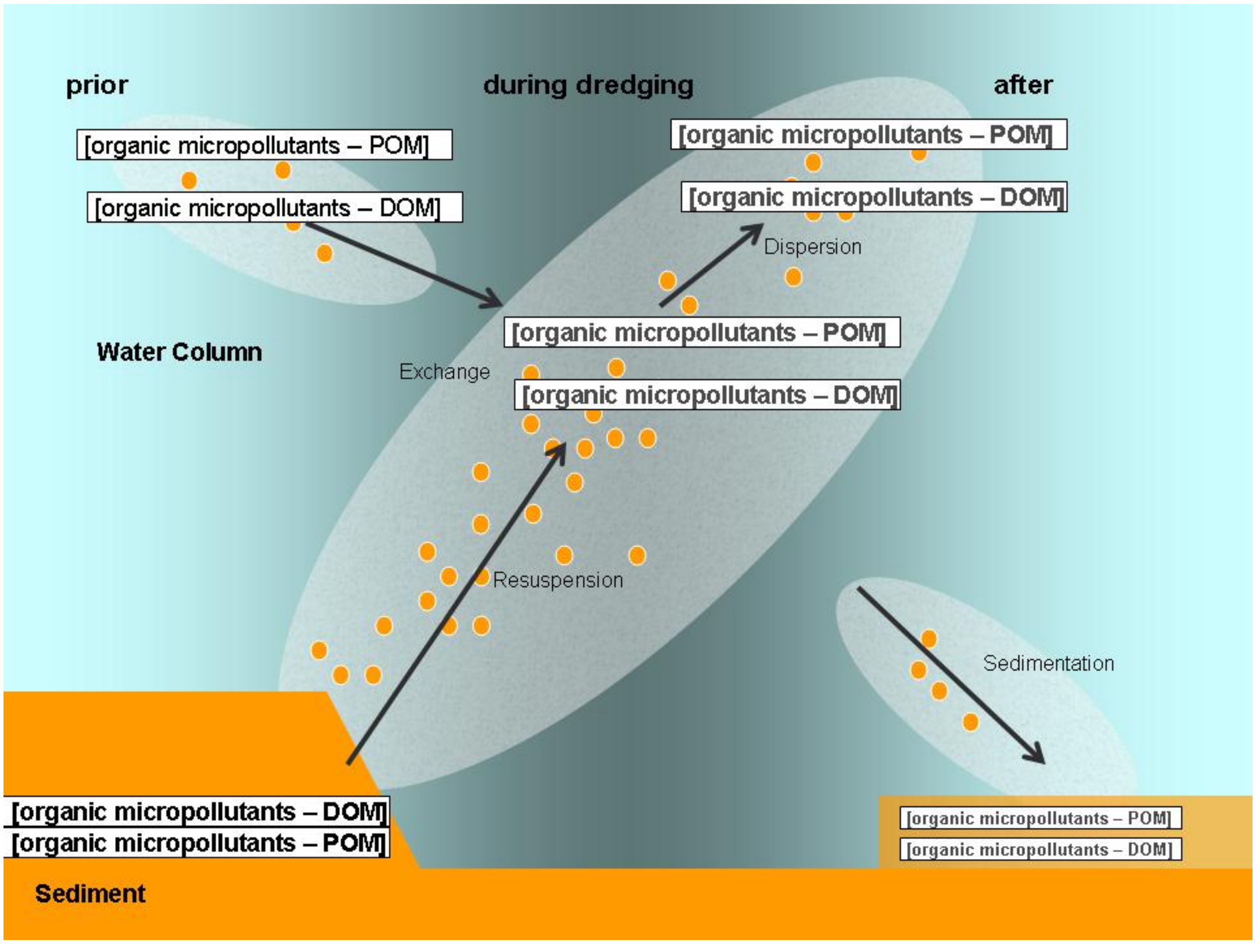


Figure 8.3: Schematic representation of the processes controlling the chemical and biological availability of organic

Changes in bioavailability: Contaminants are available to fish via gill uptake or ingestion with food. Branchial uptake of dissolved contaminants in the water column is presumably the most significant route of exposure for short-term acute toxicity in fish. In general, dredging and resuspension result in the exposure of anoxic sediment to DO, which results in a positive change in the redox potential (Eh), which can accelerate desorption, oxidation, complexation, and the bacterial degradation of sediment contaminants. An example is the mobilization and transfer of metals from sulfide minerals (FeS/MnS) to the dissolved phase during the initial exposure of reduced sediments to DO. However, these processes are sediment, compound, and animal specific. Dredging related bioavailability is mainly site-specific and dependent on the degree of contamination, the amount of suspended sediment, the duration of the disturbance, and the organism.

Mitigation

Fish

Potential short-term effects on fish species are a function of the type of contaminant, its concentration in the sediment, environmental conditions at the time of dredging (e.g, low oxygen or reducing environments), and the duration of the exposure. Although there are numerous studies on the direct effects contaminated sediments may have on fish, there are few studies that look specifically at the acute toxicity of suspended contaminated sediments due to dredging.

Heavy metals. Branchial uptake of dissolved metals is presumably the most significant exposure route for short-term acute toxicity in fish. Bioavailability and toxicity of waterborne metals is very speciation dependent. Chemical speciation concerns the nature and quantity of the various forms in which a chemical element occurs. Typically, the free metal ion is the most toxic form, and metals complexed with dissolved organic and inorganic anions show lower degrees of bioavailability and toxicity. This general rule, however, is not always valid. Notable exceptions are organometallic compounds such as the very toxic methyl mercury and tributyl tin. In any case, risks from heavy metals released during dredging would be primarily related to changes in conditions promoting the shift of heavy metals from the particulate into the dissolved state.

Organic contaminants such as pesticides, polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs) are generally not very soluble in water and direct toxicity by exposure to dissolved concentrations in the water column is not very likely. Nevertheless, the particulate bound portion of chemicals can also be toxic (Figure 8.4). Various acute toxicity and biological effects have been attributed to organic contaminants based on laboratory studies: pesticides may cause paralysis or avoidance; PCBs may influence enzyme activities, and PAHs have a narcotic mode of action involving interference with key membrane-mediated physiological and biochemical processes. PAHs can be acutely toxic in the parts per million (ppm) ranges. The lethal concentration for 50% of the population (LC50) values for acenaphthene and pyrene determined in short-term freshwater toxicity studies (exposure 1 day) with rainbow trout were 1.6 mg/L and 2.0 mg/L (USEPA 2007). Deleterious sublethal responses include growth and development anomalies, cancer, or susceptibility to infectious disease, but these are only known to occur due to long-term exposure.

Low dissolved oxygen (Figure 8.5). DO concentrations between the aquatic life criterion and several mg/L below the water quality objectives (WQO) would be expected to slow fish growth rate; the amount of impact is proportional to the amount of depletion below the WQO. If the DO would remain at or below a critical DO level of about 2 to 3 mg/L, significant mortality is expected in fish populations. Generally, reduced DO concentrations due to sediment resuspension would be expected to be localized and short term, with minimal impacts.

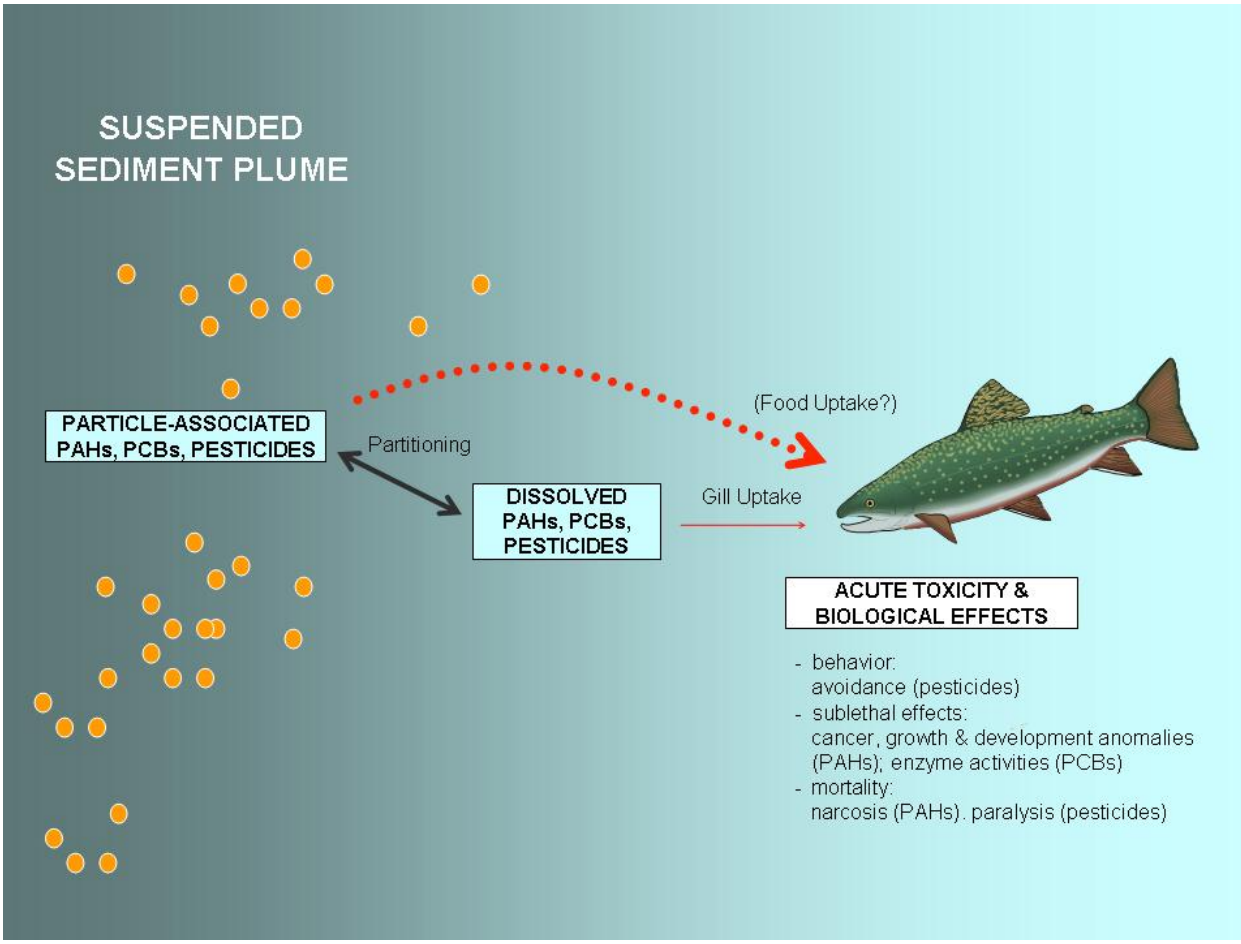


Figure 8.4: Conceptual model of direct short-term toxicity due to exposure to organic contaminants in resuspended sediments

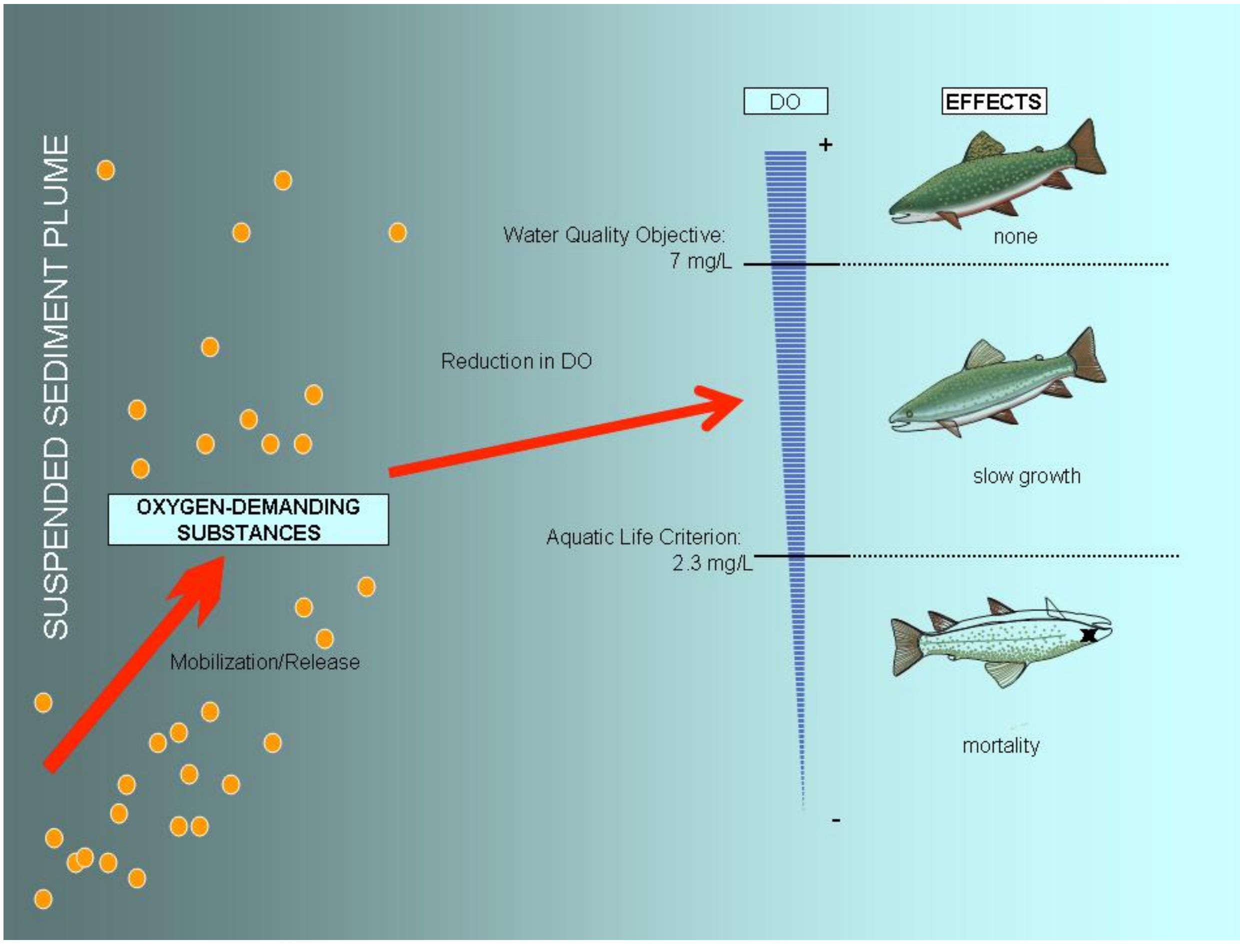


Figure 8.5: Conceptual model of reduced DO impacts on fish

Hydrogen sulfide (H_2S) is a metabolic poison that is lethal to most fish at less than 1 mg/L (USEPA 1976). Effects on fish are difficult to determine because H_2S usually occurs only in association with hypoxic conditions; that is, situations with extremely low DO below the aquatic life criterion that are also lethal to fish (Figure 8.6). Aside from ephemeral releases of H_2S, risks to fish may be of greatest concern when dredging operations result in depressed DO concentrations near the bottom. Risks of H_2S to fish are dependent on temperature, pH, and DO. In general, fish exhibit a strong avoidance reaction to H_2S.

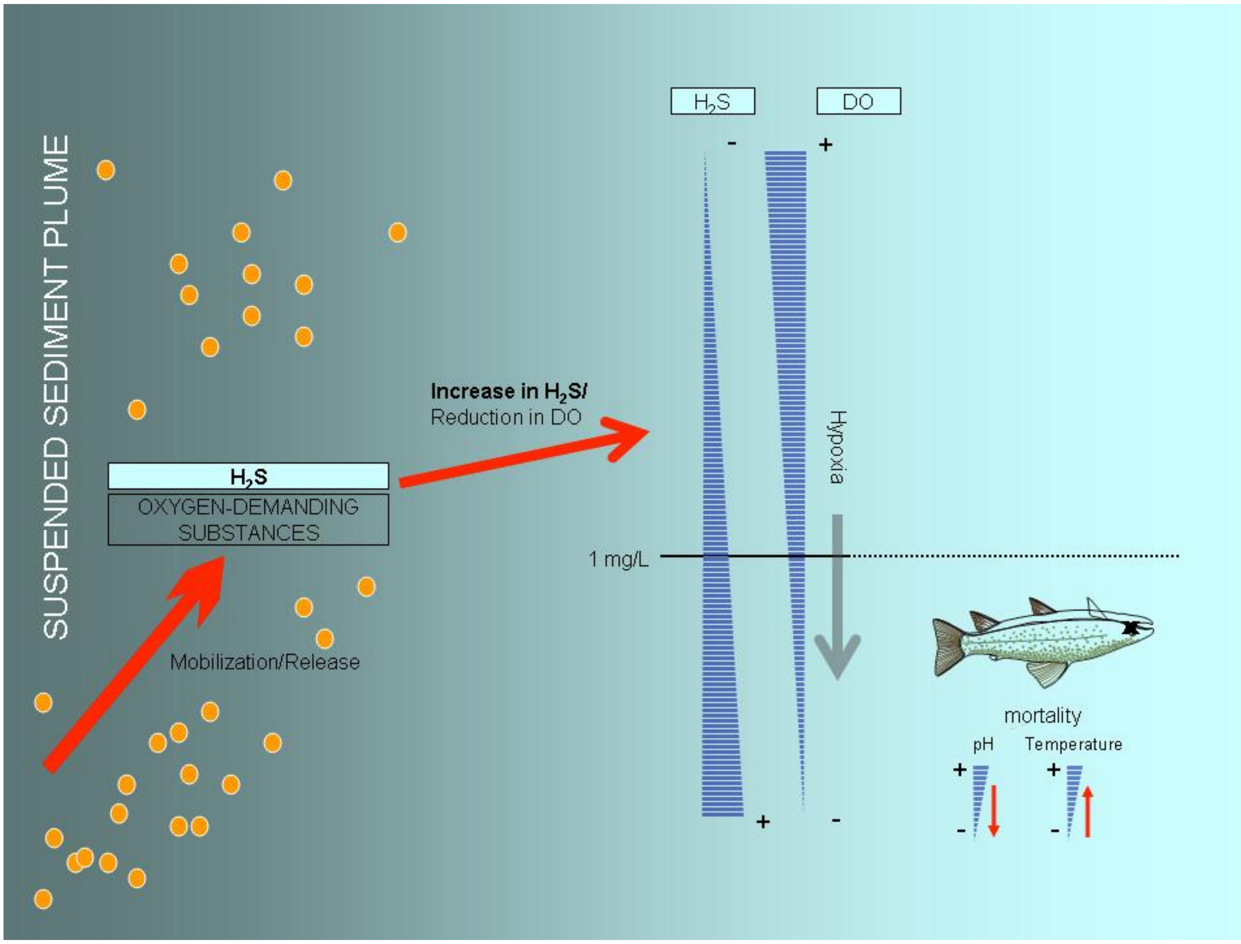


Figure 8.6: Conceptual model of potential acute H2S toxicity to fish during dredging. H2S toxicity is associated with hypoxic (low DO) conditions that are also toxic to fish

Ammonia toxicity is strongly influenced by differences between species and pH. Salinity and temperature also influence ammonia toxicity, but the effect is comparatively minor compared to pH. In general, ammonia toxicity is based on the presence of unionized ammonia (NH_3). In estuarine fish, the toxicity of ionized ammonia (NH_4^+) may also occur, since the gills show some permeability to this ion.

During ammonia exposure, estuarine fish are most likely to be at risk during larvae or juveniles stages if the temperature is elevated, if salinity is near the sea water value, and if the pH value decreases below pH 7. They are also likely to be more at risk in waters of low salinity, high pH and high ammonia levels. These conditions favor transfer of ammonia from the environment into the fish, as both ionized and unionized ammonia, and retention of ammonia by the fish is likely. Since ammonia interferes with nervous function, there may be impairment of activity and behavior. Fish will be further at risk from ammonia toxicity if they are not feeding, if they are stressed, and if they are active and swimming. Episodic exposures to ammonia, as would be the case for dredging-related exposure, should be considered in relation to the rate at which the animal is able to accumulate and excrete ammonia, and the effects of ammonia ionic regulatory and acid-base processes in the gill. The rate of unloading the accumulated ammonia from the body will be of critical importance in determining response to the next episode. If the next episode occurs before ammonia unloading is substantially complete, then a larger and potentially more damaging burden of ammonia may accumulate, with possible disruption of ionic regulatory processes.

Salinity: Many studies have reported an influence of water salinity on fish development and growth. In most species, egg fertilization and incubation, yolk sac resorption, early embryogenesis, swim bladder inflation, larval growth is dependent on salinity. In larger fish, salinity is also a key factor in controlling growth. Numerous studies have shown that 20 to >50% of the total fish energy budget are dedicated to osmoregulation. However, recent ones indicate that the osmotic cost is not as high (roughly 10%) as this. Temperature and salinity have complex interactions. Many hormones are known to be active in both osmoregulation and growth regulation, e.g. in the control of food intake (Boeuf and Payan, 2001).

Temperature: In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish (Patil *et al*. 2012). For most fish, body temperature is very close to that of the habitat. The diversity of thermal habitats exploited by fish as well as their capacity to adapt to thermal change makes them excellent organisms in which to examine the evolutionary and phenotypic responses to temperature. An extensive literature links cold temperatures with enhanced oxidative capacities in fish tissues, particularly skeletal muscle (Guderley 2004).

The general effects of climate change on freshwater systems will likely be increased water temperatures, decreased dissolved oxygen levels, and the increased toxicity of pollutants. In lotic systems, altered hydrologic regimes and increased groundwater temperatures could affect the quality of fish habitat. In lentic systems, eutrophication may be exacerbated or offset, and stratification will likely become more pronounced and stronger. This could alter food webs and change habitat availability and quality. Fish physiology is inextricably linked to temperature, and fish have evolved to cope with specific hydrologic regimes and habitat niches. Therefore, their physiology and life histories will be affected by alterations induced by climate change. Fish communites may change as range shifts will likely occur on a species level, not a community level; this will add novel biotic pressures to aquatic communities. Genetic change is also possible and is the only biological option for fish that are unable to migrate or acclimate (Ficke *et al*. 2007).

Mitigation

- Dredging area should be checked every day prior to commencement of dredging work. Rather, pingers will be used to chase away aquatic mammals, dredging equipment will ramp up slowly to minimize noise disturbances and allow for animals to swim away, and that minimum distance will be maintained with sensitive habitats (reedlands, marshlands, etc.)

- Measuring physical parameters of the aquatic habitat like surface water temperature, pH, turbidity (using Secchi disc) on a monthly basis

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8.3.3 Impact of Dredge Material Placement on Land

Under the project the likelihood of disposal of dredged materials on land is limited to upper reach of the Meghna and its tributary and distributary. Major disposal along the Lower Meghna including coastal area will be primarily in the stream. The actual need of land for on land disposal may be less than 10 ha..However the option of landbased disposal is a reality and as such it needs to be discussed. Bangladesh is highly populated country and generally has high conservation or residential value and finding land close to the water and suitable for storing dredge material is difficult. However, the likelihood of land placement is low under this project and that this approach has specifically been adopted to minimize impacts and issues (both E&S) related to on-land disposal. Therefore 10 ha of land is not expected to be needed. Nonetheless option of land-based disposal cannot be ruled out.

The excavated material is pumped to a land based site as slurry (a mixture of sediment and water). Excess water would need to be treated to remove fine particles and ensure clear water was discharged back into the aquatic environment. It takes years to dry, preventing any access to, or use of, the storage area. Areas need to be fenced off to ensure human and animal safety.

Dredged material from estuary is saline and therefore is unsuitable for agricultural and vegetation rehabilitation uses. Establishing any vegetation on spread or stockpiled dredged material is expensive and can take years to become successful. Moving the material from a land based site would involve large numbers of truck movements considering the volumes involved creating community amenity issues and increased greenhouse gas emissions.

Water Quality Impacts of on-land disposal of dredge material (Tailwater and Groundwater)

Tailwater: As part of dewatering of the dredge material, tailwater would be discharged from the bunded area within each land-based dredge material placement area (DMPA). While the discharge of tailwater would be strictly controlled to ensure it is maintained within acceptable quality standards, there is potential for this tailwater to impact upon near aquatic environment. The inherent risk with tailwater discharge is the potential for environment impacts to the receiving waterways if tailwater quality is not managed properly or as result of extreme weather conditions or infrastructure failures.

Further potential water quality impacts can arise from the pumping of dredge material in slurry form from the trailer suction hopper dredger (TSHD) coupling point to the land placement site. This activity has the potential for spills/leakages causing sediment deposition and turbid plumes during pumping operations.

Groundwater: The groundwater test results satisfy the DoE potable water quality guidelines except Noakhali (GW8) and iron is pre-dominantly high in all locations.

Placement of dredge material on land has the potential to impact on underlying and/or adjacent groundwater resources. Impacts to groundwater could eventuate due to the weight of the dredge material compressing the underlying soil structure (affecting groundwater and surface water exchange), and also due to the large proportion of saline and potentially acidic water (if allowed to oxidize) within the pumped dredge material. Placement of dredge material on land could impact on groundwater resources in the following ways:

- Change groundwater levels – most likely raising groundwater levels temporarily during and immediately after the landfarm dewatering, due to the large volume of overlying water
- Change groundwater quality – potentially increasing the salinity of groundwater resources, and changing the chemical composition of groundwater due to a shift in the groundwater/surface water dynamic
- Effects on ecology– changes in groundwater levels and quality may impact on flora and fauna reliant on groundwater resources in close proximity to the placement site
- Effects on adjacent land use (e.g. agriculture) – changes in groundwater levels and quality may impact on adjacent land uses reliant on groundwater resources in close proximity to the placement site.

In placement sites which have intertidal zones, the groundwater resource is especially vulnerable. Groundwater and soil chemistry in intertidal environments is complex and highly dynamic over small spatial and temporal scales. In these areas, the groundwater resources are effectively subterranean estuaries with oscillating hydraulic gradients. There is dynamic exchange of groundwater with surface water where groundwater seepage would take place via surface-connected pores along the intertidal slope during the ebb tide.

On the other hand, land placement options which do not have intertidal areas are located in higher elevations, and therefore are likely to have lower groundwater tables. Notwithstanding the likely lower groundwater table are possibly groundwater users in this rural area which may potentially be affected by changes to groundwater levels and quality.

Habitat Values

Significant habitat values exist across the waterways. Also, there are several places beside the waterways known to be important habitat for threatened and migratory species. Potential impacts on these areas are discussed in thesection 5.3.1. Figure 10.1 and Table 10.1 shows the environmental sensitive areas including location of dreging and disposal sites for dredged materials.

Air Quality impacts of on-land dredge material disposal

The air quality test results in Sadarghat (AAQ2) exceeded the World Bank EHS criteria. Therefore, the placement of dredge material on land is likely to generate emissions from a number of sources during the transport and placement of the material. The works are likely to generate particulate and dust emissions through vehicle movements on-site and to-site via haul roads, disturbance of soils, materials handling and wind erosion of exposed surfaces. When material is initially placed at site, it will be very wet and dust generation would be minimal. As it dries however over time, dust generation will increase and will be difficult to control as the material will be too soft for machinery to gain access. In windy conditions, a significant amount of dust may be generated. Once stabilised and treated, the contribution of dust to the surrounding environment should be significantly reduced. More detailed air quality modelling would be required to confirm the actual impact of air emissions on sensitive receivers and whether an exceedance of limits would occur.

Noise impacts of on-land dredge material disposal

The placement of dredge material is likely to generate noise emissions from a number of sources including pumping and dredge equipment, treatment equipment (e.g. booster pumps, lime dosing equipment, graders, bulldozers and trucks) and haulage of materials to site along public roads for duration of up to 12 months. Dredging is likely to occur over a 24-hour period, affecting sensitive receivers outside of working hours. However, the noise level in baseline environment satisfy the DoE noise measurement guidelines.

Legislative requirements with respect to construction noise impacts do exist in Bangladesh, with the exception of restrictions on the hours of work (6:00 am to 9:00 pm) of construction sites which produce audible noise at a noise sensitive receptor. Sensitive receptors, as defined in the Noise Pollution (Control) Rules, 2006, include dwellings, libraries and educational institutions, childcare centres and kindergartens, outdoor school playground areas, medical institutions, commercial and retail activities, protected areas, parks and gardens. Bangladesh Standard for Noise Level at Different Types of is given in Table 8.3

Table 8.4: Bangladesh Standard for Noise Level at Different Types of Areas (as per Noise Pollution (Control) Rules, 2006)

		Zone	Day	Night
BD Noise Standard (2006)		Silent areas	50	40
		Residential	55	45
		Mixed	60	50
		Commercial	70	60
		Industrial	75	70

As stated above, it is likely that material placement would occur beyond these standard hours. In the worst case scenario, excessive night time noise can cause human health impacts over a period of time. Because of the noise emissions; migratory birds which use this area could also be impacted and may avoid the area temporarily during works. Excessive noise at the dumping site would cause disruption to businesses, tourism and nearby residence; this is likely to be considered an unacceptable impact for the area.

Odour and pest impacts of on-land dredge material disposal

The material to be disposed will be mostly anaerobic sediment, containing hydrogen sulphide. On exposure to air during drying processes this can cause temporary nuisance odour (of a duration of a few days). The extent of the odour impact will be dependent on the drying method and prevailing wind conditions at each site as well as the proximity of sensitive receptors.

Land-based placement of dredge material will involve large bunded areas where dredge material in slurry form will initially be placed. These placement areas would represent modified habitats and large areas of ponding water would be present during the dewatering and treatment of tailwater. There is a small chance that these areas may become attractive to pests or other species due to the modified nature of the placement areas and the exposed areas of water.. These pests include:

Birds attracted to areas containing open water bodies, including dredge disposal sites. This could be considered a positive impact overall if it occurs, except if dredge materials disposal sites are close to an airport, in which case it represents a safety risk to aircraft landing and taking off from the airport. Mosquitoes – due to the modified nature of the placement site, and areas of open water, additional mosquito breeding habitat could be unintentionally created. This impact is expected to be minor, given that only a small percentage of dredge material may eventually be disposed on land (with the rest being disposed in the river), and also given that on-land disposal if required will be done in confined disposal facilities designed to facilitate proper drainage of excess water to avoid ponding.

Traffic

Placement of dredge material on land would involve the transport of materials for treatment of the dredge material and for construction purposes. To provide an indication of potential traffic issues which may result from transport of this material, a high level estimate of heavy vehicle use has been determined for each land placement option. This high level traffic assessment is based on the concept designs of the land placement options, and includes consideration of the delivery of materials such as lime, clay, stone and geo-synthetic liner to the placement site. It should be noted that to accurately determine the full traffic impact associated with the use of each land placement option, a more detailed Road Impact Assessment would be required.

The potential impacts of heavy vehicle to the external traffic network from an operational and safety perspective include:

- Operation of existing road network – impacts on traffic volumes at intersections and pavement impacts
- Hazard and safety impacts from an increase in heavy vehicle traffic
- Amenity and nuisance, including noise and dust
- Environmental issues related to potential spillage of dredge material on roads
- This section outlines the potential traffic issues for each land placement option.

Community Benefit

Land-based placement of dredge material may potentially provide some benefit to the community in terms of valuable land use, depending on the final proposed end use for the placement site.

If the land-placement area can later be developed for residential, commercial or industrial uses, the land would represent an economic value to the community. This land would also provide social benefits to the community in the form of additional areas for housing and industry, or as public recreation areas.

Land placement areas used merely as placement areas would have limited economic value and would incur ongoing maintenance costs. These costs can include lost opportunity costs and costs to maintain infrastructure associated with the placement area, such as bunding, seepage control and public safety (e.g. fencing).

Visual Amenity Issue

Land placement of dredge material would potentially cause the greatest impact on visual amenity during the construction phase. For developed sites, the visual amenity impacts after ground treatment and development will likely to be somewhat reduced. For placement sites, visual amenity impacts would likely be more prolonged.

A DMPA would cause a significant temporary visual impact, as the placement of dredge material will require the employment of trucks and earthmoving equipment on a continual basis, with night lighting, thus impacting the rural landscape character of the site. In the longer term after placement is complete, the site will appear as a raised platform of rivers sediment and will appear largely incongruous within the surrounding landscape.

Mitigation Place the dredge material as nearer as possible. Since, with increasing pumping distance there is an associated increase in the water required to pump the material which could potentially double the volume of process water required for distant sites.

In case of hazardous and toxic dredged material to be stored separately, suitable site to be identified in consultation with public representative and community people before placement on the land.

1 Pumped material would be delivered to site in a slurry form with moisture content of approximately 90 percent. It would need to be dewatered to a moisture content of approximately 40-60 percent to enable rehandling by machinery (excavators and trucks). Prior to filling commencing, the areas being filled will be subdivided into compartments by construction of temporary containment bunds of suitable material (e.g. dredged sand). Filling will be achieved by progressively pumping a slurry of sand and water into the bunded areas, allowing the surplus water to drain away to artificial and natural waterways in a controlled manner through the pipeline, without affecting floodplains.

2 Control the discharge of site runoff, including excess dredge water, by the installation and correct use of containment walls, bunds and weirs.

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8.3.4 Impacts from Dredgers and Associated Vessels

Noise

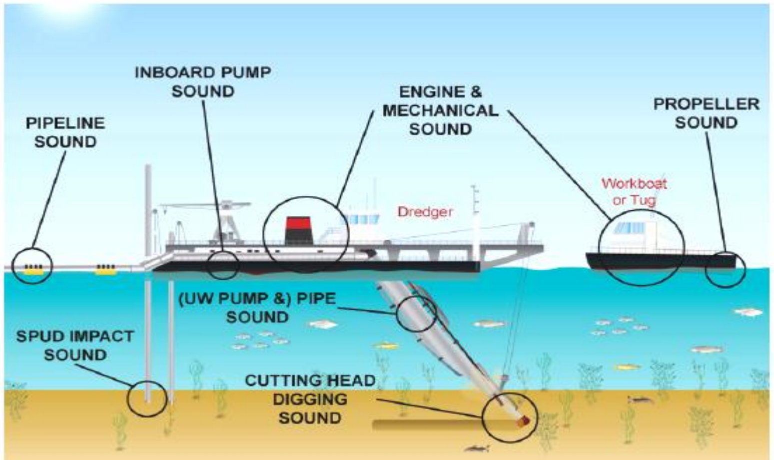
Water is an excellent medium for sound transmission. Sound travels more than four times faster underwater than in air and absorption is less compared to air. The sensory modalities of vision, touch, smell and taste are limited in range and/or the speed of signal transmission. As a consequence many aquatic organisms use sound as their primary mode of communication – to locate a mate, to search for prey, to avoid predators and hazards, and for short- and long-range navigation. Activities generating underwater sound can affect these functions and, since sound can be far ranging, the spatial scale of impacts can be quite large. Concerns for underwater sound impacts on marine mammals, fishes, and other forms of aquatic organisms have arisen primarily with the conduct of military operations, seismic exploration, dredging and various forms of construction in aquatic environments.

Short-term temporary increases to noise will occur in the vicinity of the dredging operations and staging/dewatering activities. Sources of noise include the dredging equipment, dewatering equipment, generators, loaders, and the trucks used to transport the dewatered material for placement. Noise levels generated by the dredging operation will vary according to the size and type of the equipment used, and more importantly, the size and type of the engines. For this project, the PBC contractor will use suitable dreder depending on type of sediment to be dredged. Generally speaking during dredging operations, there are three categories of sound sources that are associated with:

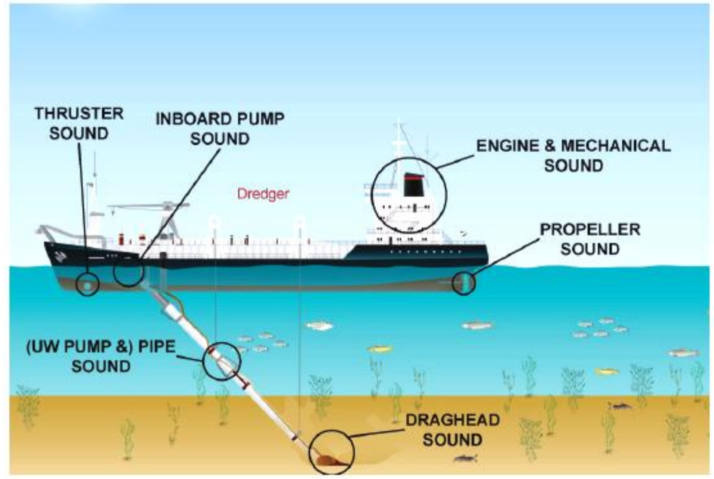
- Dredging excavation
- Dredging vessels during transport
- Dredged material placement.

Figure 8.7 gives an overview of the different types of dredging vessels and the sources of underwater sound for each type of vessel. Sound production is largely influence by sediment properties – to excavate hard, cohesive and consolidated soils, the dredger must apply greater force to dislodge the material. Sounds from dredges can be variable, depending on the phase of operation, and the type of dredge used, but typically occur at low frequencies (<500 Hz).

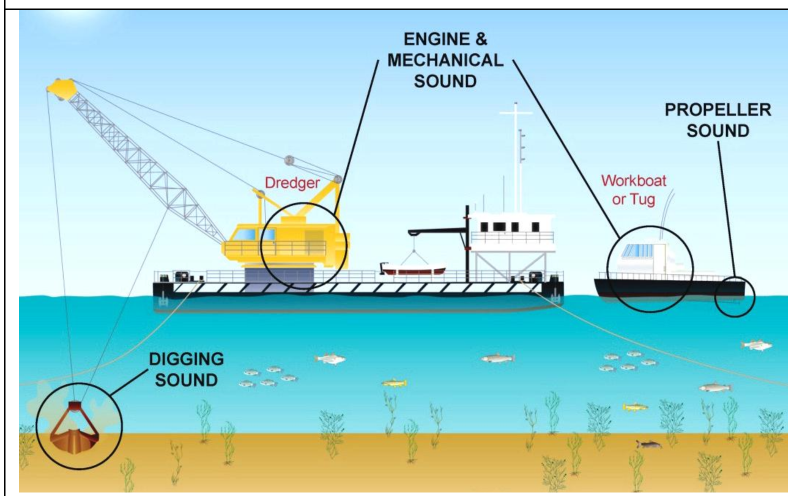
Noise from dredgers and associated vessels was not assessed under this ESIA study. This information is gathered from various secondary sources. In few areas of the Project Influence Area exceeded the guideline due to the unplanned urbazination and industrialization. Therefore, instrument and machinery should be controlled and maintain with manufacturer recommendations especially the use within residentaila and environmentally and socially sensitive areas. Some of these areas are Sadarghat, Chandpur Launch ghat, and Bhola. However, the dredgers produce minimum noises that are within the limit of prescribed guidelines. The following table shows the sources of the noise in a cutter and hopper suction dredgers.



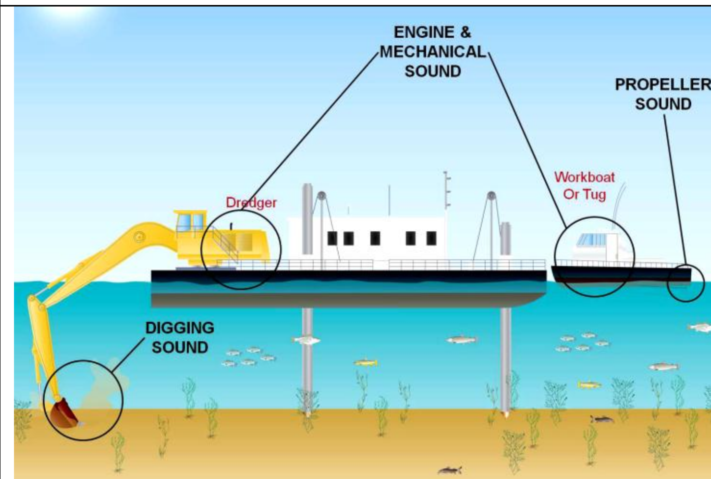
cutter suction dredger



hopper dredger



grab dredger



backhoe dredger

Figure 8.7: Sources of Noise from several types of dredgers and associated vessels

Hydraulic pipeline cutterhead dredges are commonly used for both new work and maintenance dredging operations. They are capable of removing most types of material and pumping the slurry through pipelines for several miles or longer with the use of booster pumps. The major processes contributing to hydraulic dredging sounds include: 1) dredge material collection sounds originating from the rotating cutterhead in contact with the bed and intake of the sediment-water slurry, 2) sounds generated by pumps and impellers driving the suction of material through the pipes, 3) transport sounds involving the movement of sediment through the pipes, and 4) ship and machinery sounds, including those associated with the lowering and lifting of spuds and moving of anchors by dredge tenders. Pipeline cutterhead dredges have a source level at 1 m of 172 dB – 185 dB re 1uPa rms, ranging from 100 – 500 Hz. However, cutterhead sounds might be peaked at 100-110 dB in the frequency range of 70-1000 Hz and are inaudible at ~500 m from the source.

Hopper dredges hydraulically remove sediment from the seafloor through dragheads. Sediment is sucked upward through a pipe by means of centrifugal pumps, and the slurry is transferred to the hopper bin. Much of the sound is associated with propeller and engine noise with additional sounds emanating from pumps and generators. Similar to the cutterhead suction dredge, produce noise ranging from 70 to 1,000 Hz with peaks at 120 to 140 dB. Hopper dredges have a source level of 186 dB – 188 dB re 1uPa rms ranging from 100 – 500 Hz.

Grab or Bucket dredges produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The noise generated from a mechanical dredge entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. Once the barge is full, it would be towed by a tug offshore and emptied into the approved placement sites. The maximum noise spike with mechanical dredges is when the bucket hits the bottom. All other noises from this operation (i.e., winch motor, spuds, etc.) are insignificant. The sound of a bucket impact with the substrate is at the limit of detection by a low-noise hydrophone and hydrophone audio amplifier at 7 km from the impact point. These dredges are anticipated to be used in the lower harbor and in the entrance channel to dredge soft rock from the channel.

Backhoe dredgers require the use of transportation barges. Production of underwater sounds by this mechanical dredger depends on the dredging cycle, including the availability of barges. In general, this produce relatively low frequency sounds.

Sounds can have a variety of effects on aquatic life, ranging from subtle to strong behavioural reactions such as startle response or complete avoidance of an area. It is well documented that short and impulsive sounds such as those produced from pile driving strikes, seismic airguns and military sonar can cause behavioural reactions by fishes and cetaceans (whales, dolphins and porpoises for example) up to distances of several tens of kilometres from the sound sources.

Certain sounds can also mask biologically important signals such as communication calls between baleen whales or fish. If the level that the animals receive is high enough, sound can affect hearing either temporarily or permanently and extremes can lead to injury or even death. The latter, however, usually occurs only in the case where animals are very close to very high intensity sounds, without having the opportunity to move away. Even when sound alone is not severe enough to affect the wellbeing of populations of concern, together with factors such as fishery by-catch, pollution and other stressors, sounds may create conditions that contribute to reduced productivity and effects on survival.

While there would be an increase in the ambient noise level during the dredging phase of the project, the source of noise is at a distance far enough away from any sensitive receptors that no significant impact is anticipated. The closest the dredging would be to any sensitive receptors would be along the river channel. Most of these communities are buffered from the river by the regular activities within these rivers. Since dredging does not occur in one position for any extended period of time, there will be no disproportionate impact on any communities.

Ganges River Dolphin: The Ganges-Brammaputra-Meghna River sysem is a favorable river dolphin habitats especially upper and lower Meghna of the Project area. Potential impacts of noise on dolphins include mortality, hearing damage, masking of communication and other biologically important sounds, and behavioural responses[5]. Mortality only occurs in the immediate vicinity of very high energy noise sources, such as blasting, and is unlikely to occur for the considered pump noise.

Behavioural response - Behavioural responses to noise include changes in vocalisation, resting, diving and breathing patterns, changes in mother-infant spatial relationships, and avoidance of the noise source[6].

Southall et al. (2007)[7] conducted a review of numerous studies into behavioural disturbance in high-frequency cetaceans from continuous man-made noise. Most of these studies concerned the effects on harbor porpoise. A ranking of behavioural response severity was adopted to emphasise that not all behavioural responses are equally significant. Behavioural changes may be relative minor and/or brief, have the potential to affect important behaviours such as foraging, breeding and resting, or are likely to affect these vital behaviours.

The review by Southall et al. (2007)[8] concluded that harbor porpoise display behavioural response at very low noise exposures of SPL 90 to 120 dB re 1 μPa, at least for initial exposures. It is noted that for the majority of observations, the behavioural changes to levels below 120 dB re 1 μPa were relatively minor or brief. Significant and sustained avoidance behaviour was recorded when noise levels exceeded 140 dB re 1 μPa. Habituation to sound was noted in some but not all studies.

The United States (US) National Oceanic and Atmospheric Administration (NOAA) adopts interim noise exposure criteria for assessing behavioural disruption and injury in cetaceans

[5] Richardson et al. (1995). Marine Mammals and Noise. San Diego: Academic Press.
[6] Richardson et al. (1995). Marine Mammals and Noise. San Diego: Academic Press.
[7] Southall et al. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33(4).
[8] Southall et al. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33(4).

from underwater noise. An exposure criterion of SPL 120 dB re 1 μPa is conservatively adopted for behavioural disruption (NOAA 2011)[9].

Whether the harbor porpoise data reviewed by Southall et al. (2007) can be extended to the Ganges River Dolphin is unknown. However, combining the conclusions of their review and the conservative interim criterion adopted by NOAA, it is assumed as a precautionary measure that noise levels above SPL 120 dB re 1 μPa may cause behavioural disturbance.

A study into the habitat use and distribution of the Ganges River Dolphin in the VGDS concluded that the number of motorised boats and boat noise were not significantly correlated with dolphin encounter rates (Kelkar, 2008)[10]. Small boats equipped with outboard engines can produce source levels in the order of 160 dB re 1 μPa at 1 m, or received levels of over 120 dB re 1 μPa at 1 m up to 500 m. Although the study results suggest that boat noise is not displacing dolphins, it is not conclusively showing that such noise levels do not impact on their behaviour.

Masking - 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. 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)[11]. This is well above the dominant frequency range of most man-made noise, including pump noise. Masking of echolocation signals is therefore not a significant issue for most man-made sources (Richardson et al., 1995). In other words, the dredge noise 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

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[9] National Oceanic and Atmospheric Administration (NOAA 2011). Interim Sound Threshold Guidance for Marine
Mammals. http://www.nwr.noaa.gov/Marine-Mammals/MM-sound-thrshld.cfm.

[10] Kelkar, N. (2008). Patterns of habitat use and distribution of Ganges river dolphins Platanista gangetica gangetica in a human-domintaed riverscape in Bihar, India. Master Thesis, Manipal University, Centre for Wildlife Studies, Bangalore.

[11] Sugimatsu et al. (2011). Annual Behavioral Changes of the Ganges River Dolphins (Platanista gangetica) Based on the Three Long-Term Monitoring Seasons using 6-Hydrophone Array System. IEEE Symposium on and 2011 Workshop on Scientific Use of Submarine Cables and Related Technologies, (pp. 1-7). Tokyo.

low as 1-6 kHz. Communication signals are therefore more likely masked by man-made noise than echolocation clicks.

Hearing damage - When the dolphin's auditory system is exposed to a high level of sound for a specific duration, the sensory hair cells begin to fatigue and do not immediately return to their normal shape (NRC 2005)[12]. This causes a reduction in the hearing sensitivity, or an increase in hearing threshold. If the noise exposure is below some critical sound energy level, the hair cells will eventually return to their normal shape. This effect is called a temporary threshold shift (TTS) as the hearing loss is temporary. If the noise exposure exceeds the critical sound energy level, the hair cells become permanently damaged and the effect is called permanent threshold shift (PTS).

Noise exposure criteria for marine mammals were recommended by a group of experts based on a review of available data (Southall et al. 2007). An M-weighted exposure criterion of SEL 215 dB(M) re 1 $\mu Pa^2 s$ is recommended for PTS from continuous noise. This is based on a TTS-onset level of SEL 195 dB(M) re 1 $\mu Pa^2 s$ measured in mid-frequency cetaceans, and adding 20 dB to estimate PTS on-set (Southall et al. 2007).

The United States (US) National Oceanic and Atmospheric Administration (NOAA) adopts interim noise exposure criteria for assessing injury in cetaceans from underwater noise. An injury criterion of SPL 180 dB re 1 μPa is adopted for PTS conservatively based on available data for TTS (NOAA 2011).

Noise exposure criteria – Table 8.4 summarises the noise exposure criteria adopted for assessing hearing damage (PTS or TTS) and behavioural effects on the Ganges River Dolphin from pump noise. The noise exposure criteria are based on the review presented by Southall et al. (2007) and the current interim criteria adopted by the NOAA (2011), which were discussed above.

Table 8.5: Noise exposure criteria for physiological (PTS and TTS) and behavioural impacts from impact piling on cetaceans

Impact	Noise exposure criteria
Permanent threshold shift	SEL 215 dB(M) re 1$\mu Pa^2 s$
Temporary threshold shift	SEL 195 dB(M) re 1$\mu Pa^2 s$
Behavioural response	SPL 120 dB re 1 μPa

[12] NRC. (2005). Marine Mammal Populations and Ocean Noise - Determining When Noise Causes Biologically Significant Effects. National Research Council, National Academies Press.

Air Pollution

Navigation channel maintenance dredging equipment needs to be mobile and capable of operation without an external power source, making diesel fuel the predominate choice. The combustion of diesel fuel releases pollutants into the atmosphere that can be quantified and compared between dredging crews to determine the lowest adverse environmental impacts for each type of equipment and scenario. These contaminants impact air quality and may add to global climate change considerations. However, air quality test results indicate that all test results are within the national standards.

Air pollution from ships causes a cumulative effect that contributes to the overall air quality problems on a local scale, particularly in coastal zones in the case of sulphur oxides (SOx), nitrogen oxides (NOx), Particulate Matter (PM), and on a global scale with CO_2 emissions contributing to climate change. Most of these airborne pollutants are produced when burning fuel oil.

Potential air quality impacts associated with the Project have been identified and assessed. As dredging activities of the Project are river based and no dusty activity is anticipated, negligible dust impact on nearby air sensitive receivers (ASRs) is expected during both the construction of the Project as well as for the maintenance dredging activities. **Waste (Solid and Liquid)**

The marine-based construction activities also bilge water from ship and accidental spills during operation phase will result in the generation of a variety of wastes which can be divided into distinct categories based on their nature and ultimate method of disposal. The types of waste include:

- river sediments
- construction waste
- chemical waste; and
- general refuse

The definitions for each of these categories and the nature of their arising and potential impacts are discussed in the following section.

River Sediments: Dredged river and marine sediments will arise from the construction activities and it is estimated that a total of approximately 5-6 million m^3 of dredged materials will be generated annually. The potential environmental effects of the removal and disposal of these sediments comprise water quality impacts and indirect adverse effects on aquatic biota, as discussed in detail in Section 8.3.2.

Construction Waste: During construction activities carried out by the contractor, wastes including materials packaging and equipment wrappings, may be generated. As the volume of construction waste generated will be dependent on the Contractors operating procedure and practices, it cannot be quantified.

Chemical Waste: Chemical wastes likely to be generated by construction activities will mainly arise from the maintenance of equipment. Waste arising from these activities may include cleaning fluids, solvents, lubrication oil and fuel. The cumulative effect of a potentially large number of small spillages during maintenance operations by faulty equipment, accidents, and carelessness may be significant.

Chemical wastes arising during the construction phase may pose serious environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the Chemical Waste Regulations. These hazards include:

- toxic effects to workers
- adverse impacts on water quality from spills and associated adverse impacts on aquatic biota and
- fire hazard.

General Refuse: General refuse may include food wastes and packaging, waste paper, etc. and have the potential to cause impacts on water quality. Release of general refuse into river waters should not be permitted as introduction of these wastes is likely to have detrimental effects on aquatic biota in the area.

The amount of general refuse which is likely to arise cannot be quantified at this time as it will be largely dependent on the size of the workforce employed by the contractor and the implementation of practices on board the works vessels.

Mitigation

- Select appropriate dredger to minimize the noise as much as possible
- Regularly measure underwater noise level and avoid Ganges Dolphin movement area for dredging. Difficult to specify these areas however, during dry season location of scour holes, river confluences and river bends may be avoided. Under water noise may not exceed 145dB at 70kHz, which is also the maximum noise level to be used by the pingers to drive the dolphins away
- Minimize underwater noise impacts on nearby fauna by slowly ramping up equipment, using pingers etc to allow fauna to swim away in advance of dredging
- Regularly check and carry out maintenance work of dredgers and associated vessels to reduce air pollution from them
- Do not dishcharge liquid and solid waste into the river from vessels

8.3.5 Impacts from Disposal of Contaminated Dredged Material

Although generally not heavily contaminated, much dredged material is subject to some contamination. A variety of harmful substances, including heavy metals, oil, TBT, PCBs and pesticides, can be effectively ‘locked into’ the riverbed sediments. These contaminants can often be of historic origin and from distant sources. The dredging and disposal processes can release these contaminants into the water column, making them available to be taken up by animals and plants, with the potential to cause contamination and/or poisoning. The likelihood of this occurring depends upon the type and degree of sediment contamination; however, some remobilization of very low levels of pollutants would be expected during many dredging campaigns.

The highest levels of contaminants generally occur in silts dredged from industrialized estuaries. If low level contaminants are released into the water column during disposal, they may accumulate in marine animals and plants and transfer up the food chain to fish and sea mammals.

General effects of contaminants on marine life:

- When found in sufficient quantities in the food chain, contaminants may cause morphological or reproductive disorders in shellfish, fish and mammals.
- Generally young shellfish and crustaceans (oysters, shrimp, crab and lobsters) are much more susceptible to the toxicity of contaminants than adults.
- Concentrations of heavy metals in most estuaries are too low to cause adverse effects on eelgrass *Zostera*.

Years of point and non-point source discharges from industrial and municipal facilities, and urban and agricultural runoff to the rivers in Bangladesh and its distributaries/tributaries have contributed toxic substances into the ecosystem, resulting in major contamination issues. The occurrence of very contaminated sediments is certain in the river of Buriganga and in some locations of Meghna also.

Mitigation

- Test the dredged material to measure the level of contamination.
- In case of contaminated dredged material, it will be by isolated and stored in confined trences at designated location based on discuswsion with community people before disposal according to national or other applicable guidelines.
- Do not dispose the dredged material in the fish spawning or breeding areas.

8.3.6 Sediment Dispersion Modelling and Impact Assessment

There are a number of dredging locations in the meghna estuary for the improvement of navigability along the Dhaka Chittagong corridor route. During dredging process the river bed will be disturbed and a small part of dredge material are very likely to be in suspension due to the fine sediment content of the bed material. High levels of fine suspended sediment over long periods may have an adverse environmental impact therefore a dredge dispersion modelling was commissioned to investigate these potential impacts. The dredging location along the vola island and sandwip island were selected for sediment-dispersion modeling to investigate the extent and concentration of sediment dispersion considering 5% and 10% dispersion of dredge material due to dredging. During dredging the instantaneous suspended sediment concentration of the navigational channel results in a plume of fine sediment, which is dispersed upstream and downstream through ebb current and flood current.

The available Two-Dimensional Bay of Bengal model covers the whole coastline of Bangladesh. The modelling system used for the development of model is the MIKE21 FM, which is based on an unstructured flexible mesh consisting of linear triangular elements. The mesh enables to increase the resolution of grid around Islands, along coastline and other area of interest. It uses Finite Volume method for discretization of the flow and transport equations.

The upstream end of the model is extended up to non-tidal zone and the downstream end of the model area extends up to 16^0 Latitude in the Bay of Bengal. Three open boundaries are defined in the model, two in the north in the Upper Meghna river at Bhairab and in the Padma river at Baruria. Another one is in the south in the Southern Bay of Bengal at 16o latitude. The maximum depth along the southern open boundary of the model area is more than 2000 m. The northern/ upstream boundaries measured discharge and southern boundary is tidal boundary generated from Global Tide Model. Bathymetric data have been collected from different sources and used for the generation of bathymetry. C-map provides the bathymetry data in the deep sea. In the estuary, different rivers and other areas, available recent surveyed bathymetry data has been used. The model domain for Bay of Bengal Model (BoB) is shown in Figure 8.8

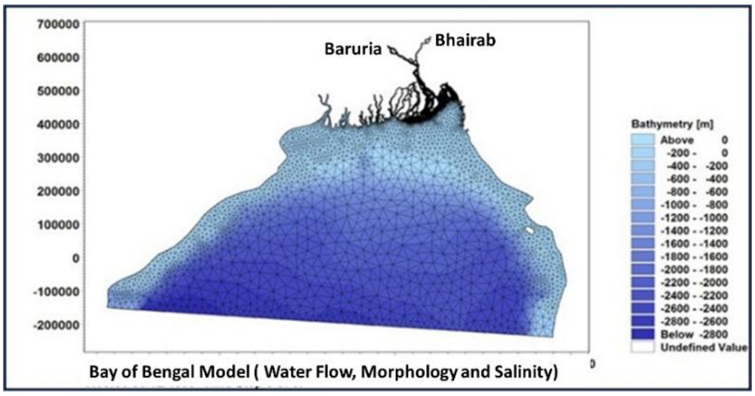


Figure 8.8 The domain of Bay of Bengal Model (BoB)

Hydrodynamics

The existing hydrodynamic model was used to provide a description of tidal current flows and water level variations based upon an unstructured triangular mesh. The water levels and flows are resolved on a flexible triangular mesh, when provided with the bathymetry, bed resistance, wind field, and hydrographic boundary conditions. The model is provided with additional functionality through application of a Mud Transport Module which extends the model capabilities to consider the transport, deposition, erosion and re-suspension of fine sediments. This module was applied to consider the potential impacts of the proposed dredging operations. Water level calibration plot is shown in Figure 8.9 and Figure 8.10

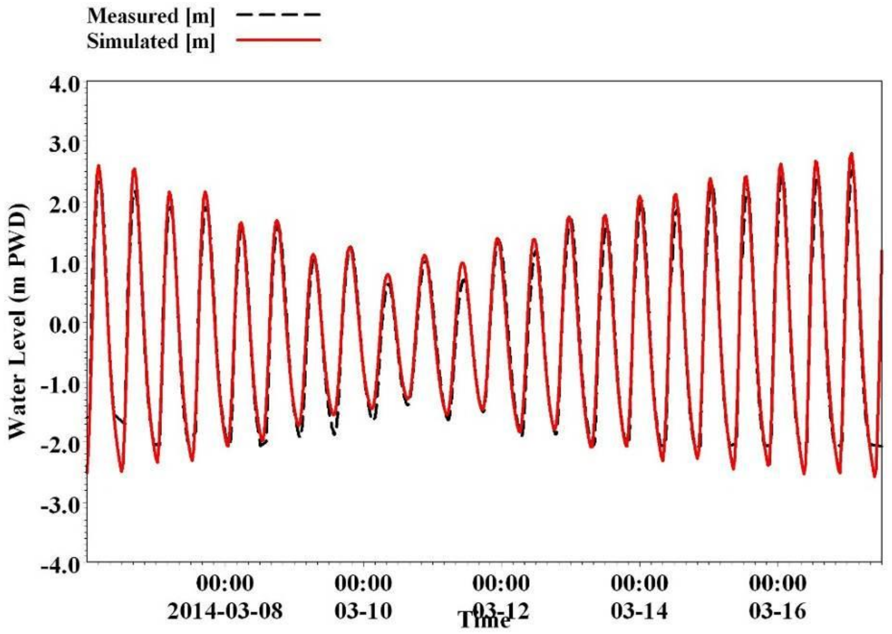


Figure 8.9: Comparison of simulated and measured water level Near Sandwip

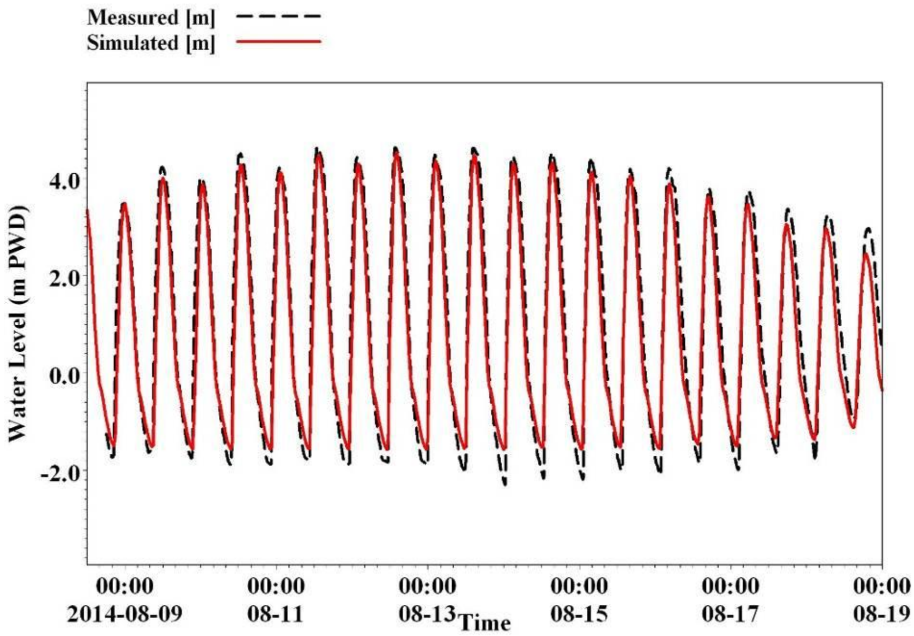


Figure 8.10: Comparison of simulated and measured water level Near Jahazer Char

Simulation of Sediment Dispersion

The hydrodynamic model was used to drive the mud transport model, which simulates the fate of fine sediment associated with dredging. The model results were extracted over the model domain for suspended sediment concentration and unconsolidated sediment accretion. Suspended sediment calibration plots are shown in Figure 8.11 and Figure 8.12

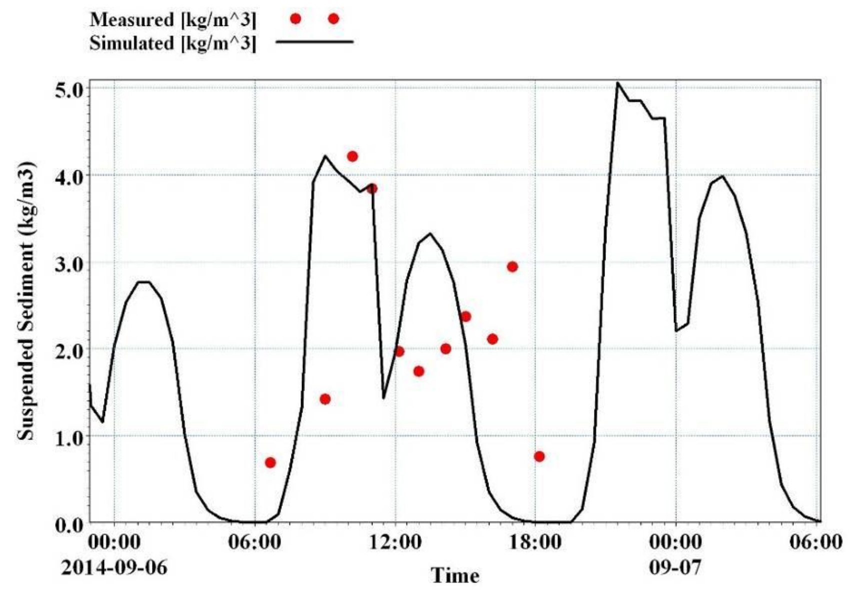


Figure 8.11: Comparison of simulated and measured suspended sediment concentration near

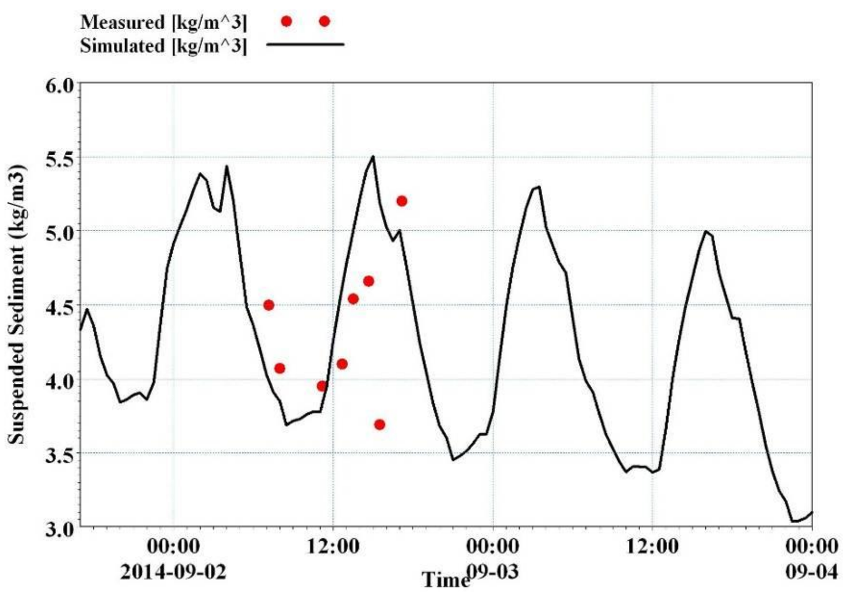


Figure 8.12: Comparison of simulated and measured suspended sediment concentration near Jahazer Char

Impact of dredging operation

The instantaneous suspended sediment concentration during dredging of the navigational channel results in a plume of fine sediment. This plume is dispersed over a significant distance by the strong tidal currents at the point of dredging, which also leads to increased sediment dispersion. During the ebb tide the plume is transported to the south. During periods of slack tide when the tidal currents change direction, an area of the dredge plume passes to the north .During neap tides, suspended sediment concentrations are slightly increased locally due to the reduced current speed, however the plumes follow a similar path and direction, but of reduced extent.

The time-step of the sediment dispersion model simulation was set at 600s (10 mins). At every time-step sediment is released into the water column based on the specific scenario. Sediment concentrations averaged over the entire water column are presented for each modelled scenario. At the end of each simulation (14 days), the maximum sediment concentration that occurs within each model element is calculated. The final maximum concentration results are therefore, not a
representation of any point in time but are instead a time independent view of the sediment plume extent. In reality, the actual sediment concentration at any point in time is likely to be much lower.

The proposed dredging operation lasts for 14 days for the modlled section. The representative snapshots of the plume development (>5 mg/l) are shown in Figures 1.3 and 1.4 for two current directions. It can be seen that the sediment plumes generated during the dredging operation are confined to the alignment of the current directions. The sediment plume is created immediately after dredging works starts and disperses in the direction of the dominant current direction. The presence of the plume (>5 mg/l) can be expected to persist for entire dredging operation, after which it quickly dissipates within 4-6 hours after the dredging activity stops.

The model shows that sediments will migrate and distribute over a large area under the tidal currents. The spreading of sediment is confined in a smaller area under for northerly currents due to the lower magnitude of the current speed compare to the southerly currents.

Figure 8.13 and Figure 8.14 illustrate the map plots of maximum depth averaged concentration over 14 days. The impact (excess concentration) in terms of the extent and area affected has been derived from the model results for four thresholds: 5 mg/l, 4 mg/l, 3 mg/l and 2 mg/l. These plots show the spreading of the suspended sediment. Table 8.5 summarize the maximum affected area and distance from the dredging to the contour defined by a given threshold concentration.

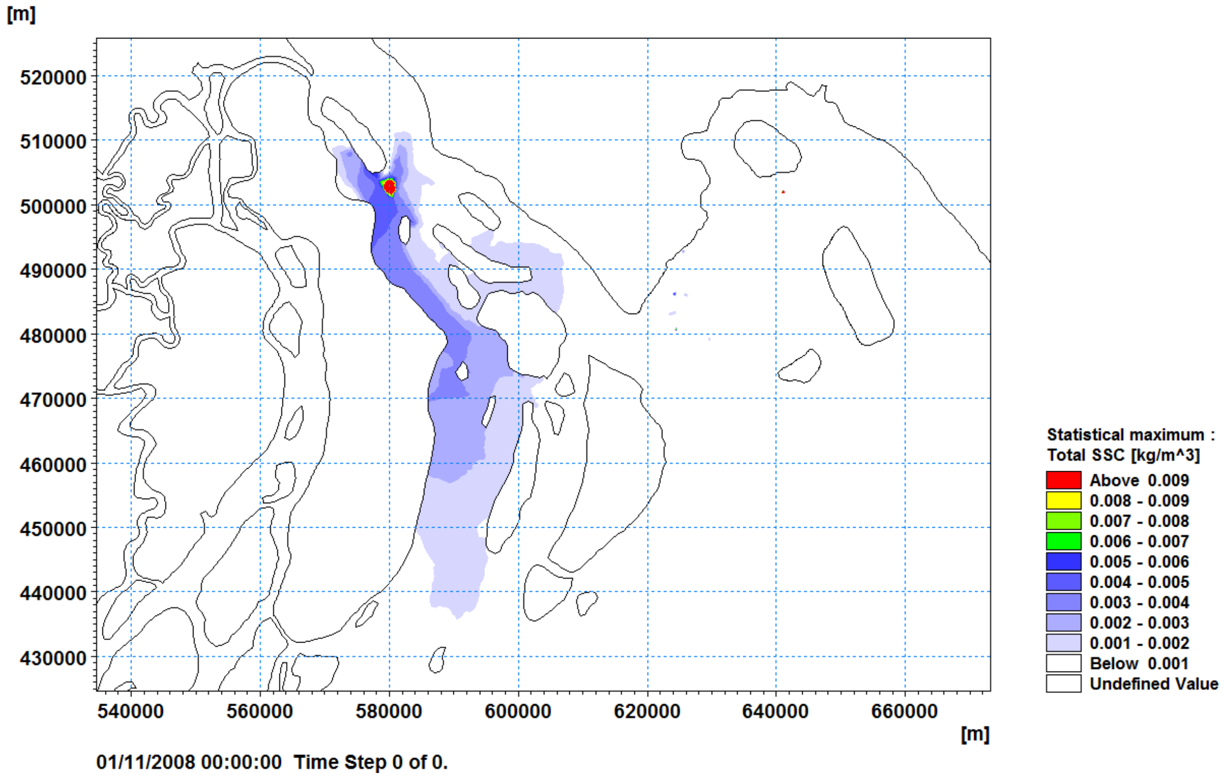


Figure 8.13: Extent of excess sediment concentration for 5% dispersion due to dredging at north of Bhola

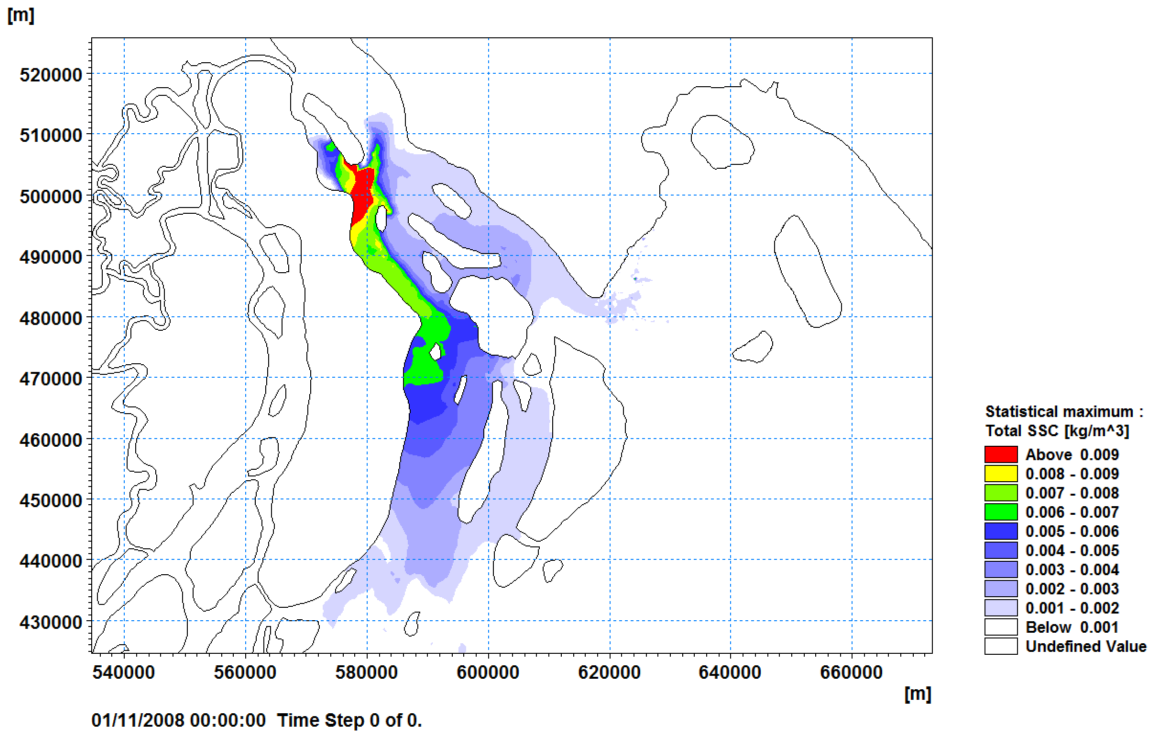


Figure 8.14: Extent of excess sediment concentration for 10% dispersion due to dredging at north of Bhola

Table 8.6: Distance and area affected by the excess sediment concentration

Sl No	Dispersion	Affected area/distance	≥5mg/l (0.005kg/m^3)	≥4mg/l (0.004kg/m^3)	≥3mg/l (0.003kg/m^3)	≥2mg/l (0.002kg/m^3)
1	5%	Distance(km)	13	41	57	80
		Area(km^2)	34	157	372	833
2	10%	Distance(km)	57	66	80	93
		Area(km^2)	375	553	868	1476

Sediment dispersion modelling shows that the maximum excess suspended sediment concentration due to dredging in the Lower Meghna river and Meghna estuary is 42mg/l within 100m from the centre of the dredging in addition to the base suspended sediment concentration. Beyond 100m the excess sediment concentration is very insignificant. The base sediment concentration during dry season in the Lower Meghna river and estuary is in the range 200mg/l to 300mg/l, whereas in the monsoon it varies from 300mg/l to 953mg/l as per field measurements of 2015 under this. The additional suspended sediment concentration is about 4.4 % increase if maximum sediment concentration is considered. If dry season is considered then the percentage increase is about 14%. It implies insignificant impact of dredging in on the flora and fauna of the Lower Meghna river and Meghna Estuary. Feeding and socializing behavior of dolphins, turtles, some fishes may be affected with increased levels of turbidity

8.3.7 Worker Health and Safety

Safety at water applies to all vessels and personnel working in the aquatic sector. Safety also extends to the protection of the aquatic environment, waterborne global trade and consequently in all these aspects to the dredging industry. Safety on dredging vessels and during dredging operations embraces an overall approach towards ensuring the safety and health of personnel, the safety of the ships and the quality of the environment.

Safety standards are applied during every phase of a dredging project, paying close attention to the safety of ships, crews and all other personnel as well as marine life. Ships, operations and offices must comply with the strictest of international standards regarding Quality, Health, Safety and Environment (QHSE).

Works on the water particularly near the coastal area is hazardous due to the hostile and sometimes unpredictable nature of the environment in which it is carried out. Additionally, a variety of potential hazards are believed associated with the project scope of work. The following Table 8.6 can be used to identify anticipated hazards for the project based on the project scope of work and site conditions.

Table 8.7: Anticipated hazards for the project based on the project scope of work and site conditions

Hazard	Control Measures
Cold Stress	Warm clothes, water proof outer layer, regular breaks as necessary.
Water Drowning	Personal Floatation Device (PFDs) will be worn at all times when in support boat
Vehicular Traffic	One person will be on watch for approaching vessels
Slips / Falls	Proper boating footwear must be worn when on board
Sun Exposure	Shaded glasses to be worn during sunny conditions.
Inclement Weather	Field activities will cease in the event of approaching storms or high winds/seas
Heavy Machinery Area	Be aware of machinery operations. Obey no-go-areas where machinery is operating
Physical/Back Injury	First aid will be applied as necessary. Team lifting when weight over 50 lbs.
High Crime Area	Lock all boats and equipment at the end of every day.
Flammable Materials	No smoking will be allowed during work activities. All flammable substances will be stored in appropriate fire-proof containers.
Chemical	PPE worn when there is a potential for sediment contamination
Biohazard	PPE worn if there is a potential for contact with sediment or water. Wash hands prior to eating/drinking.

Personal Protective Equipment (PPE) is a crucial part of worker safety and can include face shields, safety glasses, hard hats, and safety shoes. Additional PPE may also include high-visibility vests, high-visibility fleeces, and raincoats and trousers. This type of equipment has become standard for the dredging industry and has accounted for a significant reduction in accidents and incidents that could endanger a worker. In each case the type of PPE to be used is determined through a risk assessment.

8.4 Social Impacts from Maintenance (dredging) and Vessel Shelter Related Activities

The communities have very high expectation from the project regarding dredging of the river and construction of storm vessels shelters. They expect positive impact on livelihood through better transport and business opportunities. Although there will be some land acquisition due to the project but the project will mostly use government land therefore, the impact will be minimal. Some squatters, lease holders and private land owners might face negative impact due to the project, which can be specified during detailed design stage. Some positive and negative impacts according to respondents' observation are presented in Table 8.7.

Table 8.8: Some positive and negative impacts according to respondents' observation

Expected Positive impacts of the project	**%**
The project will enhance livelihood opportunities	29%
It will improve transport facility	27%
It will upgrade environment and play role in disaster management	20%
The project will enhance social development	5%

Expected Positive impacts of the project	**%**
The project will cause environmental degradation	30%
Transport cost will increase	19%
Negative impact on livelihood during construction	16%
The project will fail in maintenance	11%

8.4.1 Land Acquisition and Resettlement

The project will follow World Bank Operational Policy 4.12 and GoB policy to avoid, minimize and mitigate any adverse land acquisition and resettlement impacts to the communities to be affected by the project. Most of the terminals are on GoB land, but proposed launch terminal facilities will require approximately 2.093 ha land acquisition, which is minimal compared to the overall benefits and influence area of the project. The proposed 06 vessel shelters are planned to be constructed on public land to avoid any negative impacts on the population near project sites. The ESIA study findings indicate that area wise land value is different in various regions based on access to service facility and transport-communication system. In case, where land acquisition is unavoidable, the project will ensure that replacement value in current market price of the affected land is provided to the legitimate owners. Also, structure value, compensation for trees, standing crops will be paid in current market price and business loss will be paid to the business owners for any interruptions caused by the project. The project will consider all possible options to avoid, minimize and mitigate resettlement impacts. For the situation, where land acquisition or displacement is unavoidable, a resettlement action plan will be designed based on policy matrix provided in the RPF to minimize and mitigate any negative impact caused by resettlement due to the project.

If required (i.e. if no suitable in river dumping location is available), Dumping points or stack yards for dredge materials will be identified in consultation with the project stakeholders and community preference. In most cases, the dredge materials will be directly moved and sold to willing buyers. The project will consider all possible means to avoid soil contamination and degradation of top-soil to avoid adverse impacts on agricultural production.

The Project Implementation Unit (PIU) of the Bangladesh Inland Water Transport Authority (BIWTA) will arrange land for disposal of the dredged materials following GoB law i.e. Acquisition and Requisition of Immovable Property Ordinance 1982 (Ordinance No. 2) and subsequent amendment until 1994. The land will be requisitioned through the concerned

Deputy Commissioners of the project districts. The PIU will pay the required amount to DC office as per law as required for renting/leasing for the particular land for the sand deposition. DC office will annually assess the rent for the land and claim fund from the PIU to disburse to the lessees.

In case, where land acquisition is unavoidable, the project will ensure that replacement value in current market price of the affected land is provided to the legitimate owners. Also, structure value, compensation for trees, standing crops will be paid in current market price and business loss will be paid to the business owners for any interruptions caused by the project. The project will consider all possible options to avoid, minimize and mitigate resettlement impacts. For the situation, where land acquisition or displacement is unavoidable, a resettlement action plan will be designed based on policy matrix provided in the Resettlement Policy Framework (RPF) to minimize and mitigate any negative impact caused by resettlement due to the project interventions.

A lease agreement would be signed between the PIU and the land owners according to the broad principles as under-

-DC will identify the actual owners of the proposed land taking into account of the record of rights to the property

-Rent would be paid through the DC office on yearly basis at the beginning of the year

-Land will be used for project purposes only (sand deposition)

-Land will be restored to original condition and returned to the land owners after agreed lease period.

The lease agreement will be based on requisition of land

8.4.2 Impact on livelihood sources

The people of the area are looking forward to earn their livelihood by establishing shops, temporary and permanent businesses etc. after implementation of the project. It goes without saying that there will be a kind of dynamicity throughout the project. Some people will search out their livelihood by working in ferry ghats and proposed storm shelters. When it will be put into practiced all over the river way, a large number of people can get an opportunity to be appointed there. Ghats and terminals related markets are the hearts of economy of local population. If it is possible to expand the market place then a large numbers of peoples will reconcile their livelihood with new hope and they can enlarge it by investing more capital. Some of these markets play an active role in regional or even national economy.

In Harina ferry ghat approximately 500 fishermen are leading their lives by catching fishes. Chairman ghat (Boyar char) is providing livelihood opportunity to a large number of fishermen (about 15000-20000). The fishermen near Hatia and some other char area have been enthusiastic about dredging as the fishermen community depend a lot on river transport system for fishing as well as transporting the fish to the markets. Some river sites lose navigation during low tide, which causes difficulties to the fishermen. On the other hand, some fishermen expressed their concern that dredging causes distortion to regular fish habitats and some fish might migrate to other spots due to dredging.

The population of Bangladesh depends on wild fish for food and the generation of income. A large portion rural family are engaged in part time fish capture from the rivers and beels. Until 70s, there was an abundance of fish in the natural waters of the country to well-satisfy the demand. In recent years, however, capture fish production has declined to about 50%, with a negative trend of 1.24 % per year (Ahmed, 1995). In spite of these in 2013-14, Bangladesh has produced 3548115 MT fish of which 83.22% and 16.78% comes from inland and marine fisheries respectively (FRSS, 2015).

Fishermen comprise a major portion of the inhabitants by the riverside in this project area. They catch fish all the year round. Although they have some modes of established system of their product transportation, this project will add a new dimension in the fish trade as it will develop the navigation as well as port management through vessel shelter construction. However, agriculture (excessive removal of surface water and abstraction of groundwater for irrigation), pollution (domestic and industrial), and unregulated discharge of untreated industrial and farm effluents, habitat destruction also have significant impact, as does the regular over flooding and lack of flooding rain in the last few decades (Hossain, 2014).

The present study has identified an ethnic community named *Bede* in Dakatia river (a tributary of Meghna river in Chandpur). They are living here for round 100-150 years following their ancestors. Their daily income is about 300-500 BDT. Their main occupations are fish capture and selling. No proper sanitation system has been developed for them. Their children get no schooling facility. They drink river water by mixing with Alum. There is several floating net culture's evidence in the Dakatia river. Though it is under culture practice, some people are still making money out of it. Tilapia and carp species are mainly cultured in this system.

In Horinaghat, fishermen stated that, they usually eat the small fishes (Bacha, Dain etc.) of the net and sell the big fishes (Hilsa, Pangus etc.). Another important living source among the fishing communities is the net sewing. A consultation meeting with local residents of Choumohuni, Barisal revealed that, if vessel shelter is made here, a lot of people will earn money for their livelihood and will contribute in this area's economic status. Most of the fishermen near this area are in debt from different loan providers (ASA, Grameen Bank, BRAC, Podokkhep etc). This same situation was observed in Daulatkhan, Bhola where some families were recorded to leave their home and fishing boat to escape from the loan supplier's reminder. This has become a common phenomenon in the fishermen's village. Katha fishery (a special type of fishing, practiced in Bangladesh to aggregate fish in a certain place of open water) is also a temporary subsistence option for some people around the area. This practices were quite familiar in Dakatia river, Koroitola Khal (a tributary of Kirtonkhola river, Barisal), Shitalakkha river (less common than the previous two). One of the main problems was lack of capital for buying fishing gears and craft. Most of the fishermen are Muslim in religion but Hindu are another significant group. Fishermen are engaged in fish catching in the Meghna River throughout the year. January, February, March, April are almost dry season. At that time water level was very low and riverine environment is not suitable for the growth of fish.

So, during this period fish were not available (Mia *et al*., 2015). Fishermen basically change their income source then; to labor based other works at their locality. Almost all fishermen community is disadvantaged in social capital such as the networks, groups, trust, access to institutions etc. There was poor existence of social organizations in the surveyed areas. Lack of social capital has affected socio-economic condition of poor people in fishing communities (Mia *et al*., 2015).

The government of Bangladesh has adopted a programme to protect *jatka* in 2003-04 to ensure sustainable *Hilsa* production. By this programme, *jatka* catch, sell, carry and transport has been prohibited during 1st November to 31st May (7 months). It is not unlikely that *jatka* fishers earn their livelihood by selling *jatka* and they do not have any alternate source of income. That's why the government has given special importance this year for alternate sources of income for *jatka* fishermen so that they can earn their livelihoods by some other means during the 'no catch period' of *jatka*. For the rehabilitation of *jatka* fishers there was a programme named '*Jatka* Protection and Jatka Fishers Rehabilitation Programe'. A total of Tk.2.00 crores/year has been allocated for rehabilitation of *jatka* fishermen during the years 2008-2010. Beside this programme a project named "Jatka Conservation, Alternate Income Generation for the *Jatka* Fishers and Research Project" has been implemented within *jatka* available and sanctuary surrounding *upazilas* for giving alternate income generation activities during the ban period. As this rehabilitation programme was implemented and it helped their livelihood, this made it comparatively easy to keep the fishermen away from catching *jatka*. This project covers 21 *upazilas* of 4 districts. Through this project the Government has allocated 10,000 Tk for each *jatka* fisheries to maintain their family during the *jatka* catch ban period since the project started.
The Government initiated to help the fishers affected by *Hilsa* ban which includes rice provision through VGF (vulnerable group feeding) per household for four months during the ban period in order to mitigate the sufferings of the fishermen. This programme has started since 2004-05. Programme has covered 85 *upazilas* of 15 districts for each year (Ahsan et al., 2014).

According to Mondal *et al*. (2013) in Lakshmipur (Ramgati upazilla) of Lower Meghna a total of 82% of fishermen are professional and 18% are seasonal where 25500 fishermen in this area are dependent on the riverine fish for their livelihood and protein supply. The study also states that, two types of fish marketing channel exist in the study area. In first type (84%) involving fishermen to directly consumers and 2nd type (16%) involving three intermediaries (*aratdar*, *wholesaler* and retailer). During the peak season, the monthly incomes of fishermen were adequate and the range was 5000 to 30000 BDT. But during the lean period their income became low and even zero. 80% fishermen are fishing with boats (Consider as one unit) and the rest without boats. This underprivileged group of people of our society is the basement of our national protein demand.

A large market of vegetables takes place in Chandpur Sadar launch ghat. There are more or less 1000 business shops located there. Most of the vegetables are coming from the chars by boat. The people of this area will get new hope to work in the new proposed river way. Better transportation always promotes business and industrialization and local traders and business owners are enthusiastic to the project for this opportunity.

Ashuganj, Mozu Chaudhuri Ghat, etc. have been playing a major role in transporting construction materials and receiving international goods. The project will create more opportunity for the people in terms of employment and income. From the consultation findings, in Ashuganj ferry ghat, about 1500-2000 labourers work in a day. In this case many employment opportunities can be generated there and the community will have new dimensions in terms of occupation. Many mobile vendors of vegetables, raw materials, fruits, etc. are dealing in these ghats, jetties and terminals. This opportunity will grow more when the project will be implemented. Therefore, developing the terminals by extending its capacity and efficiency will directly enhance local economy in each case. It means after implementation of the project, these terminals can attract a massive number of people for their livelihood. Here GoB will get more revenue from the ghats once business units are increased.

The operators/crews of water vessels advised the project to include improved river traffic system by inclusive development of signaling across the river routes. Safety is a major concern of the vessel operators and passengers. Better navigation system will remarkably improve safety and security of the vessel users. This may also create provision to divert some laborers to new occupational groups after implementation of the project. Vessel operators, country boatmen, fishing boat owners and operators, lessees of the terminals will continue livelihood with better pace after completion of the project. Some ghats, terminals, jetties, ferry crossing routes are in vulnerable state; these should be constructed as early as possible on priority basis. It is expected that a massive progress will come forward in their livelihood after completing the planned interventions. The project will promote advancement of the infrastructure in the river routes and proposed locations. Development of infrastructure will amplify the livelihood and increase the income as well as standard of living of local people.

So, colossal positive impacts will come to all walks of people in their daily livelihood through all along the river route. According to people’s opinion there will be no negative impact of the project on livelihood. The proposed launch ghats /vessel shelters will offer fresh income and livelihood opportunities and can play a major role in economic development of the surroundings.

8.4.3 Impact on boat/ Vessel traffic

Floating pipe is the only means of discharging dredged materials followed in navigation dredging in Bangladesh. Deployment of dredger, ancillary crafts, placing of floating pipes and shore pipes disrupt uninterrupted traffic. These occupy most part of the channel and leave a narrow lane for other vessels or boats to negotiate. Most of the cases, this lane is so narrow that allows a one-way traffic with caution. Such cases increase transportation time.

Again, some channels are so narrow where after deployment of dredger and placement of floating pipe lines leave no room for vessels to move. In such events, traffic remains closed during dredging. This happens in case of Bamnirchar in the Chandpur-Barisal route and in some ferry routes.

Deployment of dredger and placement of floating pipe lines is also a potential threat of accidents. There are instances of such accidents caused by dashing of vessels to dredger, ancillary crafts or pipe lines.

Mitigations

Prior consultation with the relevant stakeholders including notification, arrangement of safety measures to avoid accidental collition and proper planning as well as involvement of public representative shall be in place to avoid major disturvance to riverine traffic.

8.4.4 Public Health Impacts and Safety Issues

Construction phase activities associated with dredging and disposal activities may affect noise, air quality, safety of personnel and have the potential to increase disease vectors such as mosquito and biting midges. These Project variables may potentially affect the wellbeing of the surrounding community and each is discussed in more detail below and section references made where appropriate.

Noise Level Impacts

People have widely varying reactions to noise. The key areas of concern to the community in relation to noise pollution from dredging and disposal activities are as follows:

Annoyance, reduced quality of life;
Sleep disturbance;
Performance and learning of school children;
Cardiovascular disease;
Mental health; and
Neuro physiological stress.

Predicted noise levels generated from the construction of the Reclamation Area complies with site- specific noise criteria for all identified noise sensitive receivers and due to the distances between the site and any receivers, noise and vibration impacts will likely be insignificant.

Air Quality Impacts

The main air quality impacts from dredged material reclamation activities will be vehicle emissions consisting of nitrogen oxide (NOx) compounds, dust and particulates due to vehicle movement on unsealed areas. Dredging will also result in exhaust emissions from the dredgers, however, these impacts will be transient and will not result in a permanent, long term change to air quality in a particular locality.

Particles are a broad class of chemically and physically diverse substances. They exist as discrete particles spanning several orders of magnitude in size, 0.005 to 100 µm. Epidemiological studies show a correlation between exposure to particles and adverse health effects. At this time there is no conclusive evidence regarding the role of particle size and health effects, however different sizes may be important for different health outcomes. There is no threshold concentration established for particulates or different size ranges amongst particulates below which adverse health effects will not be observed.

Dust impacts to the sensitive receiver during construction of the reclamation area are unlikely to be of concern due to separation distances and the moist nature of the dredged material being used for the reclamation. Exposure to nitrogen dioxide (NO_2) has been associated with increases in daily mortality, hospital admissions and emergency room attendances for cardiovascular and respiratory disease, increases in respiratory illness and symptoms and decreases in lung function. The elderly, asthmatics, children and people with existing disease are particularly susceptible to the effects of NO2. Material which has been dredged and relocated to the reclamation area may release odours. Hydrogen sulfide (H_2S) generated by the decay of organic material within the dredged material is the principal cause of potential odours. The nature of the material to be dredged and the proximity of the reclamation to populated areas and exposure of construction workers are the main aspects that will determine if odour is an issue for this project.

Mitigations

- Inspect and maintain equipment in good working condition. Proper maintenance of engines ensures full combustion with low soot emissions.
- Use low-sulphur heavy fuels to reduce noxious emissions.
- Provide exhaust filtering.
- Gaseous emissions to be monitored monthly (visual monitoring daily) and emissions should be within limits as prescribed in the DOE air quality standards

Impacts of Reclamation Construction

As a result of the filthy environment brought about by unplanned disposal of dredged materials and indiscriminate refuse dumping at reclamation sites, there could be an increase in the prevalence of communicable diseases. These refuse collections could contaminate surface soil and underground water, attract breeding of houseflies and act as sources of occurrences of diarrhoeal diseases such as Typhoid and Cholera. The waste heaps can also serve as breeding sites for mosquitoes and consequently increase the prevalence of vector borne diseases. Such breeding sites would have both indirect and direct impact on the epidemiology of malaria in the city and the health systems.

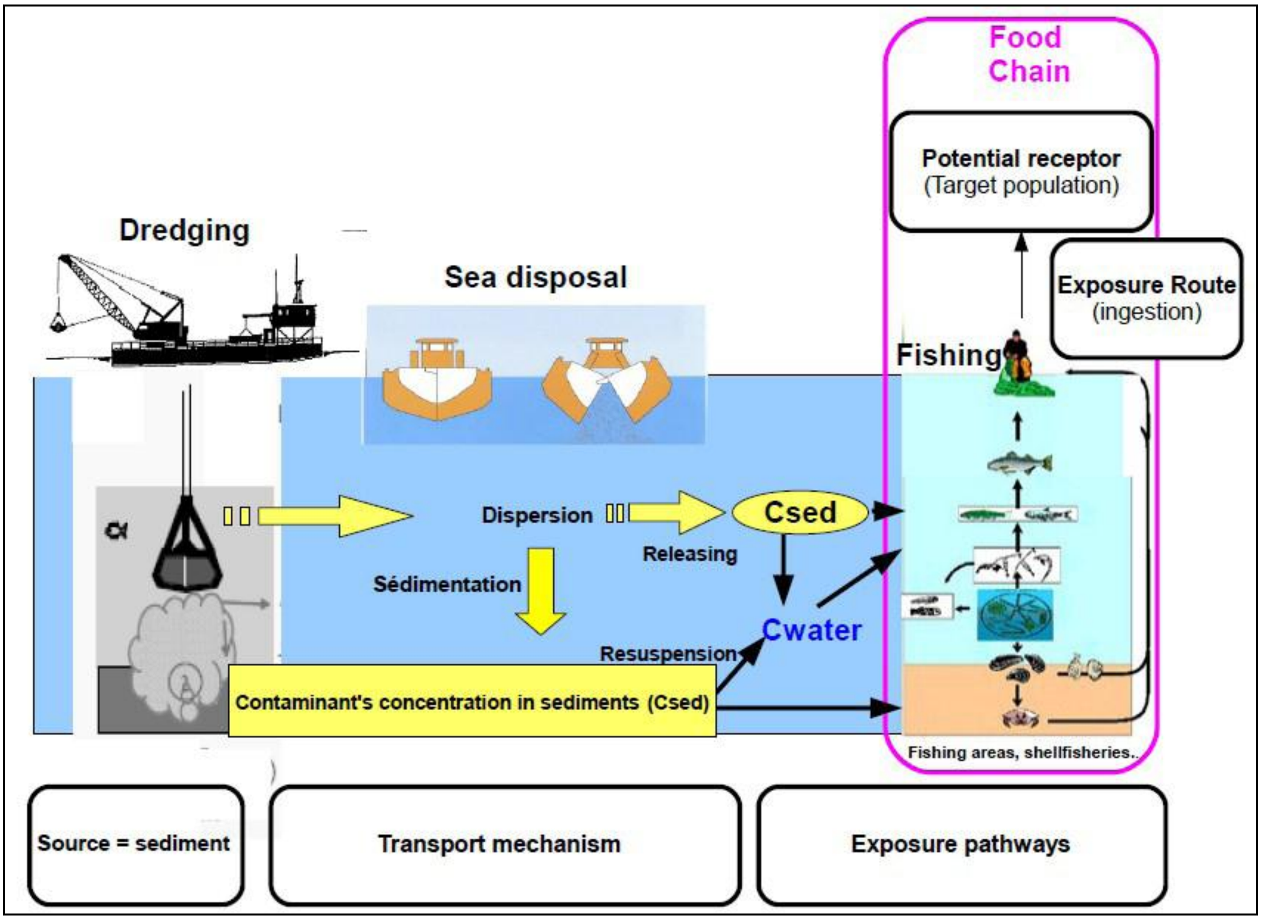
Though dredging brings about an improvement in flow of water and its speed, it may lead to an increase and change in pattern of the epidemiology of diseases associated with fast flowing rivers such as Meghna.

Mitigations:

Dredge material management plant is prepared and implemented and OHS plan will be implemented by contractors on the basis of the WBG EHS Guidelines (2007)and ECoPs

Impacts from Contaminated Disposal

The conceptual model defines individual risk scenarios. For chemical risk assessment, the only scenario to consider is the ingestion of contaminated fish or shellfish.



Food Chain
Potential receptor
(Target population)
Dredging
Sea disposal
Exposure Route
(ingestion)
Fishing
Dispersion
Csed
Releasing
Sédimentation
Cwater
Resuspension
Contaminant's concentration in sediments (Csed)
Fishing areas, shellfisheries.
Source = sediment
Transport mechanism
Exposure pathways

Mitigation

- Always maintain the noise level within the national standard during construction period.
- To reduce the noise impact contractor should not work at night time near the settlement area.
- Air emission from construction activities should comply the national guideline as stipulated in Table 10.7 .
- Regularly check and repair the faulty equipment if found to minimize the noise and air pollution.
- Dredge material is not likely to be contaminated; if contaminated then it will be disposed in-river. Only in exceptional circumstances, if in-river locations are not available, would contaminated dredge material be brought onshore. In such cases, it will be isolated and disposed at proper site to be identified in consultation with relevant stakeholders to be used for land reclamation.
- Reclamation site should be restricted for local people until it is declared to use for general people.
- Observance of ECoPs, OHS Plan and dredge materials management plan.
- Continue liaison and provide information to relevant community leaders, stakeholders and potentially affected communities.
- Provide adequate training to staff to operate equipment, to carry out dredging, and to transport dredged material

8.5 Impacts from Inland Water Transport

8.5.1 Development of Efficient and Environmentally Friendly Transport

Inland water transport (IWT) is a competitive alternative and addition to road and rail transport, offering a sustainable and environment-friendly mode of transport in terms of energy consumption, noise and gas emissions. IWT is also often the most economical inland transport mode due to low infrastructure and external costs – a characteristic of crucial importance. However, IWT is often still under-used and suffers from infrastructure, institutional, legal and technical barriers, which call for pro-active policies by Governments and international bodies.

Almost 100% respondents have willingly welcomed the project considering its' magnitude and ultimate result. Majority of them stated during consultation and survey that there will be no negative impact due to the project. Participants from Ashuganj, Shadarghat, Munsiganj, are enthusiastic about the project as it will improve transport system across the country and international river transport channels including playing a major role in transporting goods from India and other cross border countries. Project will also facilitate better transportation among three sea ports. Some of them were concern about unplanned dredging, which may cause erosion at some locations and therefore homesteads and agricultural field may become victim of unpredictable erosion.

The rivers of Bangladesh have played a major role in overall development of the country. Each river has offered biodiversity to its connecting region, enriched the topsoil for cultivation and many other direct and indirect benefits in addition to providing complete livelihood for the contiguous communities. There are potentials that have improved various industrial hubs along the neighboring areas. A profusion of industries have been constructed bordering the rivers, which have become intimidating to the environment. For example, fertilizer, cement, dyeing factories along the major rivers have contributed to environmental hazards through unrefined disposal of chemical directly to river, noise and air pollution, etc.

The river ports and terminals possess employment and livelihood opportunities for thousands of households. For example, the Mozu Choudhuri ghat itself has 500-600 shops focusing on the inbounds and transport facilities of the ghat. Local produces like coconut, areca nuts ('*Shupari'*) and other agricultural products along with construction materials are transported through the ghat. Therefore, developing the terminals by extending its capacity and efficiency will directly enhance local economy in each case.

Shatnal, Dakatia (Boro Stationtek), etc launch terminals can promote great tourist spots in the surrounding for national and international tourists based on barely the natural resources and scenic beauty of the adjacent rivers. River routes can assure ultimate comfort packages that the tourists would admire without the hustle of traffic congestion through road transportation.

Previous studies comparing road, railway and water way indicates that the water based transport system produce lowest amount of greenhouse gas, makes least noise pollution and is the cheapest way of traveling throughout Bangladesh. Therefore, the proposed project initiatives can play a major role in promoting an echo-friendly transport system in the country. However, the project should take account of potential environmental hazards through awareness raising and minimizing any possible negative impacts. Project scopes may also be extended through involving other government agencies like fisheries, agriculture, etc departments and developing a collective panel to ensure environmental sustainability of our rivers. The environment team will elaborately scrutinize these issues.

8.5.2 Environmental Impacts of the Inland Water Transport

Transport has several impacts on the environment. Emissions contribute to air pollution and climate change, noise causes nuisance and health risks and infrastructure has serious impacts on landscape and ecosystems. In addition to these impacts on the environment, transport has also other severe impacts on society. Every year hundred thousands of people are killed and injured in accidents and in various densely populated areas; high congestion levels result in time losses.

Technical and economic developments during the last decades have significantly increased the mobility of people and goods. As a result, the transport sector has undergone dramatic expansion during this period. In order to achieve long-term sustainable development, new demands are placed on transport sector actors to promote greater environmental compatibility both individually and jointly.

The distribution between various transport modes has a considerable bearing on the sector's environmental impact. Comparative assessment of the environmental impact from different transport alternatives is complicated, due to the fact that environmental problems from different modes of transport are of differing dimensions, and most of these effects are difficult to quantify.

In the next subsections we briefly explain the main environmental impacts of transport:

- Impacts from greenhouse gas emissions on climate change.
- Impacts from pollutant emissions on various problems related to air quality.
- Health and nuisance impacts from noise.
- Impacts on landscape from infrastructure.
- Impacts on biodiversity and ecosystems because of infrastructure fragmenting natural habitats.
- Impacts on water quality.
- Impacts on soil quality.

Climate Change

Climate change is one of the great challenges of current society, a global environmental problem. In the last decades there has come more and more evidence that the emission of greenhouse gases contributes to the effect of global warming. Transport makes a considerable contribution to the greenhouse effect. For the transport sector, the greenhouse gas emissions are dominated by the carbon-dioxide (CO_2) emissions from burning fossil fuels. Carbon-dioxide emissions from transport are increasing, and are expected to increase in the future. Emissions of greenhouse gases are an extremely relevant issue when it comes to our choice of transport means.

The Intergovernmental Panel on Climate Change (IPCC) has examined a range of future climate change scenarios and found that the globally averaged surface air temperature is projected by models to warm 1.1 to 6.4°C by 2100 relative to 2000, and globally averaged sea level is projected by models to rise 18 to 59 cm by 2100. The warming is expected to vary by region, and to be accompanied by changes in precipitation, changes in the variability of climate, and changes in the frequency and intensity of some extreme climate phenomena (drought, flooding) as well as impacts on ecosystems, and diseases.

The amount of CO_2 emissions, which are particularly relevant for climate change, can be directly derived from the amount of energy consumption. These emissions result from burning of fuel by motors of trucks, diesel locomotives and vessels. For electrical locomotives, emissions are caused by corresponding power generation. The lowest CO_2 emissions per unit of energy occur with electrical trains. Their future development depends on the structure of primary energy used for electricity generation. As regards trucks and inland ships, future emissions depend on the development of specific fuel input.

In case of water transport, the main load derives from the vessel's engine. This is used mainly to provide power to drive the vessel, to cool the products, to operate the ship's equipment, and to ensure the needs of the staff. The engines of the vessels also run while mooring, providing power also for loading and material handling. Air pollution also derives from the internal material handling at the ports, as well as from the energy use connected to the operation of the port, e.g. heating.

Calculations have been prepared for selected origin-destination (OD) pairs (routes). Clearly, the highest specific CO_2 emissions are caused by road trucks. This remains valid if the additional collection and distribution transport by trucks is considered for containers carried by railways or ships on their main route section. For five of eight analysed bulk freight transport cases, inland shipping causes lower CO_2 emissions than railways. As regards container transport in the Dhaka-Chitagong corridor, the CO_2 emission per TEU (twenty-foot equivalent unit, a measure used for capacity in container transportation) of inland shipping is by 19% to 55% lower than for railways.

Air Pollution

Transport-related air pollution causes damages to humans, biosphere, soil, water, buildings and materials. The most important pollutants are the following:

- Particulate matter ($PM_{2.5}$, PM_{10});
- Nitrogen oxides (NOx);
- Sulphur oxide (SO_2);
- Ozone (O_3);
- Volatile organic compounds (VOC).

The emissions of pollutants give rise to health costs, building/material damages, crop losses and costs for further damages for the ecosystem (biosphere, soil, water). Each impact is related to one or more type of pollutants:

- *Health impacts*: Impacts on human health due to the aspiration of fine particles ($PM_{2.5}$/PM_{10}, other air pollutants). Exhaust emission particles are hereby considered as the most important pollutant. In addition, ozone (O_3) has impacts on human health. The main health impacts are increased health problems for people who suffer aspiration diseases and a higher risk for anyone to get such a disease.
- *Building and material damages*: Impacts on buildings and materials from air pollutants. Mainly two effects are of importance: soiling of building surfaces/facades primarily through particles and dust. The second, more important impact on facades and materials is the degradation through corrosive processes, due to acid air pollutants like NOx and SO_2.
- *Crop losses in agriculture and impacts on the biosphere*: crops as well as forests and other ecosystems are damaged by acid deposition, ozone exposition and SO_2.

The main impacts are the health impacts mainly caused by particulate matter (PM) from exhaust emissions or transformation of other pollutants. There is increasing evidence that in particular ultra-fine particles have severe health risks.

Unlike the climate impacts of CO_2, the impacts from air pollutant emissions depend on the location. Air pollutants that are emitted in densely populated areas cause considerably more harm than pollutants emitted in remote areas.

Numerous studies have prepared extensive estimates of pollution caused by road and railway transport. Inland shipping gained less attention, and related estimates are based on highly aggregated figures. Such calculations referring to the aggregated vessel fleet do not allow reliable conclusions.

The level of exhaust emissions by trucks depends largely on the traffic situation. With growing level of traffic disturbances, exhaust emissions per vehicle-km increase significantly. Exhaust emissions of electricity-powered railways depends on the structure of primary energy used for electricity generation.

Electricity-powered railway transport causes clearly lower pollutive emissions than road and ship transport. Accordingly, the external costs of air pollution caused by railway transport are significantly lower than those of competing modes. When comparing inland shipping with road transport, there is a clear advantage for ship transport[13].

Waterborne transport contributes significantly to the emission of air pollutants, both locally and globally. The local effect primarily occurs in port areas. The sources are the same as the CO2 sources responsible for climate change; however, the amount of emitted pollutants - mainly SOx, and diesel particulate matter - depends heavily on the quality of the fuel used. The bunker fuel that is mainly used in shipping causes a much greater environmental impact than the diesel used in trucks and trains.

Concerning the local effects, the onward transport of goods is an important issue, i.e. the land transport (road, rail) connections of the port. The distance of the port and the transport routes from the residential or other sensitive areas is also an important question.

Noise Impacts

Traffic noise has a variety of adverse impacts on human health. The World Health Organization (WHO) has recognized community noise, including traffic noise, as a serious public health problem. The effects are often indirect and combined in a pattern of interacting factors. The most widespread effect is simply annoyance. In addition, there is substantial evidence for serious health problems caused by traffic noise. The main problem is disturbance of sleep patterns, which affects cognitive functioning (especially in children) and contributes to certain cardiovascular diseases. There is also increasing evidence for an impact of noise raising blood pressure.

The degree of noise from different modes of transport differs. The frequency of the noise, the location of the source and variations in the level of noise all affect the experience of it.

[13] BFG & PLANCO Consulting GmbH (2007), Economical and Ecological Comparison of Transport Modes: Road, Railways, Inland Waterways

Sensitivity to disturbance varies considerably from person to person. Disturbance depends on the sound level at the time and the number of noise events, their duration, the time and the situation of the individual when exposed to noise.

The difference of noise emissions per unit of freight, between road and rail, measured along road/railway lines is only small. However, noise from rail transport has a lower subjective nuisance level of the same average level of physical emission compared to noise from road traffic. Inland shipping causes only lower emissions, with a difference of –10 dB(A). This difference represents 50% lower emission loads as perceived by people[14]. Inland shipping is not seen as a relevant noise polluter, because emission factors are comparably low and most of the activities occur outside densely populated areas. Marginal noise costs due to maritime shipping and inland waterway transport are assumed to be negligible[15].

Noise emission from shipping has an impact both on human population and wildlife. The impact on wildlife is dominant near the waterways, as these often lead close to protected natural areas. The impact on the population mainly appears in the vicinity of ports, connected partly to road and rail connections, and to internal material handling. The noise emission of the engines of mooring vessels has to be considered as well.

The noise emissions of ships can be reduced by using modern engines. The optimal choice of speed, traffic management reducing acceleration and deceleration also have a positive impact on this load.

Noise emission within ports and near access roads can also be reduced by measures used to mitigate the emissions of CO_2 and other pollutants. Construction of bypass roads or noise barriers can in some cases also lower the noise impact of access roads.

The time and location of noise emission is an important issue. Emission during the day has a different effect than the same emission during the night, or over the weekend. This has to be considered when designing the operational regulations of the port and it should be enforced at the rail and road links of the port as well. The activities with higher noise pollution, and the cargo operations during the night should be carried out at more remote areas of the port from the populated areas.

Mitigation:

- Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding.

Limit the noisy dredging to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife) or during night time hours. Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. This will encourage riverine and terrestrial fauna to move away from the source area prior to significant noise emissions.

Inspect and maintain equipment in good working condition.

[14] BFG & PLANCO Consulting GmbH (2007), Economical and Ecological Comparison of Transport Modes: Road, Railways, Inland Waterways

[15] Maibach, M., et al. (2008), Handbook on estimation of external costs in the transport sector - Produced within the study Internalisation Measures and Policies for All external Cost of Transport (IMPACT), CE Delft, Delft, the Netherlands.

- The noise emissions of ships can be reduced by using modern engines. The optimal choice of speed, traffic management reducing acceleration and deceleration also have a positive impact on this load.

Water Quality

Transport activities have an impact on hydrological conditions. Fuel, chemical and other hazardous particulates discarded from aircraft, cars, trucks and trains or from port and airport terminal operations can contaminate groundwater, rivers, lakes, wetlands and oceans. Water transport emissions represent the most important segment of water quality inventory of the transportation sector. The main effects of water transport operations on water quality predominantly arise from dredging, waste, ballast waters and oil spills[16].

Waste generated by the operations of vessels at sea/river or at ports cause serious environmental problems, since they can contain a very high level of bacteria that can be hazardous for public health as well as aquatic ecosystems when discharged in waters. Besides, various types of garbage containing metals and plastic are not easily biodegradable. They can persist on the water surface for long periods of time and can be a serious impediment for navigation in inland waterways and at sea and affecting as well berthing operations.

Major oil spills from oil cargo vessel accidents are one of the most serious problems of pollution from inland water transport activities.

Mitigation:

- Select dredging equipment and methodology with low risk of sediment dispersal.
- Monitor local suspended sediment concentration by sediment sampling and laboratory.
- Regularly inspect and maintain equipment in order to prevent leaks. Develop and implement a Spill Prevention Plan to prevent and contain accidental spills, monitor sediment spill

Operational Oil Pollution

Ships are designed to move safely through the water when they are filled with cargo. When empty, they fill their tanks with ballast water in order to weigh them down and so stabilize them as they cross the ocean. Before entering the port where they are to load up, they discharge the ballast water, whose weight will be replaced with freight. The water discharged is typically somewhat unclean, being contaminated with oil and possibly other wastes within the ballast tanks. Its discharge is therefore a source of water pollution. It should be noted, however, that segregated ballast tanks, which are required on newer tank vessels, reduce or eliminate the oily ballast problem. A similar source of pollution is bilge water; this is seepage

[16] Rodrigue, J-P, C. Comtois and B. Slack (2009), The Geography of Transport Systems, Second Edition, New York: Routledge.

which collects in the hold of a ship and must be discharged regularly. On oil tankers the bilge water is typically contaminated with oil which seeps out of the cargo tanks; thus this is also a source of oil pollution. Such discharges are referred to as “operational” pollution because they have long been considered a part of the normal operating procedures both of oil tankers and of other ships managing their fuel.

Mitigation:

- Refuel of barges and boats with a proper care to avoid any spills.

- Make available spill kits and other absorbent material at refuelling points on the barges

- Develop and implement spill contingency plans for pipeline and hull leakages. Ensure that emergency response equipment, e.g. floating booms, are serviceable and available to deal with any oil spills or leakages

Solid Waste Disposal

The disposal of plastics at sea is a significant source of environmental harm, since the materials are both buoyant and persistent. Debris is generally of several types. Fishing boats discard old nets and lines, frequently made of plastic. Freighters accumulate and sometimes discharge materials used to pack break bulk freight to keep it from shifting as the boat moves. This material, called dunnage, is typically either wood or plastic.

Discarded plastics pose a threat both to rivers species and to coastal regions. Discarded nets carry out so-called "ghost fishing", continuing to trap animals as they drift through the water. Bandshaped packing materials can encircle aquatic mammals fish, or birds, forming a girdle which tightens as the animal grows. Aquatic organisms also ingest plastics, which can kill them or reduce the nutritional value of their food intake. Wood used for dunnage, if not grated or pulped can damage small boats which run into it.

Mitigation

- Enforcement of national and international regulations e.g. Management Regulations on Preventing Vessels from Polluting Marine Environment.

- Solid waste are forbidden to be discharged into the rivers, and must be unloaded to the nearby waste treatment facilities for treatment.

- Protocol to be developed by the contractor and approved by the BIWTA and DOE for waste management.

Impact of increased waving

Waterborne traffic increases surf, which causes problems primarily on the bank. Surf threatens the wildlife of the riparian zone, especially invertebrates and juvenile fish. The coastal vegetation may be affected as well, as reeds do not tolerate continued strong waving.

Mitigation

Limit speed of water borne traffic at sensitive locations by less than 10 Knots/hour.

Introduction of foreign species

Waterborne transport can result in the introduction of foreign species to new territories, a part of these travels on board, or within the cargo, and spread to the area. Thus, parasites, bacteria, or other organisms can appear in a particular area, infecting or expelling native species, weakening biodiversity. This process can be controlled by quarantine rules, but their effectiveness is questionable.

Other foreign species are carried to new territories stuck to the hull or in ballast water, causing environmental problems there. This problem is related specifically to waterborne transport.

Mitigation:

- Strict observance of national and international rules related to disposal of ballast and bilge water.
- Biological/chemical/mechanical control of introduced foreign/invasive species.
- Regular monitoring of water quality including analyses of planktons and Benthos

8.5.3 Risk of Accidents and Collisions

Accidental Spills

Spills from waterborne vessels are one of the major sources of water pollution from shipping. They are of several types. Cargo spills frequently occur while loading or unloading in port, due to handling errors or equipment problems. Such spills are typically relatively small in volume. They may be of any kind of cargo, though petroleum products (primarily cargo rather than fuel) and other chemicals are most common. Spills of non-hazardous cargo are more common than spills of toxics or flammable materials, because the precautions taken in handling dangerous products tend to promote much greater vigilance and far fewer careless spills.

Much less common, but potentially more dangerous, are cargo spills which occur when a boat runs aground or breaks up in bad weather. Such disasters typically occur when boats are moving into or out of ports or in other restricted areas, where there is little or no room for maneuvering or going off course in case of bad weather. In comparison, in the open ocean, boats can handle storms or high winds with little risk of accident, because if they are blown off course they are unlikely to run into anything.

Collisions of Ships

Inland waterway traffic records an ever increasing traffic density. Consequently, new channels are being built and new solutions are being found in order to enlarge inland waterways, etc.

The safety of waterways is considered satisfactory if they are regularly maintained, if they possess accurate necessary signs, if they possess the means to facilitate navigation such as, for example, River Information System - RIS, Vessel Tracing System - VTS, Electronic Charts Display Information System - ECDIS, Automatic Information System – AIS etc. Apart from the abovementioned factors, the accident statistics done for waterways with satisfactory level of safety and observed through a longer time period should provide data on accidents that occur rarely.

Despite the vastness of the IWT network, it has many problems associated with safety and navigability. Natural obstacles cause a lot to inadequate navigability, as well as to marine disasters. It is a painstaking job to find the permissible routes for navigation, as routes vary in a wide range with the change in seasons. During the monsoon, the navigable inland waterways are approximately 5,968 km in length, which however, decrease to 3,600 km in dry seasons[17]. The problem gets intensified due to alluvial deposition, which is profoundly caused by geographical position of the country, deforestation and unplanned construction of dikes and embankments in the coastal region.

As the country is located in the vicinity of the nadir of the Himalayas, which is comparatively young and vulnerable to soil losses due to both natural and man-made causes, high rate of sediment transport is prevalent here. Since the river gradient within Bangladesh is very low, a significant amount of that sediment load cannot be naturally transported to the Bay of Bengal and is deposited on the river beds, as well as flood plains, each year. The Ganges River mobilizes a total of 729 megatons of sediments annually through a narrow zone within its river valley. Under the present hydro-geological conditions, the river sedimentation is climatically controlled and is predicted to produce a 2000 km long, 2 to 40 km wide and 25 to 50 m thick ribbonshaped, well-sorted symmetrically skewed fine sand body. The river of Ganges is marked by its second highest siltation rate in the world. The current situation of the waterways demands for a prominent dredging service. Annual dredging demand in core waterways network is estimated as 18 million cubic meters, while the annual productivity of the dredgers, currently in work, is 6.36 million cubic meters only. This is due to the dearth of dredgers as well as the aged state of most of the dredgers, resulting in reduced efficiency. Due to low budget allocation, hydrographic surveys to all classified waterways remain impossible. Only a limited number of navigation routes of 965 km, 16% of the total, were surveyed in 2006-07 according to a need-based priority. Thus, due to all the shortcomings stated above, the current classification system of inland waterways is believed to outlive its usefulness. Navigational aids like beacons, lighted & unlighted buoys, iron & bamboo marks etc. are used to mark shoals, while channel bends, shallow patches etc. are used in waterway routes for the vessel safety. Observation at various river ports exposed that the intense traffic

[17] Huq, N.A. & Dewan, A.M. (2003). Lauch Disaster in Bangladesh: A Geographical Study, Geografia, Vol.1, Issue 2 (14-25), ISSN 0126-7000.

density in the ports prevent the vessels to berth alongside the pontoon and persuade them to resort to nose berthing. Due to acute congestion, the vessels keep colliding with each other recurrently, causing damage to the fender as well as the hull. These collision events are often ignored as long as these do not result in human death or severe hull damage. Other hazardous effects such as crack formation and propagation, metal fatigue and so on, leading to ultimate hull damage, often seem to be underrated[18].

Mitigation

- A direct investigation of accidents through an interactive system may serve the purpose of both developing an authentic and reliable accident database and updating the current fault trees.

- Regular hydrographic survey on the waterway should be carried out and the navigation aid service should be provided appropriately.

- For improved hydro-meteorological forecasting a modern station could be developed in appropriate place like Chandpur to avoid collision and accidents.

[18] Hossain, M. T., Awal, Z. Ibn., Das, S., (2014). A Study on the Accidents of Inland Water Transport in Bangladesh: The Transportation System and Contact Type Accidents, Journal of Transport System Engineering volume 1, Issue 1, p 23-32.

9 CUMULATIVE IMPACT ASSESSMENT

This Chapter discusses the cumulative and induced impacts of the Dhaka-Chittagong Inland Water Transport Projects.

9.1 Overview

The Government has prioritized the improved development and maintenance of the Class I routes and linked Class II and III routes along the Dhaka-Chittagong Inland Waterway corridor. The main trunk route is about 300km, of which it is initially estimated that about 40km currently require dredging and channelization to maintain the advertised depth for the existing traffic. Another 110-130km of linked routes is part of this corridor, of which about 33-50km requires constant maintenance. The objective of the current cumulative impact assessment is to evaluate the combined effects of proposed developments along the proposed IWT corridor. The most significant valued environmental components (VECs) related to the proposed developments are identified as aquatic biodiversity from river environment, spawning areas from coastal environment, and flood affected areas from floodplain environment. These VECs are considered from the national stakeholder consultation and also from survey findings described in Baseline Environment chapter of this EIA report. Significance of these VECs is described later in the Chapter.

9.1.1 Study Boundary

The study boundary of for CIIA has been considered based on the full lengths of the waterways themselves (including islands, chars and shoals within the waterways as well as riverbed and banks), the river basins/catchments upstream and downstream of the waterways, floodplain and drainage areas and patterns, areas of potential influence of existing and planned river ports, landings, terminals, vessel shelters, ferry crossings, and dredge spoil dumping locations along the waterways (including roads leading to on-land spoil dumping sites that would be used by locals to haul spoils to secondary markets), areas of ecological importance along the waterways such as any parks/reserves/forests, current and planned areas being irrigated by or otherwise using waters from the waterways, roads leading to the spoil disposal sites, etc. According to GoB development plans, inland water transport, third sea port in Tentulia River in Rabnabad channel, construction of embankments and river training works along the bank of major rivers, development of a road network on the embankment, integrated river management program, economic zone and fish processing zone on the proposed corridor, mega power plants and defense training camps are considered as future major developments in next 20 years; and hence these projects are considered for CIIA study. Brief summary of these developments along the tentative locations are presented below.

9.2 Current and Future Development Projects in Context of CIIA

Inland Water Transport and Integrated River Management Program: The GoB has an ambitious plan of undertaking about $100 billion 'Performance Based Capital Dredging Project' in all major rivers including the Padma, Meghna, and Jamuna for sustainable river management. The objective of the project is control of river bed siltation and aggradation, land reclamation, and develop inland navigation through extensive dredging programs.

Payra Sea Port in Tentulia River: Development of the Payra Sea Port at the Rabnabad Channel in the Patuakhali District is under active consideration of the Government of the People's Republic of Bangladesh (GOB). Economic and social development would be enhanced rapidly in this zone if a sea pot is established. International sea borne trade of Bangladesh has been using two existing sea ports, with about 92% passing through Chittagong Port. The coast line of Bangladesh is about 710km and coastal area is characterized by many tidal rivers, which can be utilized in development work for enhancement of economic growth of the country and creating employment opportunity of growing population of Bangladesh. The objective of the project is to build a sea port in the central coastal zone for economic, business, industrial and social development of the country. With the increasing population, demand of development for sea port in the central coastal zone is crucial for creating employment opportunity and social development of the country.

Construction of Embankments, Development of a Road Network on the Embankment and River Training Works along the Bank of Major Rivers: The future development projects under RMIP, FREMIP, and other development projects includes (i) construction of and rehabilitation of 150 km embankments and development of a two lane highway along the embankment under RMIP Project, which would subsequently be expanded to 4 lanes, (ii) construction of about 32 km of additional new riverbank protection works and rehabilitation of about 13km of existing revetments, six spurs, one hard point and one groyne under RMIP project, (iii) rehabilitation of about 40km length of BRE from downstream of Jamuna Bridge to Chandpur along with necessary river training works.

Economic Zone and Fish Processing Zone: An economic zone and a fish processing zone are under implementation stage of the Government of Bangladesh near Sandwip island which is close from the project area. The objective of this development projects are to bring industrial growth of the country and will use IWT as major means of transport for both national and international purpose.

Sandwip is close to Bay of Bengal and an ideal place for fish catch. Government of Bangladesh with the help of lending agencies is planning to establish a fish processing zone in Sandwip area.

Proposed Mega Power Plants: Supercritical Coal Based mega power plant is currently under consideration to be built in Sandwip area. The objective of this project is to import coal from overseas through water channel. Mother vessels will use Dhaka – Chittagong IWT corridor for carrying coals not only to deliver in proposed Sandwip power plant but also other coal based power plants in Ahsuganj areas.

Defense Training Camps: Bangladesh Army is planning to develop the Jahizzar Char, an island in the Bay of Bengal, to use for advance defense training centre. The future development of the Charland will include (i) a number of infrastructure, (ii) cyclone shelters, (iii) power plant, (iv) polder for embankment purpose, and (v) harbour development. The objective of this exclusive project is to operate amphibian tanks and navy ships in that area mainly for security patrolling and training purpose.

9.1.2 Current and future development projects and plan

At present six development projects are under implementation by BIWTA in the Dhaka-Chittagong corridor and adjoining routes. 13 projects are in planned status. Feasibility study of one project is underway, investment projects of which will be implemented on PPP basis. Table 9.1 will illustrate the situation:

Table 9.1: Project List in the Dhaka-Chittagong IWT Corridor and Adjoining Routes

Sl	Name of the Project	Project Cost (in million BDT)	Project period	Status
Project under Annual Development Programme (ADP) :				
1.	Capital Dredging of 53 River-routes in Inland Waterways (1st Phase: 24 River Routes).	18736.4	July 2012–June 2018	Under implementation
2.	Dredging on 12 (twelve) Important River Routes.	5084.6	October 2011 – June 2016	Do
3.	Development of launch ghats and way side ghats in rural areas of Bangladesh.	806.3	July 2013 – June 2016	Do
4.	Establishment of Inland Container River Port at Ashuganj.	2457.5	January 2011-June 2016(Proposed)	Do
5.	Procurement of 10 Dredgers, Crane Boats, Tug, Officers' House Boat and Crew House Boat with other accessories (1st Revised).	7456.022	July 2011-June 2016	Do
6.	Procurement of 2 dredgers, Crane Boats, Crew House Boat and Tug Boat with other accessories for maintaining the navigability of inland waterways (2nd Revised).	1512.893	January 2009 – June 2015 (Proposed)	Do
7.	Capital Dredging on 53 Rivers Routes in Inland Waterways (2nd phase: 29 River Routes).			Planned
8.	Removal of garbage from the Rivers of Buriganga, Shitalakhaya and Turag (partly) and decontamination of water.			Do
9.	Establishment of 2nd Terminal Facilities at Shashanghat area under Dhaka River Port.			Do

10.	Procurement of Different Types of Service Vessels for BIWTA.			Do
11.	Construction & placement of special type terminal Pontoons with allied facilities.			Do
12.	Dredging of different River Routes under Protocol.			Do
13.	Construction of Walkway and Bank Protection on Evicted Foreshore Land of the river Buriganga, Shitalakhaya and Turag (partly).			Do
14.	Construction of 10 River Ports 8 ferry ghats.			Do
15.	Modernization of 9 River Ports and 6 ferry ghats.			Do
16.	Establishment of 3(three) new Training Institutions and Modernization of 1(one) old Training Institution.			Do
Self-financed Project:				
17.	Extension of Sadarghat terminal building at Dhaka port.	191.051	March 2014 - June 2016	Under implementation
18.	Development of Sadarghat to Shasanghat road under Dhaka river port.	199.09	January 2015 - June 2016	Do
19.	Development of port facilities at different landing stations of the southern region.	321.8	March 2014 – June 2016	Do
Under Public Private Partnership (PPP):				
20.	**Construction & Operation of Inland Container Terminal (ICT) at Khanpur, Narayanganj.**			Do (Feasibility Study)

Source: BIWTA

9.3 Valued Environmental Components

The following valued environmental components (VECs) are identified from river environment, coastal environment, and floodplain environment for the CIIA study that is based on the rationale explained below. These VECs and their significance are:

Based on the baseline condition of river environment of the project influence area, a number of VECs have been identified which are not limited to hilsa, dolphins, migratory birds, other identified key species, sediments, water quality, char lands, aquatic biodiversity, and etc. Out of these for the CIIA, aquatic biodiversity has been considered

Based on the baseline condition of coastal environment of the project influence area, a number of VECs have been identified which are not limited to coastal sedimentation, sanctuaries, spawning areas, and etc. Out of these for the CIIA, spawning area has been considered.

Based on the baseline condition of floodplain environment of the project influence area, a number of VECs have been identified which are not limited to agriculture, beels, water pockets, low lands, and etc. Out of these for the CIIA, flood affected area has been considered.

VECs selected for CIIA identified during national stakeholder consultation, field survey, secondary data courses, three significant VECs are considered that are Aquatic Biodiversity, Spawning Areas, inland navigation, hilsa and dolphin

9.4 Aquatic Biodiversity

9.4.1 Background and Trends

The baseline on aquatic biodiversity of the Dhaka-Chittagong IWT corridor is extensively discussed in baseline chapter of this ESIA report. Upper Meghna, Lower Meghna, Padma, Tentulia, Arial Khan rivers are within the corridor of IWT project and its floodplains are the important source of both capture and culture fresh water fish in Bangladesh. Major habitats of capture fisheries are main river channels, khals and beels. These beels, khals and the Jamuna are naturally connected during floods and will act as migratory routes for the carp's fishes, which migrates to floodplains during flooding season for spawning.

The dredging and its associated activities may disturbe the sanctuaries and spawning areas of fishes specially hilsa, dolphins and other aquatic species. Moreover, the fisheries in the floodplains have been declining significantly since the construction of flood control embankments, which have blocked the migratory routes of carp fishes from the river to floodplains. The fish production in the proposed corridor has been declining due to increased fishing pressure. The trend analysis of the Department of Fisheries time series data 1984-2012 shows the decrease of annual fish production in the Meghna River is approximately 2,700 tonnes in last 30 years.

9.4.2 Cumulative Effects

The sedimentation load in the Lowe Meghna is about one billion m^3 per year. Out of which one third is deposited in river bed consequently decreased river depth over time. The shallow depth of these rivers increased the frequency of the flooding on the banks of the rivers and also decreased fish population. Number and type of fish species are also decreasing over time as few species require depth on the river to breed. The proposed dredging activity under IWT project and other future projects will restore the type of species due to restoration of the original depth of these rivers.

The proposed project will also improve and maintain navigation channels and land reclamation that will have some impacts on the aquatic biodiversity. Dredging activities will disturb the benthic habitat and the bottom fish feeders that depend on the benthic habitat. The sediments generated from the dredging activity will affect the water quality and in turn the quality of the entire river habitat. The water quality of the river will also be affected due to risk of oil spills from the barges and disposal of bilge water. There will be a risk of collision of dolphins with the barges and ships.

To address the cumulative impacts associated with the future dredging activities and also with induced environmental impacts, fish and dolphin sanctuaries need to be established in the corridor. Detailed ecological baseline studies are recommended for the entire CIIA study area to be carried out prior to commence the dredging and to identify suitable areas of sanctuaries and spawning areas.

9.5 Spawning Areas

9.5.1 Background and Trends

Habitat changing pattern due to this intervention may prove as a risk. Along with this, if the dredged sites are breeding ground for any unknown or unidentified species, the whole system can be collapsed as well. It will change the species composition of the water area and the fishermen depended on the fishes will not be able to catch them frequently and gradual effect on livelihood may be experienced. Fish sanctuaries which are built to facilitate the sound breeding of fish should be avoided from dredging demarcation. Otherwise, it can cause negative impact on the population size as well as fish catch of the fishermen.

On the other hand, if a fish population is aware of the new way that has been created by dredging; they may use it in the consecutive years for both migration and feeding. Some dredging sites create artificial scour that can also be used as habitat and hiding place for fishes like Boal (*Wallago attu*) or Chital (*Notopterus chitala*) who prefer low temperature and lying in deep water bed for a certain period of their lifespan. Nutrient cycling is another key objective that can be taken under consideration as positive impact.

River dolphins are among the world's most threatened mammal species. They inhabit some of the largest river systems of southern Asia, and their environmental requirements link them to food and water security issues in the world's most densely populated human environments. Populations of river cetaceans have declined dramatically in recent years and much of their range has been lost. River cetaceans are threatened in many ways. Overharvesting of fish and crustaceans reduces the availability of their prey. Deforestation and intensive floodplain farming increase the sediment load of river channels and degrade cetacean habitat. Industrial effluents, human sewage, mining waste, and agricultural runoff contaminate water. Dolphins die from accidental entanglement in gill nets, and mortality rates increase as the use of these nets spreads. Possibly the most significant threat to river cetaceans is the construction of large water development structures, most notably dams, barrages, and levees.

The environmental consequences of water development projects are significant and far reaching. These structures fragment populations and reduce the environmental complexity that makes rivers suitable for aquatic species. Water development proceeds, however, with little understanding or concern about the effects on cetaceans, or on the assemblage of other life that shares their habitat.

The Ganges or Asian Freshwater Dolphin (locally known as shushuk or susu) occurs in the inland waters of Bangladesh, India, and Nepal. Its traditional strongholds have been the Ganges, Brahmaputra, Meghna, and Karnaphuli river systems. Gangetic dolphins still occur in these rivers and, at least seasonally, in many of their tributaries. There are at least a few hundred dolphins in both the Ganges and Brahmaputra systems, and their total abundance may be in the low thousands. However, with the extensive development of irrigation, flood control, the dolphin's metapopulation has become increasingly fragmented. Groups of dolphins upstream of dams and barrages have either disappeared or declined with little prospect of recovery. Dolphins are caught either incidentally in fisheries and are also hunted deliberately in portions of their range in both India and Bangladesh. There is a strong localized demand for their oil to be used as a fish attractant and as medicine or liniment.

9.5.2 Current Threats

The trend for this species is towards a shrinking range, as dolphins are eliminated from smaller tributaries, and a declining population, as animals are killed in fishing gear and directed hunts, and as they compete unsuccessfully with humans for shrinking water and prey resources.

Accidental capture in fishing gear is among the most critical threats facing river dolphins. The absence of systematic effort to investigate the problem, however, makes it difficult to quantify its magnitude or to establish priorities for regulating fishing activities. Information on dolphin bycatch is particularly difficult to obtain. In some cases, there is a strong disincentive for fishermen to report by-catch because they can be prosecuted for causing the death of a dolphin. In other cases, fishermen keep the carcass for oil, or sell it or use the carcass or parts of the decomposing dolphin in pile fishing to attract fishes.

Small-mesh monofilament plastic nets cause the greatest damage because of their extensive use and because dolphins cannot break free of them once entangled. Dolphins also become entangled in large-mesh nets but, apparently, often manage to escape.

Very little is known about the effects of vessel traffic on river dolphins and porpoises. Ferry crossings, commercial ports, and primary fishing grounds in rivers are generally located downstream of convergent channels or sharp meanders, which are also the preferred habitat of river dolphins. River dolphins are often observed swimming in areas with high vessel traffic, that includes small boats, motorized ferries, and in some locations large container ships and oil tankers, with no visible damaging effects. Mortality from propeller collisions, however, has been reported for baiji and finless porpoises, particularly in the lower reaches of the Yangtze River, where waterways contain high levels of large commercial vessel traffic (Zhou 1992). A single susu was also reported by fishermen to have been killed by the propeller of a cargo boat in the Brahmaputra river near the India/Bangladesh border (Mohan 1996). Dolphins may be more vulnerable to collisions during calving and nursing periods.

9.5.3 Cumulative Effects

Dredging and disposal processes cause temporary increase in the level of suspended solids and turbidity, thereby influencing the positive variation in other physico-chemical parameters. The potential environmental effects of dredging arise due to the excavation of sediments at the estuary/sea bed, loss of material during transport to the disposal site and during disposal. Dredging has a strong impact on marine water environment, especially to the suspended solids and turbidity. Usually turbidity has a positive correlation with total suspended solid. Maintenance dredging usually has near-field and temporary effects and lasting as long as dredging operation takes place (Sangita et al. 2014).

Usually the release of organic rich sediments during dredging or disposal results in localized oxygen depletion. Higher values of nutrient and total suspended solids also cause low Dissolved Oxygen. River runoff and sediment transport are the main sources of nutrients in the estuarine region. Re-suspension of sediments during dredging and disposal result in an increase of the levels of organic matter and nutrients available to marine organisms. The values of nutrients such as phosphates and nitrates are higher in the surface water due to increase in suspended sediment loads in water which releases nutrients to the water column due to dredging.

9.6 Inland navigation

9.6.1 Inland navigation and Trends

Bangladesh is crisscrossed by a network of about 24,000 km. of inland waterways. It provides cheaper transit of passenger and goods and most important in case of Bangladesh is that about 25.1 percent of rural population has only access to rivers for the purpose of transport. A World Bank Report on Revival of Inland Water Transport: Options and Strategies revealed that modal share of IWT registered a gradual declining trend during last decades and estimated at 8.9% in passenger and 16% in freight movement in 2005, while in 1975 IWT modal hare of passenger traffic was 16% and freight traffic 37%.

One of the main causes of declining trend of IWT identified by many studies is the deteriorating condition of the river system in Bangladesh caused by both morphological, natural processes and withdrawal of water beyond the border and within the country. Length of navigable waterways determined by a survey in 1989 was about 6,000 km in the wet season which reduced to about 3,600 km in the lean period. Inland waterways were divided according to LAD in to four hierarchical classes in 1989 and which were found to be inappropriate now with the change of navigability and of transport pattern and type over the years. But no comprehensive survey has been conducted since 1989. However a Core Waterways Network of 1,822 km was recommended in the IWT Masterplan 2009.

So far BIWTA has established 21 inland river ports and 380 landing stations in the country. Infrastructures and facilities now available in these ports and landing stations are very much marginal and primitive in nature to such extent that head-load remains the general means of loading and unloading of cargo. BIWTA does not have details traffic data of passenger and freight movement in inland waterways, In 2013-2014 BIWTA recorded 87.40 million of passenger and 35.18 million tons of cargo throughputs at 9 major river ports. IWT is mainly used for transport of bulk, dry bulk and liquid bulk of construction materials, food grains, fertilizer, clinker, petroleum product etc. A large fleet of about 10,000 inland vessels are engaged in the carriage of goods and passengers. Besides there are approximately 750,000 country boats powered by the pump engines operate mainly in the rural waterways.

A Protocol on Inland Water Transit and Trade between Bangladesh and India has been in force since 1972 without any disruption for commerce between two countries and for passage of goods between mainland India and the land-locked north-east through the waterways of Bangladesh. A total volume of more than 19.33 million tons of cargo was transported under this Protocol in 2013-2014 of which more than 98% were transported by Bangladesh vessels despite the provision of sharing the carriage of cargo on equal tonnage basis. In this regard IWT trade is dependent on only fly ash required by the cement manufacturing factories. One of the main factors for revival of IWT would be container traffic in inland waterways. To meet the growing demand of transporting containers between Dhaka and maritime ports, utilization of inland waterways has become inevitable. Railway suffers from capacity constraint and the road does not have bearing capacity to accommodate trailers, so all the studies conducted recently recommended for inland waterways. An Inland Container Terminal has already been developed through a joint venture project of BIWTA and CPA with an annual handling capacity of 116,000 TEUs which is to be followed by another 4 inland container terminals under construction by private sector. The length of navigable IWT network in Bangladesh (seasonal and perennial) was determined by the DHV Consultants, the Netherlands back in 1989 is yet to be surveyed to determine the updated length. Due to deteriorating condition of rivers and information gathered from the actual field it is very much reasonable to assume that the length reduced significantly over the years. It is also evident from the River Notices published monthly by BIWTA. Maintenance of a network of 6,000 km may not be cost effective and dredging or human intervention otherwise may not result any benefit. Economic justification is there where large or medium inland vessels navigate .No rationale exists to augment the navigability in thousands of kilometer used exclusively by mechanized boats and the smallest size of inland vessels. The rural waterways are being used by country boats and smaller inland vessels under existing condition. The Inland Water Transport Master Plan Study, 2009 limited public responsibilities of maintaining navigability to the following routes termed as Core Waterways Network. It is evident from the chart table of distance, the length mentioned above (BIWTA) were not accurate. However according to traffic and economic importance almost all routes were included in the recommended network. The waterways linking two maritime ports and Dhaka/N'Ganj area and routes under Bangladesh-India Protocol on IWT were marked as priority routes. With the above the following should be included:

- Raimangal-Khulna-Noapara 165 km as route under Protocol
- Rajshahi-Daulatdia, 173 km, this could be an important domestic route and a route for transit traffic,
- Tongi-N'Ganj, 35 km, this route may contribute modal shift of passenger of greater Dhaka to remove congestion on road.

Table 9.2: Core Waterways Network Recommended in the Master Plan, 2009

IWT Route	Length (km)
1.Dhaka-N'Ganj-Chittagong	306
2. Dhaka-Barisal-Mongla	418
3. Chandpur-Bhairabbazar/Ashuganj	102
4. Mohonpur-Daikhawa	385
5. Bhairab-Chatak	228
6. Jamuna/Hurasagar-Baghabari	15
7. Dilalpur-Fenchuganj	191
8. Chatak-Sylhet	53
9. Mongla-Khulna-Noapara	80
10. Dhaka-Tongi	40
11. Barisal-Patuakhali	85
12. Barisal-Barguna	97
13. N'Ganj-Narsingdi	77
14. N'Ganj-Meghnaghat	42
Total	1,822

Source: *IWT Master Plan, Final Report, 2009*

Passenger and Freight Movement

Modal share of IWT in respect of passengers is gradually declining. This trend will continue further as time is valued more than before. With the completion of Padma Bridge, IWT modal share in respect of passenger will be decreased to a significant volume as the present principal passenger corridors between Dhaka and districts in the southern region will inevitably experience of large modal shift. But in respect of cost IWT will remain the first option of thousands of poor people. Savings of BDT 100 will be more valued than increase of traveling time by two hours.

On the contrary, freight movement will certainly experience a significant increasing trend. IWT will emerge as the principal modal option for the carriage bulk, break bulk and liquid bulk. Pacific Consultants International, Japan in its Report on Techno-Economic Feasibility Study on Deep Sea Port projected traffic volume of general cargo at the ports of Bangladesh at 12 million ton in 2020, 35.66 million ton in 2035 and about 50 million in 2055. And IWT will share 38% of the modal split.

Container Transport

Container traffic to and from the maritime ports in Bangladesh is growing by 12% per year. Due to the growth of international trade container traffic must continue. Major problem of container movement is the inefficient hinterland connectivity. Due to inherent weaknesses and limitations of road and rail transport , river transport is given importance by all concerned. Significantly, the private sector has come up in a big way in this trade. Constructions of four river side terminals are underway. The Pacific International, Japan estimated container traffic volume in the ports of Bangladesh at 3.33 million TEU, 8.52 million and 19.60 million respectively in 2020, 2035 and 2055 while modal split in IWT will be 38%. The number of inland container vessels will be 55 in the short term, 152 in the mid term and 305 in long term. Number of container terminal will be 5 in the short term, 10 mid term and 24 in long term.

The World Bank in the KCT Pre-Feasibility Study, 2014 under the Bangladesh Trade and Transport Facilitation Program projected as follows;

Table 9.3: Projection of IWT Container Traffic (000TEU)

Year	Setting sail	The world wears Bangla
2021	1,299	1,588
2022	1,402	1,763
2023	1,514	1,958
2024	1,635	2,175
2025	1,766	2,415
2030	2,469	3,790

Source: *The World Bank Study on Chittagong Port Efficiency, 2014*

Setting sail assumes growth potential of inland waterway is unlocked and modal share of IWT (containers in TEU) rises from 5 to 45% over the period 2014-2018 and maintains share at that level. **The World Wears Bangla** allows for GDP growth to accelerate over previous trends but is below the Government of Bangladesh target of 8-10 percent.

9.6.2 Cumulative Impacts

Possible impacts for dredging on environment of wild life and mitigation measures are illustrated in Table 9.4. Impacts and mitigation measures on biological resources presented in Table 9.5. Impact matrix for dredging activities is mentioned in Table 9.6

Table 9.4: Possible impact Impacts for dredging on wildlife and their mitigation measures.

Activities	Possible Impacts	Impacts on Wildlife	Mitigation Measures
Dredging	- Erosion and sedimentation - Deterioration of water quality by disposal of liquid and solid waste -Increased turbidity in water caused by the discharge process - Nuisance from dredger - Noise, dust, exhaust gas emissions from dredging equipment	**Positive:** -Opportunistic Species **Negative:** -Damage, disturbance or modification to aquatic life or stream habitat -Disturbance of aquatic (plankton & benthos) organisms in the river bed - Disturbance of fish and mammals in the river - Increased water turbidity. -Degradation of wildlife habitat - Loss of aquatic vegetation	- Examine alternatives to proposal especially if the area is sensitive or a breeding area -Ensure all activities are well managed to reduce runoff and water quality reduction -Provision of sewage and waste treatment facilities, cleaning of the water -Continuously monitor water turbidity. - Likely to have significant impact on aquatic life and vegetation -Restrict dredging only to the area where required - Minimize habitat loss by applying careful control of cutter head, restrict digging to specified boundaries -Dredging area should be checked every day prior to commencement of dredging work. All dredging activities should be stopped at sight of aquatic mammals
Deposition of Sediments	Filling low lying areas of wildlife	**Positive**: -Reintroduction of	- A plan for the deposit of dredged material

Activities	Possible Impacts	Impacts on Wildlife	Mitigation Measures
	resources - Change of landscape - Nuisance from stockpiling of spoils -Soil pollution	wildlife in some case - Opportunistic species **Negative:** -Alteration and disturbance of wildlife habitat -Aquatic life may adversely affected by deterioration of water quality due to deposition of sediments -Reduction of photosynthesis Processes	will be implemented -It is recommended to avoid exceeding said concentration in the smallest area possible - Properly baseline environmental conditions for site specific proposals to ensure no impact on wildlife habitat
Occupying land for vessel shelter & ferry terminal	-Degradation of wildlife habitat -Loss of scenery and landscape -Alteration and natural habitat	-Clearance, disturbance, modification or destruction of vegetation & natural habitat of wildlife	- Restore native vegetation to riverbanks -Examine alternatives to proposal especially if the area is sensitive or a breeding area
Constructional activities of vessel shelter & ferry crossing	- Nuisance from dredger & constructional equipments - Noise, dust, exhaust gas emissions & other pollutants from equipments	-Direct or indirect adverse effects on the feeding, breeding and migration of wildlife -Hampers of photosynthesis	-Ensure machinery is well serviced and in good working order -Have to take efficient efforts to mitigate the pollution
Movement of heavy equipments	-Occupying a large area -Erosion of river bank -Air, water & sound pollution	-Distraction of natural habitat of wildlife -Natural life of both flora & fauna hampered adversely	-Constant maintenance of dredging equipment and other machineries - Ensure the minimum impact code, and that special care is taken during bird nesting periods -Ensure water vehicles reduce speed where wildlife may be present

Activities	Possible Impacts	Impacts on Wildlife	Mitigation Measures
Longtime presence of workers & project developers	-Generation of sanitary wastes and debris in general wastes from dredge activities -Temporary housing in natural habitat -Occurrence of different type pollution	-Direct killing and disturbance to wildlife -Introduce several challenges to the natural environment of wildlife	-All wastes arising from the activities must be disposed of in accordance with the current regulations -Provision of sewage and waste treatment facilities, cleaning of the water - Ensure human waste is buried at least 50m from all water sources

Table 9.5: Impacts and mitigation measures on biological resources.

Ecosystem/ Biodiversity –related Factors	Predicted Impacts		Mitigation Measures
	During Dredging	**Post-Dredging**	
Aquatic Habitat alteration: Water quality, benthic environment, transportation of dredged materials	Increase in turbidity, suspended materials, transparency hindering sunlight penetration and affecting phytoplanktons	Localized effect, recovery in a short time	Curtains placed on dredge, or other mitigation measures, to trap sediments and therefore limit the lateral movement of turbid water; Spoil dispersion outfall characteristics to be evaluated by collecting grab water samples during dredging operations and operations modified accordingly; Avoidance of sensitive locations (mudflats, reedlands, etc.) for dredge material depositing on land Keep increased
Benthic fauna	Changes in species composition Fluctuation in population Habitat alteration due to increase in depth	Changes in species composition Changes in vertical depths May impact livelihood of some people	
Aquatic Species Affected (Dolphins, turtles, etc)	Noise and disturbance-changes in movement routes and pattern	May recover over time	
Terrestrial Habitats: Chars, Mudflats, Reeds & Grasslands	Sediment deposition	Sediments may render mudflats unsuitable for migratory birds	
Terrestrial Species	Localized disturbances due to presence of labourers, other activities	Recovery over time	

Cumulative impacts: Aquatic Habitat	Expected	-	turbidity and suspended solid levels at dredging site to no more than 20% increase over baseline conditions during the dredging activity. In orer to do so, some methods to explore may include for example, avoiding dredging in periods of rapid water movements, for example, in the afternoon when trade winds are strong, or during the rainy season when large influxes of fresh water could move significant volumes of sediment laden waters to the Bay of Bengal; The connection of a conical reflective shield to the outlet as silt suppression and dispersion control mechanism; Preventative maintenance of equipment to mitigate negative environmental impacts such as leakages and spillages.
Cumulative Impact on Species	Expected		
Impact on fisheries			
Predicted Impacts	**During dredging**	**Post dredging**	**Mitigation measures**
Habitat degradation of Hilsa, Catfish and other fin-fishes	The nursery and rearing ground of diverse fishes may be damaged due to the operational activities i.e. cutter head circulation, flat open	Turbidity increases, as a result some fishes, bivalves and gastropods loss their natural habitat due to the excess alteration	To avoid this scenario, the suction pump can controlled through pressure diminishing where efficient data is

	scraper movement, etc.	of optimum water quality.	available to trace organisms like crab, catfishes and other scavenging aquatic species. Some bathymetric reports also provide these kinds of evidence. Pre and post dredging sampling of mud of the 12 dredging points can be utilized to identify its success.
Habitat and feeding ground destruction of shellfishes	During this whole process the bottom dwelling crabs and other benthic community are compelled to shift their scavenging route and eventually affect their feeding and subsequent breeding.	The dredging may leave them scattered and misplace the populations to some extent. After the extraction of sand and mud carrying pipelines, some artificial depressions may be created to inhabit some new organisms.	Avoid starting set up dredging and additional supplementary instruments close or near to the habitat and feeding ground of the species.
Disruption in feeding and breeding migration	Agitating water throughout the dredging period may confuse the fish school and interrupt their migration	The new environment in the topography of water after dredging may misdirect the fish migration which will result in the unwanted dispersal of fish/fishes out of its/their natural navigation area.	Raw data on pre dredging water quality assessment of the project area should be available to the dredging authority and need to compare them with the during-dredging to measure whether it is optimum for maximum freshwater riverine fishes or not.
Physiological deformities in fishes	Elevated temperatures during dredging increase the metabolism, respiration and oxygen demand of fish and other aquatic life, approximately doubling the respiration for a 10°	The physiological changes may lead to long term deformities in fish body which ultimately can somehow affect their copulation, swimming and associated	This impact is not expected to be significant due to project activities.

	C.	movements.	

Impacts & Mitigation Measures of dredging activities (both Hopper & Cutter dredging

Activates	**Impacts**	**Mitigation Measures**
Lifting	Life of aquatic fauna (like, dolphin, turtle, mollusks, crabs etc.) will hamper greatly. Due to turbidity aquatic fauna have to face several challenges (like, scarcity of food, hampering of respiration & breeding etc.) to survive. Photosynthesis process of aquatic flora will be reduced adversely.	-Suitability of lifting on the proposed spots has to be evaluated carefully. -Have to take proper efforts to sustain the determination level as low as possible. -restrictions on sediment suspension during dredging and dredge disposal, to be monitored on an ongoing basis by contractor and consultant. -
Transportation	• Pathway may be polluted and dirty due to leakage during carrying of sediments. • Great disturbance may be occurred to the terrestrial fauna. • Flora of influenced areas may be damaged.	-Carrying equipment should be well designed. -Have to make appropriate plan for transportation of sediments. Follow ECoPs outlined in the EMP. -Priority should be given to the safety of wildlife during transportation.
Disposal	-Habitat of terrestrial flora and fauna may be occupied in a broad scale. -Natural activities of fauna (both terrestrial & aquatic) like, movement, feeding, breeding etc. may face several adverse effects. -Existence of wildlife species of the affected area may be threatened.	-Disposal of sediments should be well planned and should follow EMP requirements. -Activities should be performed through maintaining the

		natural environment of wildlife. -Proposed sites have to justified for the protection & safety of wildlife.
Impact on Benthic communities		
	Impacts	Mitigation measures
Depth of Overburden at Disposal Sites	Some benthic organisms such as burrowing polychaetes, amphipods and molluscs can colonize newly deposited sediments through vertical migration, therefore, if dredged material depths are limited to within the vertical migration capacity of these organisms (20-30 cm), recovery rates may be quicker than if colonization is dependent upon the lateral migration of juveniles and adults from adjacent areas and larval settlement.	Placement of dredged material in the tidal river shall not be made during High Water and Low Water slack time of a tidal cycle when velocity is very less. Specific restrictions on dredge material placement and management are outlined in the EMP. Management actions for the disposal site following unfavourable monitoring results may include, but are not limited to: additional confirmatory monitoring to delineate the extent of the problem, capping to isolate the sediments from potential biological receptors, and/or closure of the site.
Habitat Type (disturbance history)	Shallow benthic habitats (<20 m depth, Hall 1994) experience relatively frequent wave, wind, and current induced disturbances and thus are typically inhabited by low-diversity, selected benthic assemblages that can readily re-establish themselves under conditions of high frequency disturbances (Dauer 1984, Clarke and Miller-Way 1992, Ray and Clarke 1999). These communities are naturally held in early succession stages and therefore, are able to recover more rapidly than communities in deeper, more stable environments (Newell *et al*. 1998, Bolam and Rees 2003).	
Sediment Type	Rapid recolonization of soft-bottom benthic habitats is frequently associated with either unconsolidated fine grain sediments (Cruz-Motta and Collins 2004) or the rapid dispersion of fine-grained dredged material by currents (Van Dolah *et al*. 1984). Newell *et al*. (1998) characterized typical recovery times at 6-8 months for mud habitats and 2-3 years for sand and gravel substrata.	
Spatial Scale of Disturbance	The spatial scale of the dredged or disposal area may be proportional to recovery times (Zajac *et al*. 1998, Guerra-Garcia et al. 2003). For small-scale	

	disturbances, the edge/surface area ratio of the disturbed area is larger than for larger disturbances, therefore colonization through adult immigration from surrounding undisturbed areas may facilitate recovery. With larger disturbed areas, the central portion of the disturbed areas is reliant upon settlement from the water column for colonization, which is very dependent on seasonal recruitment patterns and local hydrodynamics.	
Timing and Frequency of Disturbance	Greater monitoring efforts of dredging after seasonal larval recruitment periods is a common practice when possible. Deposition of sediments in several smaller units rather than one deep deposit also may be less detrimental to the benthos. In a microcosm study, sediment deposited in a single event caused more severe changes to nematode assemblages than the same amount of sediment deposited in smaller doses (Schratzberger *et al*. 2000).	

Table 9.6: Impact matrix for the dredging works

Phase	**System affected**	**Potential positive impact**	**Potential neutral or negative impact**
During dredging Works	Impact on Resource System (physical, biological and ecological)	-	• Disturbance of aquatic (plankton & benthos) organisms in the river bed. • Risk of pollution of surface water from oil spills and leaks. • Deterioration of water quality by disposal of liquid and solid waste. • Disturbance of fish and mammals in the river. • Increased water turbidity. • Loss of aquatic vegetation. • Risk of pollution of air, surface water and contamination of disposal site.
	Impact on User System (socio-economic and cultural aspects)	• Employment opportunities • Improved navigable depth.	Noise, dust, exhaust gas emission, oil spill from dredging equipments. Obstacle to navigation traffic. Occupational health and safety risk. • Obstruction to fishing.
Post	Impact on	• Improved waterway	Hydro-morphological adjustment.

Phase	System affected	Potential positive impact	Potential neutral or negative impact
Dredging Works	Resource System	traffic. • Biodiversity.	Erosion and sedimentation. Biodiversity composition and abundance
	Impact on User System	• Navigation traffic. • Employment. • Socio-economic development. • Attraction of tourists.	Erosion and accretion. Need maintenance dredging.

9.7 Hilsha

9.7.1 Background and Trends

Overview

The Government has prioritized the improved development and maintenance of the Class I routes and linked Class II and III routes along the Dhaka-Chittagong Inland Waterway corridor. The main trunk route is about 300km, of which it is initially estimated that about 40km currently require dredging and channelization to maintain the advertised depth for the existing traffic. Another 110-130 km of linked routes is part of this corridor, of which about 33-50km requires constant maintenance. The objective of the current cumulative impact assessment is to evaluate the combined effects of proposed developments along the proposed IWT corridor. The most significant valued environmental components (VECs) related to the proposed developments are identified as aquatic biodiversity from river environment, spawning areas from coastal environment, and flood affected areas from floodplain environment. These VECs are considered from the national stakeholder consultation and also from survey findings described in Baseline Environment chapter of this EIA report. Significance of these VECs is described later in the Chapter.

Study Boundary

The study boundary of for CIIA has been considered based on the full lengths of the waterways themselves (including islands, chars and shoals within the waterways as well as riverbed and banks), the river basins/catchments upstream and downstream of the waterways, floodplain and drainage areas and patterns, areas of potential influence of existing and planned river ports, landings, terminals, vessel shelters, ferry crossings, and dredge spoil dumping locations along the waterways (including roads leading to on-land spoil dumping sites that would be used by locals to haul spoils to secondary markets), areas of ecological importance along the waterways such as any parks/reserves/forests, current and planned areas being irrigated by or otherwise using waters from the waterways, roads leading to the spoil disposal sites, etc. According to GoB development plans, inland water transport, third sea port in Tentulia River in Rabnabad channel, construction of embankments and river training works along the bank of major rivers, development of a road network on the embankment, integrated river management program, economic zone and fish processing zone on the proposed corridor, mega power plants and defence training camps are considered as future major developments in next 20 years; and hence these projects are considered for CIIA study. Brief summary of these developments along the tentative locations are presented below.

Inland Water Transport and Integrated River Management Program: The GoB has an ambitious plan of undertaking about $100 billion 'Performance Based Capital Dredging Project' in all major rivers including the Padma, Meghna, and Jamuna for sustainable river management. The objective of the project is control of river bed siltation and aggradation, land reclamation, and develop inland navigation through extensive dredging programs.

Payra Sea Port in Tentulia River: Development of the Payra Sea Port at the Rabnabad Channel in the Patuakhali District is under active consideration of the Government of the People's Republic of Bangladesh (GOB). Economic and social development would be enhanced rapidly in this zone if a sea pot is established. International sea borne trade of Bangladesh has been using two existing sea ports, with about 92% passing through Chittagong Port. The coast line of Bangladesh is about 710km and coastal area is characterized by many tidal rivers, which can be utilized in development work for enhancement of economic growth of the country and creating employment opportunity of growing population of Bangladesh. The objective of the project is to build a sea port in the central coastal zone for economic, business, industrial and social development of the country. With the increasing population, demand of development for sea port in the central coastal zone is crucial for creating employment opportunity and social development of the country.

Construction of Embankments, Development of a Road Network on the Embankment and River Training Works along the Bank of Major Rivers: The future development projects under RMIP, FREMIP, and other development projects includes (i) construction of and rehabilitation of 150 km embankments and development of a two lane highway along the embankment under RMIP Project, which would subsequently be expanded to 4 lanes, (ii) construction of about 32 km of additional new riverbank protection works and rehabilitation of about 13km of existing revetments, six spurs, one hard point and one groyne under RMIP project, (iii) rehabilitation of about 40km length of BRE from downstream of Jamuna Bridge to Chandpur along with necessary river training works.

Economic Zone and Fish Processing Zone: An economic zone and a fish processing zone are under implementation stage of the Government of Bangladesh near Sandwip island which is close from the project area. The objective of this development projects are to bring industrial growth of the country and will use IWT as major means of transport for both national and international purpose.

Sandwip is close to Bay of Bengal and an ideal place for fish catch. Government of Bangladesh with the help of lending agencies is planning to establish a fish processing zone in Sandwip area.

Proposed Mega Power Plants: Supercritical Coal Based mega power plant is currently under consideration to be built in Sandwip area. The objective of this project is to import coal from overseas through water channel. Mother vessels will use Dhaka – Chittagong IWT corridor for carrying coals not only to deliver in proposed Sandwip power plant but also other coal based power plants in Ahsuganj areas.

Defence Training Camps: Bangladesh Army is planning to develop the Jahizzar Char, an island in the Bay of Bengal, to use for advance defence training centre. The future development of the Charland will include (i) a number of infrastructure, (ii) cyclone shelters, (iii) power plant, (iv) polder for embankment purpose, and (v) harbour development. The objective of this exclusive project is to operate amphibian tanks and navy ships in that area mainly for security patrolling and training purpose.

Impacts at Dredging Sites

Although in the past decade technological developments, research activities and operational experiences, have led to an enormous expansion of knowledge about good dredging practices around the world, in Bangladesh the existing constraint is still the same; the soil management after dredging. If the soil is disposed near the dredging site, it will be of no good use rather than causing harm to the ecosystem and food chain the aquatic biodiversity. Even though sediments are natural elements in any river basin, alteration or misplacement is regarded as a threat to the existing ecosystem. If the slope is so upward, the tertiary consumer may easily reach the secondary and primary consumer which may bring about a reduction in their number as the zonation is not maintained properly. Habitat changing pattern due to this intervention may prove as a risk. Along with this, if the dredged sites are breeding ground for any unknown or unidentified species, the whole system can be collapsed as well. It will change the species composition of the water area and the fishermen depended on the fishes will not be able to catch them frequently and gradual effect on livelihood may be experienced. Due to such potential impacts, which might be unavoidable in the locations of required dredging, the project will support a biodiversity conservation program which aims to contribute towards enhancing the management of hilsha and dolphin sanctuaries and improve the aquatic ecosystem environment for key species.

On the other hand, if a fish population is aware of the new way that has been created by dredging; they may use it in the consecutive years for both migration and feeding. Some dredging sites create artificial scour that can also be used as habitat and hiding place for fishes like Boal (*Wallago attu*) or Chital (*Notopterus chitala*) who prefer low temperature and lying in deep water bed for a certain period of their lifespan. Nutrient cycling is another key objective that can be taken under consideration as positive impact.

Change in trench and Scour

Trench and scour are shallow or narrow depression or ditches that are used by many riverine and floodplain fishes for multidimensional purposes. Destruction of these specific sites may be proved as habitat alteration and unwanted movement of fishes. It possibly will change the food and feeding behavior of fishes due to unavailability of proper nutritional elements around the new living grounds. Fish catch prototype will change as well as the living of the local fish depended people will be hampered, which needs a very good insight.

Change in water velocity

Change in water velocity is another impact that can occur at the dredging spots leaving the biodiversity interrupted. High water velocity results in turbidity in the riverbed. Some fishes don't like too much velocity and some are very akin to the same. For example, hilsa requires high water velocity for their gonadal development and maturation while carp fishes cannot tolerate soaring water velocity. As the width of the river is not going to expand during this project implementation period (except natural river bank erosion), this possible impact can be considered negligible. On the contrary, this water velocity can carry nutrient from Upper Meghna to Lower Meghna and vice versa which allows nutrient cycling and availability spreading out to new species. Some freshwater fishes can move to the new habitat to avail the macronutrients.

Impacts at Disposal Sites

The dredged soil can create an artificial barrier between the movement channels of fish. Consequently, it can destroy fish passing and food intake. The dredged material produces turbidity due to the increased water velocity in adjacent areas and compels fishes to move which are not generally reared in turbid condition. While considering the Ganges floodplain fishes, it is to be kept in mind that, these fishes are not much familiar with turbid water; as a result their healthy population may be hampered in some extent. Fishes get isolated and it inhibits breeding and subsequent reproduction cycles.

Other external factors

Navigational vibration is sometime horrifying to brood and juveniles of surface water. This trembling also results in less catchment in artisanal and marine fish near the Meghna estuary. However, the water close to the estuary (Noakhali, Hatiya, Bhola region) is not static and sometime not that harmful to marine species. Oil spillage, causes plankton destruction and bio-safety of natural riverine water. This very situation creates obstruction in food chain mainly in primary and secondary consumer level.

Recommendations

1. Proper Soil Management is a prerequisite to this project. The soil management plan should include recommendations/suggestions to ensure the proper use of the dredged soil.
2. Dykes that disconnect river and floodplain should be avoided to protect the regular fish movements.

3. Although the hilsa breeding ground consist of a wide range of area, the dredging and navigation should be done as less as possible. It will save the maximum gravid fish and juveniles as well.
4. Using the concept of setback distance can be utilized. It will facilitate required amount of water flow through the corridors.

9.8 Dolphin

9.8.1 Background and Trends

Ganges Dolphin and its habitat

The Ganges River Dolphin (*Platanista gangetica gangetica*) or 'shishu/shushuk/shush' (in Bangla) is found in most of the areas of the Ganges-Brahmaputra-Meghna river system including Nepal, India and Bangladesh. This species is categorized as 'Endangered' by the International Union for Conservation of Nature (IUCN) Red List (2010) with the wild populations decreasing drastically within the range countries. These dolphins share the same ranks as the tigers and great apes that are listed as a species endangered by trade on Appendix I of Convention on International Trade of Endangered Species of Flora & Fauna (CITES). The species is listed as a 'flagship species' by World Wide Fund for Nature (WWF).

Ganges River dolphins are generally concentrated in counter-current pools below channel convergences and sharp meanders (Kasuya and Haque 1972, Smith 1993, Smith *et al*. 1998) and above and below mid-channel islands, bridge pilings, and other engineering structures that cause scouring. Dolphins could potentially be negatively affected by dumping in the scour holes because scour holes are used as a refuge by the dolphins and other aquatic animals during dry season when water levels are low in the rivers.Their fidelity to counter-current pools is probably greatest in fast-flowing channels (Smith *et al*. 1998). Annual monsoon-driven floods cause great variability in the dolphins' access to large parts of their range. Isolation in seasonal lakes sometimes occurs (especially in the Brahmaputra basin), as does "escapement" from the river channels into artificial water bodies such as canals and reservoirs. Deltaic (brackish) waters are a major component of the total range, but Ganges River dolphins are not generally known to occur in salinities greater than 10 ppt, although they have been recorded in waters as saline as 23 ppt.

Water abstraction upstream decrease river depth and the appearance of sand bars during winter season cause danger to the dolphins as the river is divided into small segments, causing a segregation of populations in deeper pools, narrowing of the gene pool, increase in the intensity of fishing, river traffic, pollution due to release of untreated effluents from industries, incidental and/or intentional capturing for oil extraction for use as fish attractant, liniment and aphrodisiac, etc., have become the major threats for its survival.

The significance of water depth as an important factor for determining the distribution pattern and habitat selection of marine dolphins is well documented (Ross et al. 1987, Hastie et al.

2005). It is perceived that the same applies for the Ganges River dolphin. Earlier studies in the Brahmaputra in India indicated certain depth range preferences of the Ganges River dolphin between 8 and 10 meters (Mohan et al. 1997); however in a recent study Wakid (2009) showed that the preferred water depth for the dolphins is between 4.1 – 6 meters for the same river. This variation may be due to the physical changes in sedimentation that might have happened over the years and other anthropogenic reasons for reduced water flow in the Brahmaputra River. In another study in the Chambal River in India the optimum water depth for dolphins was reported as 10 meters (Hussain et al. 2009). Rashid et. al. (2015) also observed the maximum numbers of dolphins preferred areas between 6 – 10 meters deep during the dry season and between 10 – 16 meters during the wet monsoon season in the Padma and Jamuna Rivers.

Seasonality, food availability and environmental conditions of the water are the main factors of the Ganges River dolphin for its habitat use/preference (Hussain et al. 2011). Depth of water and also water turbidity in the Padma, Jamuna and Meghna Rivers vary greatly due to changes of seasons, physical characteristics and other anthropogenic reasons. Water depth increases during the monsoon months and decreases during the winter and summer months in the rivers. During the winter and summer months, dolphins were found to remain concentrated in the deeper sections (*kums*) of both the rivers. Optimum water depth preferred by the Ganges River dolphin throughout the year is mostly available in sections where scours in the river exist. Secondly, most river fishes occur or should have occurred in the scours of the rivers during the winter and summer months (Hussain 2010). The dolphins feed on fishes hence distribution, composition and abundance of their prey may also play an important role in the distribution and abundance of dolphins and consequently habitat utilization.

Current Threats

Accidental killing of dolphin in the form of by-catch in net fishing is one of the main threats for dolphins in the rivers. It was reported that accidental killing of dolphins in the project and surrounding areas through getting trapped or entangled in fishing nets were higher in the past but reported less during the survey period. Other threats for dolphins in the rivers included oil spill from boats and ships, river erosion, low water depth during winter, use of harmful fishing gears (especially current net) and making cross dam of bamboos across some sections of the rivers/tributaries/distributaries for fishing. As reported by local people, the practice of intentionally trapping and/or killing of dolphins in the rivers for commercial reasons is gradually gaining momentum for oil extraction. Remains of the dolphin body, particularly the head, are used in the brush pile fishery – certain sections of the river close to the banks is fenced using bamboos and piles of tree branches are used to provide a temporary refuge for the fish during the dry season when water level gets low. During dry season the fenced area is netted and fishes are caught. By putting the remains of the dolphin body and head together with the tree branches fishes are attracted by the smell as they decompose.

Very little is known about the effects of vessel traffic on river dolphins and porpoises. Ferry crossings, commercial ports, and primary fishing grounds in rivers are generally located downstream of convergent channels or sharp meanders, which are also the preferred habitat of river dolphins. River dolphins are often observed swimming in areas with high vessel traffic, that includes small boats, motorized ferries, and in some locations large container ships and oil tankers, with no visible damaging effects. Mortality from propeller collisions, however, has been reported for baiji and finless porpoises, particularly in the lower reaches of the Yangtze River, where waterways contain high levels of large commercial vessel traffic (Zhou 1992). A single susu was also reported by fishermen to have been killed by the propeller of a cargo boat in the Brahmaputra river near the India/Bangladesh border (Mohan 1996). Dolphins may be more vulnerable to collisions during calving and nursing periods.

The direct risks associated with the current project dolphin and dolphin habitat include: (a) generation of underwater noise levels from the dredging equipment, and (b) impacts on dolphin habitat due to disposal of dredged material in scour holes.

With respect to (a): For dolphins, sound serves three main functions: (i) it provides information about their environment, (ii) it is used for communication and (iii) it enables the remote detection of prey. The sounds generated by dolphins often extend beyond the range audible to the human ear. Vocalizations of Dolphins will be in range of 125-173 (dB at 1m) for whistles and 218-228 (dB at 1m) for clicks. Underwater noise levels generated by dredging activities are expected below 175 dB. The threshold peak impulse source pressure for direct physical trauma in aquatic mammals is generally considered to be more than 200 dB and hence dolphins would not be expected to experience permanent hearing impairment from sound pressures generated by the dredging. However, effects on behavior are more likely. Behavioural studies conducted elsewhere on the impact of similar activities like pile driving on dolphin indicated a temporary displacement from the area where pile drivers are operating and they returned close to normal once pile driving had ceased. Whilst for fish, adverse behavioural aspects occur at a noise level of 150 dB and physical injury may occur at 206 dB[19]. The indirect impacts on the dolphin from dredging activities would be impact on its prey, the fish.

With respect to (b), this impact can be effectively minimized by prohibiting deposition of dredged material in deep scour holes (greater than 5m depth), which are the preferred habitat for dolphins. Only shallower scour holes will be permitted for use by contractors for depositing dredged material in river.

The cumulative impacts associated with various activities in the watershed include risk of water pollution from accidental spillage of fuels, hazardous material and bilge water from the various types of vessels used in the river for various purposes, and risk of collision of dolphins with vessels. Motor boats will be extensively used for transport of personnel, material and fuel. There is a risk of water pollution from these activities through accidental spillage of fuels, hazardous material and bilge water. Any such pollution events will seriously impact the downstream dolphin and fish habitat. Further, there is a risk collision between dolphins and motor boats.

[19] National Oceanic and Atmosphere Administration, USA Criteria for Pile Driving and its Impact on Fish

The impacts on the dolphin from the project activities can be minimized the contractor by taking utmost care to prevent such risks and will prepare an emergency preparedness plan to address these risks. The contractor will make booms, absorbents and skimmers available on site along with trained personnel to recover spilled oils from water surface. The contractor shall include training in the use of this equipment within his training plan and carryout regular drills in the deployment of this equipment. All waterborne plant shall be regularly serviced as per the manufacturer's guidelines and be inspected daily prior to operation.

Dredging work will adopt a 'soft start'; using a low energy start to the piling operations to give dolphins an opportunity to leave the area, gradually ramp up the sound levels to scare the dolphins and other cetaceans away before dredging commences. Contractor will also se pingers to chase away dolphins from the construction areas. Given that monsoon period coincides with in the dolphins' main calving period, which is July to August, the impacts on dolphins during this critical period will naturally be minimized, since little dredging is expected to be required during monsoon months. In addition, Pingers, set at 145dB at 70kHz, may be used to drive away the dolphins, if necessary. Under component 2 of the project, the facilities will be established at the river ports to collect the bilge water from the various transport vessels. During the dredging activities under the current component, the contractor shall be prohibited from bailing or pumping this water into the river, but instead shall be required to collect the bilge water, treat it by separation and dispose of the separated oil and fuel as hazardous waste. Refuelling of dredgers and boats will be properly carried out to avoid any spills.

10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 Objective

This section aims to provide methodology used to prepare the environmental management plan (EMP) for the Project to mitigate any potential negative environmental and social impacts which may occur as a result of Project activities. This chapter also specifies the Contractor's environmental obligations in performing the works to be carried out under the project.

The methodology followed for preparing the EMP consists of the following steps:

- Deriving mitigation/protection measures for identified impacts for each of the project activity and environmental component,
- Recommend mitigation, compensation and enhancement measures for each identified impacts and risks,
- Developing a mechanism for monitoring the proposed mitigation measures
- Estimating budget requirements for implementation mitigation and monitoring measures, and
- Identifying responsibilities of various agencies involved in the Project for implementation and
- Monitoring of mitigation measures.

10.2 Components of EMP

The key compoenents of EMP are summarized below and each of this component is explained in detail in the following subsections:

- Mitigation Measures
- Monitoring Measures
- Institutinoal Arrangement
- EMP Budget
- Reporting Requirements

10.3 Mitigation Measures

10.3.1 Key Impacts from the project activities and mitigation measures

The dredging and dredged material placement activities are expected to cause several negative impacts on the aquatic habitat and fauna due to generation of high sediment flows, disturbance of benthic habitat, noise and emissions from construction machinery, and accidental spillage of fuels. Various stages of the dredging and potential impacts from each of these stages is summarized below:

- Excavation: Excavation is the process of physical removal of the material from its in situ location on the bed of a water body. This will be done either hydraulically or mechanically by dredger heads. The physical changes that can take place during excavation are the generation of suspended sediments (causing an increase in turbidity), mixing of soil layers, and noise and air pollution from the equipment. Major potential impacts of these changes on the human and natural environment include but are not limited to: impacts to aquatic and benthic flora and fauna; changes to bioavailability of contaminants in the sediment due to its re-suspension; temporary impacts to navigation, fishing and other river uses; disturbances to local communities and riverine species; among others. The changes to river morphology resulting from excavation can also impact riverbank erosion patterns.
- Lifting: Lifting is the vertical transportation of the excavated material from the bed. Similar to excavation, this will also be done either hydraulically or mechanically. The physical changes that occur during lifting are the release of suspended sediments, for example as overflow losses during loading. Sediment re-suspended in the water column in high concentrations can directly lead to physical abrasion of, for example, filter-feeding organs or gill membranes of fish and shellfish. If the sediments are rich in nutrients and metals; the resuspension of sediments may release nutrients, organic matter and toxic chemicals in to the water. Other impacts noted above related to excavation are also applicable to the lifting process.
- Transportation: Transportation is the process of transferring the excavated material to the placement location. In most cases , this will be done hydraulically through a pipeline. The potential impacts during transportation are spillage and safety in relation to other transport users of the river.
- Placement: Placement is the final stage, where the excavated material will be placed at designated sites in the rivers or in on the land. Potential impacts during this stage are dispersion of deposited material and release of sediment laden runoff.

A detailed summary of these impacts and the mirigation measures for each of this impacts are given in **Table 10.1**. In addition, general construction related impacts and best management address practices to address these impacts are given in Enviornmental Code of Practices, The contractor shall comply with the mitigation measures proposed in Table 10.1 and in ECoPs. Contractor will be required to prepare the dredging plan with the help of Table **10.1** and ECoPs obtain approval from the Project Director of BIWTA to ensure that no critical habitat (Dolpin, turtles) exists at/near such dredging location.The Contractor should select the dredging methods to minimize suspension of sediments, minimize destruction of benthic habitat, and increase the accuracy of the operation.Inspection and monitoring of dredging activities should be conducted to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.

10.3.2 Location of Environmentally Sensitive Areas

Locations of known environmentally sensitive areas, including reed lands, mud flats, mangrove forests, migratory bird habitat, and hilsa sancturies and spawaning grounds are shown in **Figure 10.1**. The locations of expected dredging locations (based on 2015 hydrographic surveys undertaken by BIWTA) and pre-identified appropriate dredge material placement locations are also shown in Figure 10.1. In addition, the river banks and chars also act as breeding areas for several aquatic species including fish and turtles, as well as birds. The Contractor shall take utmost care to prevent any harm to these enviornmentally senstivive areas.

The contractor shall not carry out any dredging activities within 100 m from the river banks and char lands. The contractor shall aslo maintain a minimum of 100 m distance from all reedlands, mudflats, mangroves and migratory bird habitats. The dredging can be carried out during all seasons in the hilsa sanctuaries and spawning areas, but the contractor is required to undertake intense monitoring and reporting on all activities in these areas, particularly during the months of October to November, and March to April, to ensure that there are minimum impacts on the water quality and hilsa habitat in these areas.

On the floodplains, the contractor shall also maintain a minimum 100 m distance in establishing offices or workers camps from the environmentally sensitive areas shown in Figure 10.1.

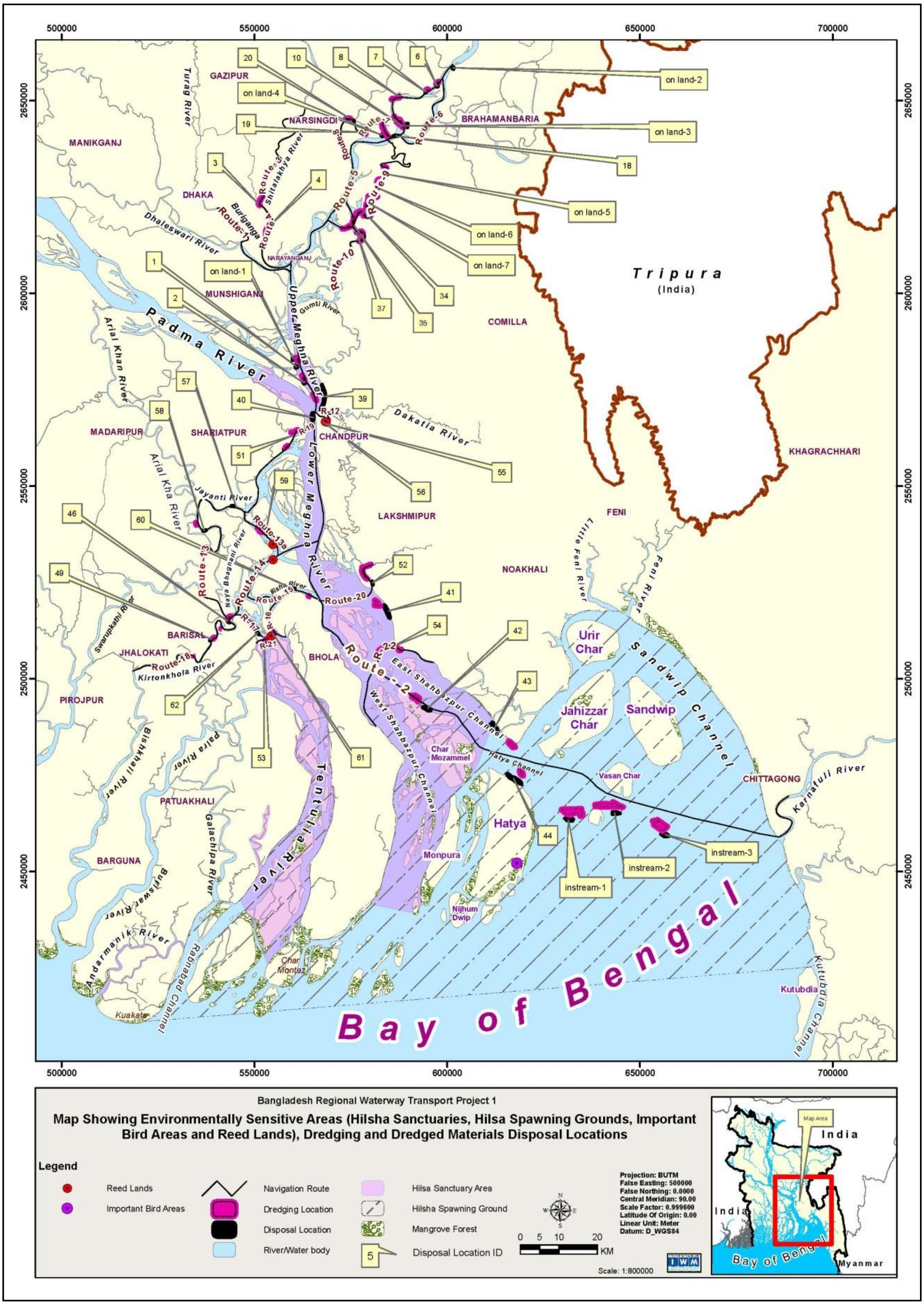


Figure 10.1: Locations of Environmentally Sensitive Areas, Dredging and Dredge Material Placement Locations

Table 10.1 : Environmental Management Plan: Mitigation Measures

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties: Implementation	Responsible Parties: Supervision/ Approval Authority	Budget (USD)*
Pre-Dredging:Navigation Routes and Ferry Crossings					
Engagement of Environmental and other Technical staff	Without adequate technical staff, it would be difficult to implement EMP as prescribed.	Contractors and BIWTA should hire all technical staff as described in institutional arrangement Section for effectiveimplementation of the EMP. Contractor's staff: Aquatic Biologist Occupational Health and Safety Specialists, Environmental Technicians, and Community Liaison Officers, BIWTA staff : Environment Management Specialist, DSC, Resettlement specialist, GRM officer, Environment Monitoring Specialist.	Contractors	PIU/ BIWTA	Included in Table 10.13 as contractor's budget
Preparation of guidelines for effective handling of dredged materials	Without proper guidelines for management of dredged materials, there will be social and environmental problems.	Prior to the mobilization of Contractors, BIWTA will ensure that for selection of sites for temporary storage of dredged materials before subsequent beneficial use or permanent on land disposal, arrangement is made for such sites in consultation with local public representatives and concerned land owners. Site-specific Dredged Material Management Plan with proper containment compartment and drainage provision Refer Table 10.4 and Figure 10.3 for the dredging and disposal sites.	Contractors	BIWTA/ PIU/ DSC DSC / DOE	Included in Table 10.13 as contractors' budget
Plan for sediment sampling to be carried out	Sediment may be contaminated posing threat at disposal sites and community.	Toxicity levels should be tested before dredging and verification to be carried out according to section 102.3 of EMP. Contaminated/ Toxic Dredged Material Management Plan.	Contractors	PIU/ DSC DOE	Included in Table 10.13 as contractors' budget
Verification of dredging area	The projected dredge volume to be re-assessed through verification prior	A bathymetry survey and analysis should be conducted jointly by Contractor and BIWTA or	Contractors and the independent	PIU and DSC	Included in Table 10.13

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	to commencement of dredging.	by independent monitoring agency for verification of dredging alignment in the selected routes.	monitoring and Evaluation Consultants		as contractors' budget
Land acquisition	The dredging operation will involve land acquisition/requisition and structure losses for the temporary storage and disposal of dredged materials on land.	All affected people of private land and structures should be compensated according to national and World Bank guidelines. RPF to be fully implemented prior to initiation of project activities.		BIWTA /PIU DC office	Included in Table 10.13
Safety of river traffic	Dredging location and activities in the waterways may result in traffic congestion or accidents or disturbance to fishermen and water vessels.	Notification to communities and river users prior to initiation of dredging. Erection of buoys in the area to alert river vessels passing the dredging site.	Contractors	BIWTA / PIU Ministry of Shipping	Included in Table 10.13
Inclusion of environmental Clauses in Construction Contracts	Compliance by the Contractor to requirements defined in the ESIA, EMP and BMP.	Specific environmental and biodiversity conservation clauses will be added to contract specifications and a separate environmental bill-of-quantities section will be prepared.	BIWTA / PIU	BIWTA / PIU	-
Affects on biological resources, endangered species	Changes in aquatic/benthic species composition; hindrances in movements of aquatic animals, increase in turbidity, etc.	Specific clauses to mitigate the impacts and monitoring and reporting on a regular basis (weekly / monthly, as the case may be) will be added to the contract specifications. Collect / document relevant/detailed information on the key threatened species within the project influence area Make the field staffs/labourers aware of the biodiversity conservation issues	BIWTA PIU and NGOs or BDM Consultants BIWTA Contractor	Department of Fisheries/, DoE / FD	Included in Table 10.13
Pre Construction Phase: Vessel Shelters					
Survey and design of Vessel Shelter sites	May cause temporary disturbance to traffic and businessmen during survey and investigation works by design Consultants	Adopt proper planning and take adequate precaution to carryout the survey with minimal disturbance to traffic and people.	Design Consultant	PIU /DSC	-
Land acquisition	Potential impacts on aquaculture	Preparation of Resettlement Plan in accordance	PIU	PIU, DSC,	Included in

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
and resettlement	farmers at locations of Shatnal, Chandpur, Char Bhairabi, Mehendiganj, Nolchira and Sarikait.	with the national and World Bank policies.		DSC	Table 10.13
Camp and storage facilities	Construction of camp and stockyards for materials can cause dust nuisance and gaseous emissions from equipment and vehicles to local residents and traffic.	Follow standard code of .construction practice and watering dry earthen surface to control dust emission, maintenance of equipment in good working condition and control of movement of vehicle, particularly on weekly market days and school timings.	Contractor	PIU, DSC	Included in Table 10.13 as contractors' budget
Siting of Vessel shelters	May affect environmentally sensitive areas, i.e. mangroves, reed lands, fish sanctuary, religious institutions	Site selection shall avoid such environmentally sensitive areas and social institutions.	PIU, Contractor	BIWTA,	-
Water and Sanitation facilities atCamps	Inadequate provision of drinking water supply, toilet facilities including solid and liquid waste management may cause poor health to workers and nuisance to public.	Ensure potable drinking water supply by installing tubewells and constructing sanitary latrineat camp sites. Provision of facility to put solid waste and adequate drainage provision for safe disposal of liquid and solid wastes. Also arrangement of first aid kit at camp sites to be ensured.	Contractor	PIU, DSC	Included in Table 10.13 as contractors' budget

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
DredgingPhase:Navigation Routes and Ferry Crossings					
Locations of dredging sites	Impacts on river morphology and bathymetric changes. Impact on habitats of sensitive species such as dolphins, migratory birds, and fish habitats	Restrict dredging to design section only where required by avoiding sensitive areas (dolphin and bird habitats, reeds and char lands) identified in the ESIA (Refer Fig. 10.2). Regular monitorin will be ensures during dredging operation. The impacts from dredging can be minimized by avoiding the sensitive habitats of fish and other important species during their breeding and spawning period. During dry season no dumping of dredged materials in the scour holes in the Upper Meghna (Refer to Fig. 10.1 for location of scour holes). Scour holes are used as a refuge by some large fishes, dolphins and aquatic animals during dry season/winter. Dredging in Lower Meghna River and estuary should be avoided in the hilsa sanctuaries during the months of March and April, and during 11 days in the hilsa spawning season in the month of October and November (see Table 10.2, Fig. 10.1). Hilsa usually take the deeper channels (preferably >10m) for migration. While dredging the contractor should maintain reasonable distance (≥100m) from the deeper channels.	Contractor Contractor Contractor Contractor	PIU, DSC DSC DSC DSC	Included in contractors' costs
Dredging: Excavation	Impacts of river morphology and bathymetric changes. Increased turbidity, loss of transparency and increased suspended sediment concentrations.	Select dredging equipment with low risk of sediment dispersal. The Contractor should select the dredging methods to minimize suspension of sediments, minimize destruction of benthic habitat, and increase the accuracy of the operation. Suspended sediment concentrations	Contractor	PIU, DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	Impact on benthic habitats,	due to dredging activities should not exceed 4,000 mg/l near the dredger (a threshold value being followed in other projects in Bangladesh) Monitor the dredging operation and, if necessary, change the dredge location to minimise the amount of material being dredged (or the number of dredgers allowed to operate) at any one time. In ecologically sensitive locations – scours, reedlands, IBAs, fish sanctuaries - (see Fig. 10.1), the Contractor will additionally keep TSS levels below 20% over baseline levels. Inspection and monitoring of dredging activities should be conducted to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary. An ongoing ecological monitoring will be in place to evaluate the impacts of the dredging and develop additional mitigation measures as required.	Contractor Contractor Contractor BDM Consultant	DSC DSC DSC DSC	
Dredging: Lifting	The release of suspended sediments during lifting can cause mortality to fish..Increase in turbidity, due to sediment re-suspension, also reduces light penetration in to the water thus resulting in to reduction in primary productivity for phytoplankton.	Select dredging equipment with low risk of sediment releases from lifting.	Contractor	PIU, DSC	Included in contractors' costs
River Traffic	The presence of barges and associated vessels and discharge pipelines will pose a risk to local river traffic. There is also risk of	Provide proper navigational lighting and navigation aids for the barges and associated vessels	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	collision of construction boats with dolphins.	Provide appropriate lighting to all floating pipelines and buoys Check all navigational lights routinely to ensure that they are working properly. Limit the motor boat speed to ≤15 km/h in accordance with the best international practices and to avoid any collision with dolphins. Pingers set at 145dB at 70kHz(maximum) to be used to chase away dolphins from the construction and dredging areas thus minimizing the chances of any collision with dolphins. Pingers should be operated intermittently under supervision of experienced operators and if operated continuously for longer periods may harm or drive away other aquatic fauna, particularly fishes.			
Noise from dredging activities	Noise and vibration under water: Disruption to fish migration and disturbance to dolphins Noise and vibration above water: Nuisance to local community, disturbance to birds	Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. Limit the noisy dredging to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife) or during night time hours.Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. This will encourage riverine and terrestrial fauna to move away from the source area prior to significant noise emissions. Inspect and maintain equipment in good working condition.	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
Exhaust emissions	Air pollution and release of greenhouse gases from construction equipment	Inspect and maintain equipment in good working condition. Proper maintenance of engines ensures full combustion with low soot emissions. Use low-sulphur heavy fuels to reduce noxious emissions. Provide exhaust filtering. Gaseous emissions to be monitotred daily and emissions should be within limits as prescribed in the DOE air quality standards	Contractor	DSC	Included in contractors' costs
Oil spills	Oil spill will cover large area from a specific point location through tidal and wave action at Meghna estuary and lower Meghna river.	Refuel of barges and boats with a proper care to avoid any spills. Make available spill kits and other absorbent material at refuelling points on the barges	Contractor	DSC	Included in contractors' costs
Bilge water	Waste water disposal from the barges and associated vessels	Properly collect, treat and dispose on land the bilge water from the barge and boats. Empty barge or hopper from rest load by washing or mechanical cleaning before moving between different dredging areas, particularly between the ecologically sensitive areas (fish sanctuaries, important bird areas – Fig. 10.1) to prevent distribution of contaminated material through residual loads.	Contractor	DSC	Included in contractors' costs
River Water Quality	Increased suspended sediment concentrations	Select dredging equipment and methodology with low risk of sediment dispersal. Monitor local suspended sediment concentration by sediment sampling and laboratory analysis and sedimentation at the proposed dredge channel and adjacent area including disposal site and prepare a monitoring response plan to modify dredging and placement operations	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		should threshold levels be exceeded under the prevailing hydrodynamic and wave conditions. Regularly inspect and maintain equipment in order to prevent leaks. Should a pipeline leak occur, the pipe or joint should be repaired or replacedimmediately. Develop and implement a Spill Prevention Plan to prevent and contain accidental spills, monitor sediment spill. Monitor the dredging operation and, if necessary, change the dredge location to minimise finesediment. Select placement methodology for bulk filling to ensure limited spread of sediments. Suspended sediment concentrations due to dredging activities should not exceed 4,000 mg/l near the dredger (a threshold value being followed in other projects in Bangladesh)			
	Increased turbidity and reduced transparency	Dredge cuts and lifts should be designed so as to prevent undercutting of material and hence a collapse of material locally at the cutter head, leading to an increase in the sediment being disturbed by dredging. If water quality standards are not met, modify operations, e.g. restrict the amount of material being dredged (or the number of dredgers allowed to operate) at any one time. Quality Control system shall be developed by the dredging contractor before commencement of work and get approval from DSC/EMS.	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		Suspended sediment concentrations due to dredging activities should not exceed 4,000 mg/l near the dredger (a threshold value being followed in other projects in Bangladesh).			
	Spillage of oils and fuels	Develop and implement spill contingency plans for pipeline and hull leakages. Ensure that emergency response equipment, e.g. floating booms, are serviceable and available to deal with any oil spills or leakages. If water quality standards are not met, modify operations, e.g. restrict the amount of material being dredged (or the number of dredgers allowed to operate) at any one time.	Contractor	DSC	Included in contractors' costs
	Site runoff	Control the discharge of site runoff, including excess dredge water, by the installation and correct use of containment walls, bunds and weirs. Monitor the quality of water (e.g. sediment content) in site runoff to confirm that the design and operation of the bunds and weirs, and the retention time for dredge waters which facilitates the settlement out of fine sediments prior to discharge off site, is adequate. If not, take appropriate remedial action. Water quality monitoring/laboratory test results should be shared every two weeks. Water quality parameters should not exceed DOE standards Also refer to suspended sediment concentration	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		section above.			
Waste from ships	Oil containing wastewater, solid waste from ships, if discharged into water, will cause adverse impact on aquatic ecology and water quality.	Enforcement of national and international regulations e.g. Management Regulations on Preventing Vessels from Polluting Marine Environment. Wastewater and solid waste are forbidden to be discharged into the rivers, and must be unloaded to the nearby waste treatment facilities for treatment. Protocol to be developed by the contractor and approved by the BIWTA and DOE for waste management including oil.	Contractor, DSC	DSC, DOE	Included in contractors' costs
Benthic biota	Loss of aquatic communities especially benthic biota. Changes in habitat characteristics, species composition and biomass production.	Restrict dredging only to the areas where required. Minimize habitat loss by applying careful control of cutter head, restrict digging to specified boundaries. Disposing dredged material in fast flowing and deep river sections.	Contractor	DSC	Included in contractors' costs
Aquatic Fauna	Disturbance to aquatic mammals	Dredging area should be checked every day prior to commencement of dredging work. Dolphin pingers to be activated to drive away any dolphins or other aquatic animals prior to commencement of dredging.	Contractor	DSC	Included in contractors' costs
Fisheries	Disturbance of fish and damage of aquatic vegetation.	See biodiversity management plan (in Annex) for biodiversity enhancement activities	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
Geo-morphology and Bathymetry	Erosion and accretion of the river bed and bank.	Ensure adequate measure through proper design and construction of training works.	Contractor. PIU	DSC	Included in contractors' costs
Transportation of dredged materials	Leakages and spillage from the hydraulic pipeline, dust emission affectingair quality during transportation by trucks.	Ensure regular inspection and maintanance of delivery pipes and accessories to prevent leaks. Develop emergencyor contingency plan to prevent and contain accidental spills, fire or any other natural or man-made incident. The transportation of the dredged materials (dredged sediment and bulk refuse materials) using watertight dump trucks should not exceed the truck capacity to avoid spillage on the road and to be carried out night (e.g. 21.00hrs to 05.00hrs) to prevent road traffic congestion. Provide notification about the dredging activities at the dredging locations to minimize risks. Assigning a traffic officer at each dredging location. Appropriate placement and maintenance of heavy equipment. Maintain cleanliness of trucks for transporting dredged materials. Provide adequate training to staff at dredging site to operate heavy equipment.	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		Carry out dredging and transportation of the dredged materials during evening and night.. Coordination with relevant stakeholders, including district and upazilla levels, throughout the dredging period.			
Placement of dredged materials	Dispersion of sediments and release of high sediment laden runoff from the placement sites.	For directplacement of sediment on land the area will be subdivided into compartments by dredged materials. Filling will be achieved by progressively pumping slurry of sand andwater into the bunded areas, allowing the surplus water to drain away to artificia and natural waterways in a controlled manner through the pipeline, without affecting floodplains. Control the discharge of site runoff, including excess dredge water, by the installation and correct use of containment walls, bunds and weirs. Monitor the quality of water (e.g., sediment content) in site runoff following the dredged management plan and relevant Environmental code of Practice. No agricultural land will be used for permanent or temporary filling. If temporary filling is required, only government owned khas lands will be used or will be directly sold to the willing-sand buyers.	Contractor,	DSC	Included in contractors' costs
Waste Management	Generation of dredged materials that are unsuitable for use as fill / do not	Minimize waste arising through the effective use of quality control system and waste management	Contractor	DSC	Included in contractors'

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	meet specification .	plan. Adopt appropriate waste confinement and storage arrangements. Waste management contractors to have the relevant approvals and permits from appropriate authority.			costs
Drainage Congestion	Drainage can be blocked in case of land disposalin the Upper Meghna basin.	Deploy silt screens in front of drainage pipes to prevent sedimentation on surrounding lands of the disposal areas. Ensure proper monitoring so that natural drainage is not blocked. Apply measures to minimize sediment dispersion.	Contractor	DSC	Included in contractors' costs
Worker's Health and Safety	Health impact from the exposure to hazardous and chemical materials and casualty from drowning or criminal attack.	OHS plan will be prepared,followed and implemented by contractors on the basis of the WBG EHS Guidelines (2007), ECoPs, and other relevant standards including fuels and hazardous substances management plan, drinking water management plan, spill control arrangements for fuels, firefighting equipment availability at the work station and safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.	Contractor	DSC	Included in contractors' costs
Public Health	Workers mobilization,heavy equipment handling, dredging, transporting dredgedmaterials and placement of dredged materials can affect local people's health	Observance of ECoPs, OHS Plan and relevant dredged materials management plan by the Contractor. Continue liaison and provide information to relevant community leaders, stakeholders and potentially affected communities throughout the	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties: Implementation	Responsible Parties: Supervision/ Approval Authority	Budget (USD)*
		dredging period in order to maintain community support. Provide adequate training to staff to operate equipment, to carry out dredging, and to transport dredged material. .			
Institutional Responsibilities for spoil management	Identification of institutiaonal responsibilities for spoil management, ownership of the dredge disposal facilities, contaminated spoil handling and re-use of the spoil will be critical issue with out proper institutional arrangement.	Contractor should take the responsibility to construct dyke and contaminated facilities (contained) using internationally approved method for construction of these facilities. After construction of these facilities, contractor should use them for spoil disposal and will also ensure their proper functioning and maintenance until PBC is over. According to the information of spoil demand, most of the clean spoil may be re-used for construction of rural roads, improvement of yards of community facilities, commercial use, etc. However, BIWTA will ensure long-term safety of the end users. After completion of the project, these facilities will be under the custody of Office of Chief Engineer – Dredging, BIWTA.	Contractor Contractor BIWTA	BIWTA DSC BIWTA	Included in contractors' costs
Construction Phase: Vessel Shelters					
Locations of dredging	Impacts of river morphology and bathymetric changes. Impact on habitats of sensitive species suchasdolphin and migratory birds and fish habitats	Avoid sensitive areas (dolphin, otter and bird habitats incl. mudflats, reed lands, and charlands) identified in the ESIA. No dredging will be carried out within one hundred meter from these sensitive areas (see Table 10.2, Fig. 10.1).	Contractor	PIU, DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		Select the shallow sand bars along the river banks for dredging. Obtain approval from DSC (dredging supervision consultant) before starting dredging from any location.			
Dredging - Excavation	Impacts of river morphology and bathymetric changes. Increased turbidity, loss of transparency and increased suspended sediment concentrations. Impact on benthic habitats. The physical changes that can take place during excavation are the generation of suspended sediments (causing an increase in turbidity, destruction of benthic environment, and changes to river morphology), mixing of soil layers and noise and air pollution from the equipment	Select dredging equipmenthaving low risk of sediment dispersal. Monitor the dredging operation and, if necessary, change the dredging alignment to minimise fines. Maintain record of all (quantities, location shown on map, timing, any sighting of key species)	Contractor	DSC	Included in contractors' costs
Lifting dredged materials	The release of suspended sediments during lifting can cause mortality to fish. There-suspensionofsedimentscanalsorelease toxicchemicalsornutrientssuchas phosphates and nitrates, which may increase the eutrophic status of the system.	Select dredging equipmentwith a low risk of sediment released from lifting. Reduce the suspended material released into the water column by adjusting the ratio of cutter revolutions to pump velocity.Monitor the lifting operations. Use of pingers to drive away aquatic animals, including fishes prior to dredging and lifting of dredged materials	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	Release of anaerobic sediment and organic matter in high concentrations may in some cases deplete the dissolved oxygen.				
Soil erosion, and ,soil and water contamination	Impacts of river morphology and bathymetric changes. Increase turbidity and discharge of contamination from dredging activities	Efficient waste management and monitoring protocols. Reporting and changing plans, if necessary.	Contractor	DSC	Included in contractors' costs
River Traffic	The presence of barges and associated vessels and discharge pipelines will pose a risk to local river traffic. There is also risk of collision of construction boats with dolphins.	Provide proper navigational lighting for the barges and associated vessels. Provide appropriate lighting to all floating pipelines and buoys. Check all navigational lights routinely to ensure that they are working properly. Limit the motor boat speed to 15 km/h to avoid any collision with dolphins. Pingers will be used to chase away dolphins.	Contractor	DSC	Included in contractors' costs
Noise from dredging activities	Noise and vibration under water: Disruption to fish migration and disturbance to dolphins. Noise and vibration above water: Nuisance to local community, disturbance to birds.	Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. Limit the noisy dredging to daylight hours, where possible, rather than at dawn or dusk(significant for wildlife) or during night time hours. Where unavoidable, the contractor should ramp up the levels of engines or other noise producing	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		sources, so that the noise slowly increases. Inspect and maintain equipment in good working condition.			
Exhaust emissions	Air pollution and release of greenhouse gases from construction equipment	Inspect and maintain equipment in good working condition. Proper maintenance of engines ensures full combustion with low soot emissions. Use low-sulphur heavy fuels to reduce noxious emissions. Provide Exhaust filtering.	Contractor	DSC	Included in contractors' costs
Oil spills	Oil spill will cover large area from a specific point location through tidal and wave action.	Refuel of barges and boats with a proper care to avoid any spills. Make available spill kits and other absorbent material at refueling points on the barges Report immediately in case of any accident related to oil spill and measures taken.	Contractor	DSC	Included in contractors' costs
River Water Quality	Increased suspended sediment concentrations	Select dredging equipment and methodology, which are known to have a low risk of sediment dispersal. Monitor local suspended sediment concentration and prepare a monitoring response plan to modify dredging and placement operations should threshold levels be exceeded under the prevailing hydrodynamic and wave conditions. Regularly inspect and maintain equipment in order to prevent leaks.	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		Develop and implement a Spill Prevention Plan. With Cutter Suction Dredgers, the level of resuspended material released into the water column can be reduced by adjusting the ratio of cutter revolutions to pump velocity Prior to dredging, sample and analyse sediment to ensure that only 'clean' material (i.e. material with low fine sediment content) should be used.			
	Increased turbidity and reduced transparency	Dredge cuts and lifts should be designed so as to prevent undercutting of material and hence a collapse of material locally at the cutter head, leading to an increase in the sediment being disturbed by dredging. If water quality as per DOE standards are not met, modify operations. Quality Control system shall be developed by the dredging contractor before commencement of work and get approved by DSC/CSC.	Contractor	DSC	Included in contractors' costs
	Spillage of oils and fuels	Develop and implement spill contingency plans for pipeline and hull leakages. Ensure that emergency response equipment, e.g. floating booms, are serviceable and available to deal with any oil spills or leakages.	Contractor	DSC	Included in contractors' costs
	Site runoff	Control the discharge of site runoff, including excess dredge water, by the installation and correct use of containment walls, bunds and weirs.	Contractor	DSC	

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
		Monitor the quality of water and take appropriate remedial action.			
Drainage Congestion	Drainage will be blocked if vessel shelter is constructed using dredged material	Provision of proper drainage at the vessel shelter construction sites. Apply measures to minimize sediment dispersion.	Contractor	DSC	Included in contractors' costs
Noise from dredging and construction activities	Noise and vibration under water: Disruption to fish migration and disturbance to dolphins. Noise and vibration above water: Nuisance to local community, disturbance to birds.	Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. Limit the noisy dredging to daylight hours, where possible, rather than at dawn or dusk (significant for wildlife) or during night time hours. Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. Inspect and maintain equipment in good working condition.	Contractor	DSC	Included in contractors' costs
Exhaust emissions	Air pollution and release of greenhouse gases from construction equipment	Inspect and maintain equipment in good working condition. Proper maintenance of engines ensures full combustion with low soot emissions. Use low-sulphur heavy fuels to reduce noxious emissions. Provide Exhaust filtering.	Contractor	DSC	Included in contractors' costs
Worker's Health and Safety	Health impact from the exposure to l hazardous and chemical materials,	OHS plan will be prepared and implemented. Implement fuels and hazardous substances	Contractor	DSC	Included in contractors'

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	dust, gaseous emissions and accidental cause during operation of equipment, construction of anchorage facilities (pontoons, break walls).	management plan, Drinking water management plan, Spill control arrangements andFirefighting equipment			costs
Public Health	Workers mobilization,heavyequipmentmobilization, dredging, transporting dredgedmaterials and placement of dredged materials, construction of pontoons with anchorage facilities will cause deterioration of local people's health.	Observance of ECoPs, OHS Plan and relevant dredged materials management plan by the Contractor. Continue liaison and provide information to relevant h community leaders, stakeholders and potentially affected communities throughout the dredging period in order to maintain community support. Provide adequate training for staff to operate equipment, to carry out dredging, and to transport dredged material.	Contractor	DSC	Included in contractors' costs.
Aquatic Flora including Benthos	Disturbance to riverbed and benthos. Loss of aquatic communities especially benthic biota	Restrict dredging only to the area where required. Minimize habitat loss by applying careful control of cutter head, restrict digging to specified boundaries.	Contractor	DSC	Included in contractors' costs
Aquatic Fauna	Disturbance to aquatic mammals and permanent impairment	Dredging area should be checked every day prior to commencement of dredging work. If any aquatic mammals sighted use pingers to drive them away prior to dredging It is alsorecommended that adoption of a 'soft start'; using a low energy start to theoperations would give dolphins an opportunity to leave the area.	Contractor	DSC	Included in contractors' costs

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
Fisheries	Disturbance of fish and damage of aquatic vegetation.	No mitigation is required as operation will not be long lasting and due to dynamic nature of riverbed the system will regain soon. Restrict dredging during known breeding period and migration routes (see Fig. 10.1 &Table 10.2).	Contractor	DSC	Included in contractors' costs
Geo-morphology and Bathymetry	Erosion and accretion of the river bank.	Ensure adequate measures through proper design and construction of training works.	Contractor	DSC	
Post Dredging Phase:Navigation Routes and Ferry Crossings					
IWT	Massive improvement on inland water transport in the selected routes and ferry crossings	Employment and livelihood generation with socio-economic development through transportation of cargo and passengers in the project influence area as well as with India and Nepal.	BIWTA	BIWTA	-
Air pollution	Increased gaseous emission due to operation of more riverine traffics (passenger and Cargo vessels). Fuel storage facilities and transfer may also release volatile organic compounds.	To limit gaseous emission vessel engines shall be maintained in good working condition by following manufacturer's standards. Good quality fuel (i.e. no/less sulfur content, lead free) to be used to ensure complete burning. Strict observance of relevant national and international rules. Valid fitness certificate mandatory for plying in the route,	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the ADB/O&M budget of BIWTA
Water pollution	River water will be subject to increased pollution from disposal of raw sewage from ships as well as dumping of solid wastes from passenger vessels.	Observance of EMP and relevant ECoP. Strict compliance with relevant national and international rules to manage wastes from ships. Ensure facilities (thrash cans, etc.) at designated	Vessel owners, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the O&M budgets of BIWTA

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	Spillage, leakage and accidents are significant potential sources of contamination, arising either directly from vessels, e.g. fuel oil and lubricants, or from their cargoes.	locations to put solid wastes and subsequent on land disposal in sanitary manner. Treatment of raw sewage water must be ensured. To develop strategy and implement pilot programson greening the vessel fleet (including research, outreach, and incentive programs on developing and adopting cleaner technologies such as improvements in vessel engine and propeller design, fuel quality, port operational practices, cargo handling equipment, etc.). To address the potential issues associated with waste effluents generated by O&M activities, the HSE Plan to be prepared and implemented by the BIWTA will include disposal mechanism for waste effluents as well.			
Water from ships	The wastes generated from ships mainly include inert materials such as food packaging, and food waste. Solid waste is being collected by the ships and are being dumped in to the municipal dust bins located near the terminals. Liquid effluents associated with ships are sewage, bilge water (e.g. from oil tankers), and vessel cleaning wastewater from ships. Ship sewage and wastewater contains high levels of BOD and coliform	Presently there are no facilities at the vessel shelter/terminals for collection of liquid waste from the ships. The ships usually dispose these wastes in the river. During detailed design of terminals, adequate reception facilities will be provided at the terminals for receiving ship generated waste. The reception facilities can be fixed, floating or mobile and should be adapted to collect the different types of ship generated waste and cargo residues. The wastes should be adequately disposed or	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the O&M budget of BIWTA

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	bacteria, with trace concentrations of constituents such as pharmaceuticals, and typically low pH levels. Wash water may contain residues such as oil. Pollutants in bilge water contain elevated levels of BOD, COD, dissolved solids, oil, and other chemicals that accumulate as the result of routine operations.	treated, based on the type of waste, in cooperation with the local municipal authorities. No wastes (solid or liquid) to be dumped at or near the ecologically sensitive and biologically rich areas like fish sanctuaries, important bird areas, etc. (see Fig 10.1)			
Occupational Health and Safety	Potential issues associated with OHS are physical hazards, chemical hazards, dust and noise. The main sources of physical hazards at cargo and passenger vessels as well as vessel shelters and landing stations are associated with cargo handling and use of associated machinery and vehicles. Workers may be exposed to chemical hazards especially if their work entails direct contact with fuels or chemicals, or depending on the nature of bulk and packaged products. Work with fuels may present a risk of exposure to volatile organic compounds via inhalation or skin contact during normal use or in the case of spills.	During the O&M phase, the BIWTA will implement HSE procedures and its own Emergency Response Plan.	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the O&M budget of BIWTA

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	Fuels, flammable liquid cargo, and flammable dust may also present a risk of fire and explosions. Noise sources may include generators, engines of vessels, and vehicular traffic.				
Community Health and Safety	Community Health and Safety: During operation of navigation routes, the vessel shelter cargo terminals, the potential community health and safety issues are risk of accidents with activities associated with cargo handling visual impacts from the illumination of the vessels, and traffic activities. Other visual concerns from cargo operations are uncontrolled dumping, floating debris, derelict warehouses and broken machinery.	During the O&M phase, the BIWTA will be required to implement HSE procedures and prepare its own Emergency Response Plan.	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the O&M budget of BIWTA
Navjgational Safety and Risk	Rules dealing with ship safety are generally preventive, designed to improve ship safety standards by reducing the risk of probability of accidents throughout the life cycle of a ship. Though there may be some casualties caused by weather, structural, mechanical or equipment failure, most shipping casualties in Bangladesh, are caused by substandard operation. This is more often poor stowage and overloading (especially in the peak	Regular information and guidance is to be provided by mariners to improve the shipping safety. Use of radiotelephony, especially VHF, should be introduced to maintain a listening watch on general or distress frequencies. All vessels should be equipped with fog horns and powerful searchlights. A series of measures will be taken up under Component 3 of the Project, which include (i) the development of River Information Systems	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the ADB/O&M budget of BIWTA. and under Component 3.

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	holiday periods) - the main causes of capsize and loss. This situation can also be compounded in a price-regulated market where tariffs set by the Government are insufficient to generate reasonable profits. Lack of information and guidance to mariners also impacts negatively on shipping safety	to improve navigational safety, and provision of a Traffic Monitoring System for passengers and cargo; and (ii) commissioning of a study to propose an institutional structure and reforms needed to develop an effective Search and Rescue organization.			
Change in river geometry due to erosion and accretion.	Due to high variation of seasonal flow and peculiar nature of the river system carrying huge quantity of silt annually, the navigability may be hampered due to erosion and siltation.	For smooth navigability routine maintenance dredging shall be in place through bathymetric survey during post monsoon and carrying out river training works as pilot programme to reduce dredging along the navigation route.	BIWTA,	BIWTA,	To be included in the O&M budget of BIWTA and under Component 3
Operation and Maintenance Phase: Vessel Shelters					
Air pollution	Increased gaseous emission due to operation of more riverine traffics (passenger and Cargo vessels). Fuel storage facilities and transfer may also release volatile organic compounds.	To limit gaseous emission vessel engines shall be maintained in good working condition by following manufacturer's standards. Good quality fuel (i.e. no/less sulfur content, lead free) to be used and ensure complete burning. Strict observance of relevant national and international rules. Valid fitness certificate mandatory for plying in the route,	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the ADB/O&M budget of BIWTA

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
Water pollution	River water will be subject to increased pollution from disposal of raw sewage from ships as well as dumping of solid wastes from passenger vessels. Spillage, leakage and accidents are significant potential sources of contamination, arising either directly from vessels, e.g. fuel oil and lubricants,	Observance of EMP and relevant ECoP. Strict compliance with relevant national and international rules to manage wastes from ships. Ensure disposal facilities at designated locations to put solid wastes and subsequent on land disposal in sanitary manner. Treatment of raw sewage water must be ensured. To develop strategy and implement pilot programson greening the vessel fleet (including research, outreach, and incentive programs on developing and adopting cleaner technologies such as improvements in vessel engine and propeller design, fuel quality, port operational practices, cargo handling equipment, etc.). To address the potential issues associated with waste effluents generated by O&M activities, The HSE Plan to be prepared and implemented by the BIWTA will include disposal mechanism for waste effluents as well.	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the ADB/O&M budget of BIWTA
Water from ships	The waste generated from ships mainly include inert materials such as food packaging, and food waste. Solid waste is being collected by the ships and are being dumped in to the municipal dust bins located near the terminals.Liquid effluents associated with ships are sewage, bilge water (e.g. from oil tankers), and vessel cleaning wastewater from ships. Wash water may contain residues such as oil. Pollutants in bilge water	Presently there are no facilities at the vesselshelter/terminals for collection of liquid waste from the ships. The ships usually dispose these wastes in the river. During detailed design of terminals, adequate reception facilities will be provided at the terminals for receiving ship generated waste. The reception facilities can be fixed, floating or mobile and should be adapted to collect the different types of ship generated waste and cargo residues.	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the O&M budget of BIWTA

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	contain elevated levels of BOD, COD, dissolved solids, oil, and other chemicals that accumulate as the result of routine operations.	The wastes should be adequately disposed or treated, based on the type of waste, in cooperation with the local municipal authorities.			
Occupational Health and Safety	Community Health and Safety: During operation of navigation routes, the vessel shelter cargo terminals, the potential community health and safety issues are risk of accidents with activities associated with cargo handling visual impacts from the illumination of the vessels, and traffic activities.Other visual concerns from cargo operations are uncontrolled dumping, floating debris, derelict warehouses and broken machinery.	During the O&M phase, the BIWTA will be required to implement HSE procedures and prepare its own Emergency Response Plan.	Vessel owner, BIWTA,	BIWTA,Independent M&E Consultant, DoE	To be included in the O&M budget of BIWTA
Induced and Cumulative Effects					
Aquatic Biodiversity	Dredging and land reclamation will impact negatively on water quality as well as the aquatic lives.	Detailed ecological baseline studies are recommended for the entire study area to be carried out prior to commencement of the dredging and to identify suitable areas of enhancement measures sanctuaries and spawning areas. (see Biodiversity Management Plan as Annex)	BIWTA through Consultants	DSC, M & E Consultant	Included in Table 10.13
Industrialization	The potential negative impacts are loss of seasonal floodplain, deterioration in water quality, soil quality, waste generation,	The negative impacts may reduce or eliminate through proper planning at the beginning of the Project by conducting relevant baseline studies including irrigation, water resources, institutional, social, environment and floodplain	BIWTA through Consultants	DSC, M & E Consultant	Included inTable 10.13

Activity/Issues	Potential Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties		Budget (USD)*
			Implementation	Supervision/ Approval Authority	
	Land acquisition and resettlement, loss of agricultural lands and change in landuse. Major positive impacts are employment generation and gender.	ecology. The studies will also identify potential ecosystem areas of conservation significance and ensure that any development activities will not impact the quality of these ecosystems. The positive impacts should be accelerating through recruiting local people in the new industries and factories with equal gender opportunities.			

10.3.3 Criteria for Placement of Drdged Material in River or on Land

Various options have been considered for dredged material management (See Figure 10.2). These options can be primiarly grouped in to two categories: (i) placement in the river in the deep scourholes and along eroding river banks; and (ii) placement on the land for beneficial use where there is a demand and material is suitable or in river disposal is not feasible. The options for land required for on land disposal include existing stack yards of the sand traders, encumbrance free government owned land, or leasing land from private people or community. Placement of the material in the deep scour holes in the river or in the estuary is considered as a preferred option in this project since removal of sediment, by dredging, from its natural path or cycle, may have damaging environmental consequences (in the estuaries, the balance between erosion and accretion will be disturbed by dredging). Therefore, it can be beneficial to return the material into the originating system, rather than removing it to a separated site.. The placement of dredged material on the land has not been considered as the preferred option since all the land along the river are either densely populated or intensively cultivated. However, along some parts of the narrow river routes (in the branch/loop rivers in Upper Meghna where the river widths are less than 100 m), placement of dredged material on the land is considered as the preferred option.

10.3.4 Dredge Material Placement on Land

Based on 2015 bathymetric analysis of dredging requirements and river morphology, it is expected that the dredged material from the dredging locations in the narrow rivers of Upper Meghna will need to be placed on the land, given the lack of sufficient suitable in-river disposal locations. Several potential dredged material placement sites on land have been identified. Their locations, along with the respective dredging locations are given in Figure 10.3. Details of these potential placement locations and their approximate distances from the dredging locations and amount of dredged material that would potentially be accommodated at these locations are given in Table 10.2. It is important to note that these locations are not finalized, as detailed land acquisition or lease negotiations and resettlement planning (if required) has not yet been undertaken. This is in light of the ever-changing nature of the river system and the likelihood that there will be some updates to volumes and specific locations of required dredging on these routes by the time activities get underway under the PBC contract. However, stakeholder consultations as part of the ESIA process have indicated that there is general interest/willingness and community demand for dredged material in these locations. During mobilization and as part of the ongoing monthly dredging planning process, the contractor will confirm the need and dredge material volumes for on-land disposal, and specific locations will be identified, acquired or leased as necessary, and provided by the BIWTA to the contractor.

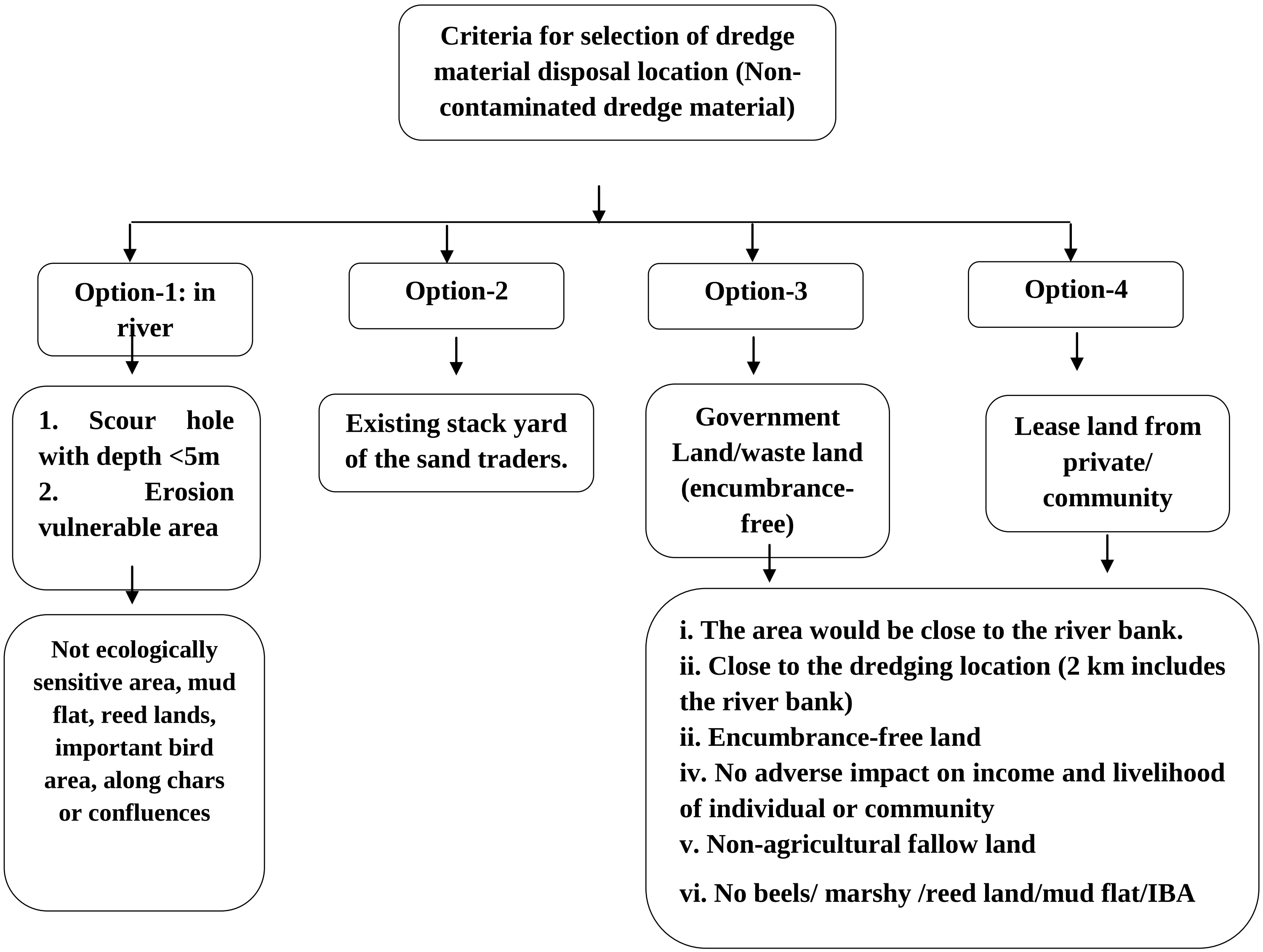


Figure 10.2**:** Criteria for selection of dredge material disposal location

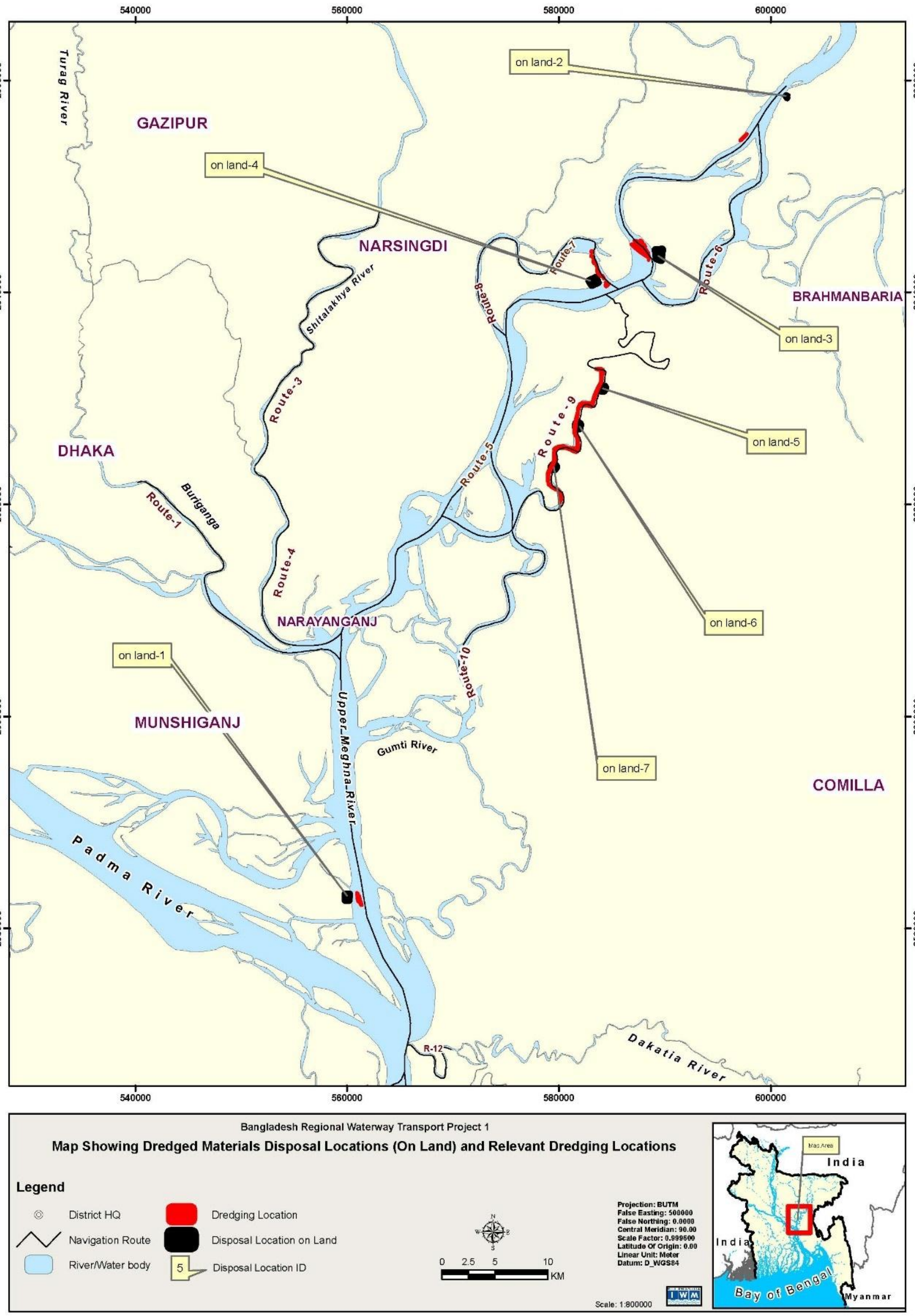


Figure 10.3: Locations of Land Based Dredged Material Placment Locations

Table 10.2 : Details of Dredging in the Loop Rivers and Dredged Material Placement Locations on the Land

Route No.	Name of the River	Part of Upper Meghna or Lower Meghna	Priority	Route Class	Channel Width, m (no slope)	Dredging Depth, m	Base Line Dredge Volume, m^3	Potential Annual Volume with 50% Re-Sedimentation Rate, m^3	Minimum Dredging Distance to be Maintained from Banks/Chars, m	Position of the Disposal location		Distance from Dredging to Placement Site, km	Area, m^2	Maximum Volume that can be Disposed at the Placement Location, m^3
										Easting (BUTM_X)	Northing (BUTM_Y)			
1 & 2	Upper Meghna	Upper	A	1	76	-4.3	37,500	56,250	100 m	560116	2582960	1	190,000	570,000
5	Upper Meghna	Upper	A	1	76	-4.3	236,000	354,000	100 m	601533	2658403	5	146,330	438,990
										589324	2643917	1.3	500,000	1,500,000
7&8	Upper Meghna	Upper	B	2	76	-2.8	370,000	555,000	100 m	583069	2641001	1.2	290,000	870,000
9	Upper Meghna (Branch)	Upper	C	3	30	-2.1	126,800	190,200	100 m	584135	2630914	1	34,500	103,500
										581828	2627380	1	33,500	100,500
										579518	2623529	1	34,000	102,000
Total								1,155,450						3,684,990

Table 10.3 :Details of Dredging and Dredged Material Placement Locations in the River

Route No.	Name of the River	Part of Upper Meghna or Lower Meghna	Priority	Route Class	Channel Width, m (no slope)	Dredging Depth, m	Base Line Dredge Volume, m^3	Potential Annual Volume with 50% Re-Sedimentation Rate, m^3	Potential Contractor Split (By Geographical Area)	Type of Sensitivity (Reed Lands, IBA, Hilsa Sanctuaries, Hilsa Spawning Grounds)	Minimum Dredging Distance to be Maintained from Banks/Chars, m	Location of Dredged Material Placement, See Figure 1	Position of the Material Placement location (central location)		Distance from Dredging to Placement Site, km	Available Depth at the Placement location during Dry Season, m	Area of the placement location, m^2	Maximum Volume that can be Disposed at the Placement Location, m^3
													Easting (BUTM_X)	Northing (BUTM_Y)				
1 & 2	Buriganga, Dhaleshwari and Upper Mehhna	Upper	A	1	76	-4.3	37,500	56,250	PBC-1	None	100 m	1	560769	2580981	1.8	6	340,030	2,040,180
												2	562796	2576859	1	7	231,220	1,618,540
												39	568018	2571594	5	12	2,875,000	34,500,000
												40	565135	2567969	2	28	1,232,143	34,500,000
2 (South of Chandpur)	Lower Meghna	Lower	A	1	76	-4.3	597,400	896,100	PBC-2	Sanctuary	100 m	41	584304	2517511	3.5	15	1,500,000	22,500,000
										Sanctuary, Spawning		42	594951	2492108	3.5	9	1,002,778	9,025,000
										Spawning		43	612123	2487402	6.5	12	1,375,000	16,500,000
										Spawning		44	618031	2473586	2.3	14	2,500,000	35,000,000
										Spawning		in stream-1	631,845	2,463,566	-	-	-	-
										Spawning		in stream-2	643,806	2,465,101	-	-	-	-
										Spawning		in stream-3	656,297	2,459,491	-	-	-	-
3 & 4	Shitalakshya	Upper	A	1	76	-4.3	22,600	33,900	PBC-1	None	100 m	3	550968	2623171	0.5	6	31,543	189,258
												4	553099	2616694	0.5	9	20,100	180,900
5	Upper Meghna	Upper	A	1	76	-4.3	236,000	354,000	PBC-1	None	100 m	6	597438	2653674	0.8	8	50,000	400,000
												7	594,389	2,652,1	0.8	9	56,889	512,000
												8	587397	2651114	0.5	6	147,333	884,000
												10	588573	2643457	2	13	98,000	1,274,000
6	Upper Meghna	Upper	A	1	76	-4.3	-	-	PBC-1	None	100 m	-	-	-	-	-	-	-
14	Lower Meghna, Nayabhanga and Bishkhali	Lower	A	1	76	-4.3	432,900	649,350	PBC-2	None	100 m	46	543066	2514951	1	15	115,000	1,725,000
18	Bishkhali	Lower	A	2	76	-2.8	1,000	1,500	PBC-2	None	100 m	49	538750	2510244	0.5	18	88,000	1,584,000
19	Lower Meghna	Lower	A	2	76	-2.8	25,100	37,650	PBC-1	Spawning	100 m	51	560012	2563276	1.2	9	9,000	81,000

Route No.	Name of the River	Meghn a or Lower Megha	Priority	Route Class	Width, m (no	ng Depth, m	Line Dredge Volume, m^3	e with 50% Re-Sedime	ctor Split (By Geogra	Type of Sensitivity (Reed Lands, IBA, Hilsa Sanctuaries, Hilsa Spawning	e to be Maintained	Material Placement,	Position of the Material Placement location (central location)		Dredging to Placement Site	ent location	the placement location m^2	can be Disposed at the Placem
20	Lower Meghna	Lower	A	2	76	-2.8	387,000	580,500	PBC-2	Spawning	100 m	52	580589	2524731	4	8	125,000	1,000,000
21	Tentulia	Lower	A	2	76	-2.8	392,300	588,450	PBC-2	Spawning	100 m	53	552667	2509530	2.5	11	84,000	924,000
										Reed lands		61	554598	2511478	1.5	15	16,500	247,500
22	Lower Meghna	Lower	A	2	76	-2.8	396,500	594,750	PBC-2	Spawning	100 m	54	585316	2508183	1.5	17	170,000	2,890,000
7&8	Upper Meghna	Upper	B	2	76	-2.8	370,000	555,000	PBC-1	None	100 m	18	586607	2640862	2	25	200,000	5,000,000
												19	577918	2641797	1	9	24,000	216,000
												20	575660	2644883	0.9	14	21,000	294,000
12	Chandpur	Lower	B	2	76	-2.8	152,800	229,200	PBC-1	Reed lands	100 m	55	568851	2565929	1.5	12	19,000	228,000
										Reed lands		56	567998	2566413	2.5	8	15,000	120,000
13	Lower Meghna and Arial Khan	Lower	B	2	76	-2.8	76,400	114,600	PBC-2	None	100 m	58	537042	2538395	3	14	62,000	868,000
13a	Lower Meghna	Lower	B	2	76	-2.8	1,000	1,500	PBC-2	Reed lands	100 m	59	552641	2537734	2	9	16,000	144,000
9	Upper Meghna	Upper	C	3	30	-2.1	126,800	190,200	PBC-1	None	100 m	34	578,206	2,621,320	0.5	5	32,500	162,500
												35	575,282	2,617,447	1	15	100,000	1,500,000
10	Upper Meghna	Upper	C	3	30	-2.1	33,274	49,911	PBC-1	None	100 m	37	576430	2615653	4	6	40,000	240,000
15 & 16	Lower Meghna and Tentulia	Lower	C	3	30	-2.1	607,500	911,250	PBC-2	None	100 m	60	558967	2523114	5	13	136,000	1,768,000
17	Tentulia	Lower	C	3	30	-2.1	500	750	PBC-2	None	100 m	62	550858	2511917	3	19	53,500	1,016,500
Total								5,844,861										179,132,378

For on-land disposal sites, the contractor will construct and maintain disposal facilities. The facilities shall meet the following minimum criteria for design and operation:

Sites shall be bunded/ closed, with a water outlet weir box at its downstream end. Bunding is undertaken with hydraulic excavators using nearby surface material, or may be constructed from previously dredged material. Bund heights can be raised as necessary using dredged material.

The weir box can be used to control the water level in the disposal area. Adjusting the weir allows control of the setting process in the disposal area. The outflow from the disposal area can either be directed to the surrounding waters by a ditch, or be pumped back from a small collecting basin at the weir box.

Depending on the physical makeup of the dredged material, the disposal area can be split into two or more bunded areas: sand (disposal) area and the silt (disposal) area/pond, placed in tandem in the downstream direction. The dredged material would be pumped first to the sand area where segregation would ensure only fines would pass into the silt pond, from which virtually clean water would flow. below gives an example of a sand (disposal) area with silt (disposal) area/pond below.

Figure 10.4: **Disposal Area with Silt Pond**

The contractor shall directly place the sediments for filling the proposed disposal areas. Filling will be achieved by progressively pumping a slurry of sand and water into the bunded areas, allowing the surplus water to drain away to artificial and natural waterways in a controlled manner through the pipeline, without affecting floodplains.

Leaching from the sediments as well as other site runoff shall be contained, either to seep into the subsoil, or to be discharged in a controlled manner so as to minimize release of sediment laden water in excess of 200mg/l of suspended materials into adjacent lands or waterways. The contractor shall regularly monitor water quality of site runoff. If necessary, additional siltation ponds shall be constructed and utilized by the contractor to settle out excess suspended materials prior to discharge into the environment.

In most cases, it is expected that dewatered sands and sediments will be removed from the site over time by local communities for land-filling or other projects. All dredged materials are the property of BIWTA (not the contractor), and authorizations for local communities or others to avail of the material will be given by BIWTA. BIWTA will inform the contractor when such permissions have been granted.

In cases where there is no local demand for the dredged materials, the contractor shall properly compact them and, when the site has reached capacity, shall restore the area. Top layer shall be the 0.5 m thick clay on the surface and boundary slopes along with grass. Side Slope of Filled Land of 1:3 for river side and other sites 1:2 shall be constructed by suitable soils with proper compaction as per design. Slope surface shall be covered by top soils/ cladding materials (0.5m thick) and grass turfing with suitable grass.

10.3.5 Criteria for Selection of Additional Sites for Dredged Material Placement on Land

Locations of dredging may change in future due to dynamic nature of the rivers. Additional placement sites may be required if there are more dredging volumes or the proposed placement sites are more than 5 km from the dredging sites. BIWTA will identify the additional land based placement sites using the following criteria and handed over them to the contractor.

(i) The dredged material placement sites on the land are not located in any sensitive environmental areas (as shown in Figure 10.3) or in any wet lands

(ii) The government owned waste lands will be given priority if available

(iii)Use of agriculture lands will be minimized to the extent possible

The following table provides an overview of the overall criteria for selection of dredged material disposal location, and order of preference. :

Options for disposal of dredged material (in order of preference)	**Description/ Intervention**	**Additional applicable criteria**
Option-1: in-river disposal	• In the river bed • Scour hole of depth <5m • Erosion vulnerable area	*Exceptions*: ecologically sensitive areas, mud flat, reed lands, important bird areas, or along chars or confluences
Option-2: on-land disposal	Existing stake yard of the sand traders (if identified near the dredging site)	i. Close to the river bank. ii. Close to the dredging

Option-3 - on-land disposal	Government Land/waste land	location (within 2 km, includes the river bank) iii. Encumbrance-free land iv. No adverse impact on income and livelihood of individual or community v. Non-agricultural fallow land vi. No impacts to cultural heritage vi. Not within 100m of beels/ marshy areas /reed land/mud flat/IBA
Option-4 - on-land disposal	• Lease land from the private • Lease Land from the Community	

10.3.6 Dredge Material Placement in River

Dredged material from all the dredging locations except for some sections of the routes 1,2,5, 7, 8 and 9 will be placed in the deep scour holes in the river. Details of the dredged material placement locations, their distances from the dredging locations, and approximate quantities of material can be placed at these locations are given in Table 10.3.

The Contractor shall place all the dredged material in these designated disposal locations. The contractor shall use submerged discharges for hydraulic disposal of dredged material. To minimize the extent of impact from the disposal activities, the contractor is recommended to use diffusers at the outlets of the hydraulic pipes (to reduce exist velocity of the sediments to minimize sediment dispersion).

Numerous scour holes were identified in the rivers using the bathymetry data (numbered in Fig. 10.1). Scour holes are important for the aquatic biodiversity and used as a refuge by some large fishes, turtles, dolphins and other aquatic animals during dry season/winter. During dry season no dumping of dredged materials in the scour holes in the Upper Meghna (refer to Fig. 10.1 for location of scour holes) has been suggested. However, for practical reasons the selection of scour holes where in-river disposal of non-contaminated/non-toxic dredged materials is to be carried out, the following criteria in Table 10.4 may be used.

Table 10.4 . Criteria for selectionof scour holes for in-river dredged spoil disposal

Scour hole exclusion Criteria	Scour hole inclusion Criteria
Located along the chars Located at the river confluences and river bends Low current (velocity) areas Shallow areas Deeper sections of the river during dry season and with low velocity	• Vicinity of eroding river banks • River sections with high velocity/ current • Areas with continuous river bank erosion • Areas with minimum river depths of 10m

Similarly, the following criteria may be used for exclusion of inland disposal sites.

- Freshwater wetlands, including ponds, ditches, beels, haors.
- Agricultural land.
- Public places like school fields, eidgahs, etc., (unless demanded by the local people).

10.3.7 Mangement of Contaminated Materials

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The Contractor shall carry out the sampling and testing of the river bed material at the starting of the dry season every year. The locations of sampling, frequency of sampling and parameters to be tested are given in Table 10.1. The river bed sediments in the Buriganga (Route 1) and Shitalakhya (Route 3 and 4) are contaminated. Based on the historic and bathymetric charts of 2015, no dredging is expected in Buriganga; while dredging may be required in some sections of Shitalakhya.

The Contractor shall minimize the dredging in Shitalakhya River by properly selecting the navigation alignment (this seems possible as per bathymetric chart of 2015). The same practice will apply to any other river section where contamination is identified during the course of project implementation. If the dredged material is found to be contaminated, the dredged material is placed back in to the same rivers and shall not be brought on to the land. The Department of Environment of Government of Bangladesh has a long term plan to clean up the rivers around Dhaka, including Buriganga and Shitalakhya, and hence requested to BIWTA to dispose the contaminated sediments back into the same rivers.

In the unlikely case that (a) the presence of contaminated or hazardous substances are encountered within riverbed materials in an area where dredging cannot be avoided by adjusting the navigation channel, AND (b) in-river disposal locations are not available, the contractor will be required to carry out one of the following:

Utilize an existing hazardous substance disposal facility that is designed, legally permitted, and operated in a manner which is in compliance with applicable laws and regulations, and which appropriately minimizes risks to the public and the natural environment associated with the hazardous or contaminated material; or

Construct and maintain, through the life of the contract, a special disposal facility at an approved location near the dredging site, which appropriately minimizes risks to the public and the natural environment associated with the hazardous or contaminated material.

If either option needs to be utilized, the Contractor shall propose a detailed site-specific hazardous materials management plan to the Engineer, as part of the CEAP (or as part of the monthly update to the CEAP, if such need arises during the course of project implementation), to be approved by the Engineer prior to initiating dredging at the location where contamination is present.

In case of option #1, the detailed plan shall include all necessary control and management measures associated wtih removal and transportation of the contaminated materials to the approved existing facility, as well as evidence satisfactory to the Engineer of the legal and safe operation of the existing facility.

In case of option #2, the detailed plan shall include a detailed site plan, construction and management specifications, for the facility to be constructed and operated by the contractor. The design shall conform to the general specifications and requirements for all on-land disposal facilities, as well as the following additional minimum specifications:

Scope of Additional Routes:

There is a possibility that additional routes may be included to the scope of the contractor's work during project implementation. In such cases, following steps have to be followed:

i. BIWTA may be required to undertake a separate, stand-alone ESIA of the additional routes / geographic scope, including an EMP (either validating that the current EMP is appropriate, or proposing additional specific measures as required), in accordance with both national and World Bank standards. This will be determined in consultation with DOE and the World Bank.

ii. This additional ESIA/EMP needs to be submitted to the World Bank and to DOE for approval and issuance of environmental clearance prior to initiation of any dredging or other activities on the added routes/geographic area.

iii. The DSC and Independent Third Party Monitor's contracts would then also need to be revised as required to ensure full coverage of monitoring arrangements for the additional geographic area.

10.3.8 The Environmental Codes of Practice (ECoPs)

The environmental codes of practice (ECoPs) are generic, non-site-specific guidelines. The ECoPs consist of environmental management guidelines and practices to be followed by the contractors for sustainable management of all environmental issues.Thecontractor will be required to follow them and also use them to prepare site-specific management plans. The ECoPs are listed below and attached in Annex K of EMF. These ECoPs will be annexed to the bid documents to all construction works to be carried out under the Project.The contractor is expected to interpret these requirements in a site-specific manner as part of the detailed, site specific Environmental Management Action Plan which shall be presented as part of the detailed dredging plan on an annual basis for DSC and BIWTA approval prior to initiation of dredging. Contractor has to make monthly work plan as an essential part of ECAP.

ECoP 1: Dredging Management
ECoP 2: Waste Management
ECoP3: Fuels and Hazardous Goods Management
ECoP4: Water Resources Management
ECoP 5: Drainage Management
ECoP 6: Soil Quality Management
ECoP7: Erosion and Sediment Control
ECoP 8: Top Soil Management
ECoP 9: Topography and Landscaping
ECoP10: Borrow Areas Management
ECoP11: Air Quality Management
ECoP 12: Noise and Vibration Management
ECoP 13: Protection of Flora
ECoP 14: Protection of Fauna
ECoP 15: Protection of Fisheries

ECoP 16: Road Transport and Road Traffic Management
ECop 17: River Transport Management
ECoP 18: Construction Camp Management
ECoP 19: Cultural and Religious Issues
ECoP20: Workers Health and Safety

10.3.9 Biodiversity Management Plan (BMP)

A biodiversity management plan is prepared as part of ESIA to manage impacts on biodiversity from project related interventions. Additional studies will be carried out during early stages of project implementation (a) to collect baseline data on biodiversity at sensitive locations; and (b) to develop and implement biodiversity management programs including habitat enhancement and protection for key species. BMP has been prepared and detaids are presented in Annex E.

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10.3.10 Site-specific management plans

The following site-specific plans will be prepared by the contractors as part of their bid package, and implemented throughout the life of the contract, to manage and mitigate/reverse potential adverse environmental impacts.All these plans will be prepared on the basis of this EMP document (including the mitigation measures items presented below in Table 10.1, ECoPs presented in AnnexK and all applicable national and World Bank requirements including WBG EHS Guidelines (2007). They will besubmitted to BIWTA as part of the bid package, and then during the mobilization period and prior to starting any physical works, will be validated, updated as needed, and re-submitted the DSC for review and approval. Each plan shall provide site-specific details for each route, and shall indicate requirements, milestones for implementation, indicators for verification and monitoring, skills and equipment required to implement, and training requirements / training plan, among any other relevant aspects:

Contractor's dredge management and disposal plan for each dredging location: The plan shall specify:

(a) the control measures to be put in place at each location in order to comply with EMP thresholds and requirements to minimize benthic and aquatic disturbances, as well as noise, air pollution, and other impacts during the dredging process – based on ecological sensitivity and presence of contamination;

(b) all exact locations and management provisions for dredged material placement and disposal, in accordance with this EMP, based on the actual anticipated dredge volumes and locations as per updated the most recent survey data. The locations shall include the pre-specified locations from Figure 10.1 and Table 10.2 and Table 10.3 above, where applicable. For any additional/new areas requiring dredging for which the pre-identified locations are not feasible, additional sites shall be proposed following the criteria specified in this EMP.

(c) Contaminated/ Toxic Dredged Material Management Plan: This has been discussed under section 10.3.6.

Documentation to be maintained and provided to the DSC on environmental management for the dredging activity.

- **Pollution Prevention and control Plan** will be prepared and implemented by the contractors on the basis of the ECoPs and WBG EHS Guidelines (2007) that will be part of the bidding documents.
- **Waste Disposal and Effluent Management Plan** will be prepared and implemented by the Contractor on the basis of the EMP, ECoP, and WBG EHS Guidelines (2007), which will be part of the bidding documents.
- **Drinking Water Supply and Sanitation Plan:** Separate water supply and sanitation provisions will be needed for the temporary facilities including offices, labor camps and workshops in order not to cause shortages and/or contamination of existing drinking water sources. A Plan will be prepared by the contractors on basis of the EMP and ECoPs, which are part of the bidding documents.
- **Occupational Health and Safety (OHS) Plan** will be prepared and implemented by the contractor on the basis of the WBG EHS Guidelines (2007), ECoPs, and other relevant standards.
- **Traffic Management Plan** will be prepared by thedredgingcontractor after discussion with BIWTA and authorities responsible for roads and traffic. The Plan will be submitted to the DSC for their review and approval before contractor mobilization. The Plan will identify the routes to be used by the contractors for all on-shore activities (including for example, movement of equipment, laying of sluice pipes for deposition of on-shore dredge material as applicable, worker camps and facilities, construction and maintenance of vessel shelters, etc.), procedures for the safety of the local community particularly pedestrians, and monitoring mechanism to avoid traffic congestion. Also plan for river traffic is to be prepared by the contractor in consultation with the vessel owner and taking adequate safety measure at disposal site. This also includes engaging watch man to warn the navigation traffic.
- **Construction Camp Management Plan**willbe prepared by thecontractor. The Plan will include the camp layout, details of various facilities including supplies, storage, and disposal. The Plan will be submitted to the DSC for their review and approval before camp establishment.
- **Fuel and Hazardous Substances Management Plan** will be prepared by thecontractor in accordance with the standard operating procedures, relevant guidelines, and where applicable, material safety data sheets (MSDS). The Plan will include the procedures for handling and storage of alloils, fuels, and hazardous substances. The plan will also outline requirements and procedures to safeguard worker and community health and safety as well as the environment in case ofaany accidental spills. Suitable equipment and materials for the clean up of small oil spill should be available for use at all time. Close attention should be paid to the location and design of fuel storage, and dispensing facilities..
- **An Emergency Preparedness and Response Plan** will be prepared by thecontractor after assessing potential risks and hazards that could be encountered during construction.

During implementation of the project, the contractor will carry out continuous surveying and will prepare a monthly work plan projecting the specific activities, dredge locations and volumes to be carried out in the coming month, based on the updated survey data. As part of this monthly plan, the contractor will include a Detailed Updated Contractor's EMP, which shall specify any relevant updates or modifications to the above-mentioned site-specific plans, to account for changes in location, scope or methodology of river channel / ferry crossing / vessel shelter maintenance activities. For example, if new geographic areas need to be dredged or if dredging volumes exceed available capacity for disposal in the pre-specified disposal areas as shown in Figure 10.1, the monthly plan shall propose new locations and all relevant mitigation and management requirements, in accordance with the criteria specified in this EMP and the detailed plans outlined above. The monthly work planwill be submitted to the DSC for approval prior to the contractor initiating activities that month.As part of this review, the DSC's Environmental Expert shall review and approve the Detailed Updated Contractor's EMP component of the monthly work plan.

10.4 Environmental Monitoring Plan

10.4.1 General

The Contractor shall perform environmental monitoring for the duration of this contract and submit results to the Engineer. Monitoring activities shall include

- Surface water quality (including spot measurements for suspended solids, turbidity, dissolved oxygen, and pH)
- River bed sediments quality
- Noise; spot measurements for noise and under water noise levels

The monitoring shall be conducted only by qualified persons or accredited laboratories approved by the Engineer in compliance with the relevant laws, regulations and/or international standards.

If any of the monitored results including laboratory test results showed excessive or long-term deterioration of water and sediment in qualities in comparison with the environmental baseline, the Contractor shall take immediate counter- measures necessary to recover the acceptable environmental conditions.

If the Contractor's countermeasures are not satisfactory in the opinion of the Engineer, the Engineer may order suspension of the work until the newly monitored results become satisfactory. No additional payment or time extension will be granted for the work delay caused by this work suspension.

Should the Contractor fail to comply with the requirements of the listed statutes as well as effect and maintain monitoring operations, the Employer may directly undertake required countermeasures and/or monitoring activities. The costs which the Employer incurs shall be deducted from the payment to the Contractor. Any deduction shall be subject to the Engineer's determination.

A monitoring plan has been prepared to be carried during implementation of the project to ensure contractors' compliance with the mitigation measures is given in Table 10.5 along with the monitoring indicators and frequencyto record the response of the project on the natural system. DSC will be responsible for supervision of implementation of the plan.

Table 10.5 **:** Environmental Monitoring Plan

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
During Dredging andConstruction Phase (Navigation routesand Ferry crossings:							
1	Aquatic Flora and Fauna including Plankton and Benthos	Sensitive habitats at the potential dredging location	Study of bathymetric Charts. Inspection, sampling, analyses and comparison with baseline condition.	1 week before dredging, Quarterly after dredging for 7 year	BIWTA through biodiversity consultant, Contractor, outsourcing to NGO having relevant survey experience	DSC, M&E Consultant, BIWTA	Included in Table 10.19
2	Aquatic Fauna (fish, dolphin)	Sensitive habitats in the area wheredredgingwillbe required	Study of bathymetric charts to identify potential dredging locations. Inspection of aquatic habitats, and monitoring of faunal species (fish, dolphin)	3 months before dreding, monthly after dredging	BIWTA through biodiversity consultant, Contractor, outsourcing to NGO having relevant wildlife survey experience	DSC, M&E Consultant, BIWTA, ES	Included in Table 10.19
3	Sediment Dispersion	Atthe dredging locations	Inspection of dredging activities, check sediment concentration and extent.	Weekly	Contractor	DSC	Included in Table 10.19
4	River	Locations	Visual	Monthly	Contractor	DSC	Included

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
	bank erosion	near dredging and placement locations	inspection of the river banks for erosion, and formation of sand bards				in Table 10.19
5	Hydro-logicalcondition	At the dredging site.	Inspection of river flow,water level and current speed	Weekly	Contractor,	DSC	Included in Table 10.19
6	DrainageCongestion	At the on land disposal site in the Upper Meghna River.	Inspection of the drainage outlets in the disposal area are functional, and adequate to discharge water	Daily	Contractor,	DSC	Included in Table 10.19
7	River transport	At the dredging location of the project influence area	Watch boat, watchman, sign boards, etc.	Daily	Contractor	DSC	Included in Table 10.19
8	Spills from Hydrocarbon and chemical storage	Material storage sites and dredging sites	Visual Inspection for leaks and spills	Monthly	Contractor	DSC	Included in Table 10.19
9	Sediment leakages from pipes	Along the dredged material carrying pipes to the placement locations	Visual inspection	Monthly	Contractor	DSC	Included in Table 10.19

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
10	Sediment disposal	At the dredgingand disposal sites of the project influence area	Inspection of the sediment disposal sites	Daily	Contractor	DSC	Included in Table 10.19
11	Surface Water Quality (spot measurements)	At 100 m downstream of all the dredging locations	Spot measurements using portable equipment (in presence of Engineer) for suspended solids, turbidity, dissolved oxygen, and pH. Visual inspection on presence of petroleum products.	Monthly	Contractor	DSC	Included in Table 10.19
12	Surface water quality (detailed analysis)	At 25 locations covering all proposed 22 river routes. The locations will be determined by the Engineerat the beginning of each sampling.	Sampling and analysis of river water quality and waste water discharges for pH, Temperature, Turbidity, TSS, TDS, EC, DO, BOD, TOC, Ca, Mg, Na, K, F,Cl, Br, SO4, NO3, PO4	Quarterly (October, January, April)	Contractor through a nationally recognized laboratory	DSC	Included in Table 10.19

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
13	Waste Water	Waste water releases from the land based dredged material placement sites	Sampling and analysis as per the requirements of ECR 1997 for waste water discharges	Quarterly	Contractor through a nationally recognized laboratory	DSC	Included in Table 10.19
14	Soil pollution	Atvessel shelter construction sites	Visual inspection that filling is through several compartments	Beginning of earth filling works	Contractor	DSC	Included in Table 10.19
		Construction and material storage sites	Ensure no contaminated effluent is leaving from the filling area to the nearby agricultural lands	Weekly	Contractor	DSC	
15	Waste Management	At the dredging work sites and construction camps	Visual inspection that proper collection and disposal of solid and liquid wastes approved by the Engineer	Monthly	Contractor	DSC	Included in Table 10.19
16	Drinking water and sanitation	Camps, offices	Ensure the construction workers are provided with safe water and sanitation facilities at the site and that	Weekly	Contractor	DSC,	Include in Table 10.19

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
			the camp site is kept clean and hygenic				
17	Air Quality (dust, smoke)	Vessel Shelter Construction sites	Visual inspection to ensure good standard equipment is in use and dust suppression measures (e.g., spraying of waters) are in place.	Daily	Contractor	DSC	Included in Table 10.19
18		Dredged Materialdumping /storage sites	Visual inspection to ensure dust suppression work plan is being implemented	Daily	Contractor	DSC	Included in Table 10.19
18	Emissions from vehicles and vessels	Motor vehicles and mechanical vessels used by the contractor	Emissions as specified in ECR 1997	Annually	Contractor	DSC	Included in Table 10.19
19	Air Quality (dust, smoke)	Construction sites and camps	Spot measurements of particulate Matter in presence of Engineer Visual inspection to ensure good standard equipment is in use and dust	Monthly	Contractor	DSC	Included in Table 10.19

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
			suppression measures (spraying of waters) are in place.				
		Land based dredged material placement sites	Spot measurements of particulate matter in presence of Engineer Visual inspection to ensure dust suppression measures are in place	Monthly	Contractor	DSC	Included in Table 10.19
20	Noise and vibration	At 10 locations; near the sensitive sites and settlements at the close to the dredging works and placement sites. The locations of sampling will be recommended by the Engineer	24 hour noise monitoring	Quarterly	Contractor	DSC	Included in Table 10.19
21	Under water noise levels	At the dredging locations	Spot measurements at 100 m away from dredging	Monthly	Contractor	DSC, ES	Included in Table 10.19

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
			locations				
22	River bed sediments	At 25 locations covering all proposed 22 river routes. The locations will be determined by the Engineerat the beginning of each sampling.	Sampling and analysis of river bed sediments for Pb, Cd, Cr, Cu, Zn, Mn, As, Se, Hg, PCBs, POPs, and hydrocarbons	Quarterly (October, January, April)	Contractor through a nationally recognized laboratory,	DSC	Included in Table 10.19
23	Drinking Water Quality	At the drinking water wells established for construction workers	Sampling and analysis for parameters specified in ECR 1997: Drinking Water Standards	Annually	Contractor trough a nationally recognized laboratory	ExternalMonitor	Included in Table 10.19
		Water wells to be used by contractors for drinking	Laboratory analysis of all drinking water parameters specified in national standards	After develop-ment of wells	Contractor trough a nationally recognized laboratory	DSC	
24	Safety of workers	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	DSC M&E Consultant, BIWTA	Included in Table 10.19
25	Cultural and	At all work	Visual observation for	Daily	Contractor	DSC M&E	Included in Table

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
	archeological Sites	sties	chance finds			Consultant, BIWTA	10.19
26	Reinstatement of Work Sites	All Work Sites	Visual Inspection to ensure removal of all buildings and equipment from the site. The site is clean and was restored to original condition	After completion of all works	Contractor	/DSC M&E Consultant, BIWTA	Included in Table 10.19
27	Grievances	In the project area	Number of grievances registered and addressed	Monthly	PIU	DSC/, M&E Consultant, BIWTA	Included in Table 10.19
28	Sound from the vehicles and vessels	Motor vehicles and mechanical vessels used by the contractor	Sound emissions as specified in ECR 1997	Annually			
During Post Dredging (O&M) Phase:							
1	River erosion and accretion	At the project influence area	Inspection of reo-morphology of the rivers	Monthlyduring Monsoon and postmonsoon	BIWTA	BIWTA	O & M Budget
2	Aquatic Flora and Fauna	At the sensitive locaton of project	Inspection of aquatic habitats, river morphology	Six Monthly	NGO with relevant background experience	BIWTA	O & M Budget

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
		influence area	and monitoring of faunal species (fish, dolphin)		(outsourcing)		
3	Surface water quality Temperature, Turbidity, TSS, TDS,TSS, EC,DO, BOD, TOC, Ca, Mg, Na, K, F, Cl, Br, SO4, NO3, PO4	At the potential dredging sites .	Collection of water sample at dredging sites	Dry season	BIWTAat recognized laboratory or relevant NGO	BIWTA	O & M Budget
4	Groundwater quality	Monitoring in accordance with groundwater monitoring program Number of related complaints	pH, Temperature,TDS, EC,Ca, Mg, Na, K, F, Cl, Fe, Br, SO4, As, Mn	Once a year	BIWTAor relevant NGO	BIWTA	O & M Budget
5	Air Quality	Number of air quality related complaints, Air quality monitoring data, Ambient air quality	PM10,PM2.5, CO, SO2, O3, NOx	Dry season	BIWTA / External Monitor	BIWTA	O & M Budget

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
		found beyond the national standards (EQS)					
6	Noise Level Measurement	Number of non-compliances, Noise monitoring data Number of community complaints	Leq in dBA	Once a year	BIWTA (External)	BIWTA	O & M Budget
7	Agriculture	Number of non-compliances, Number of community complaints	Compare the production with the baseline	Yearly	BIWTA (External)	BIWTA	O & M Budget
8	Cleanliness	At all Vessel Shelters and Ferry crossings' landing sites	Visual Inspection	Monthly	Terminal Administration Offices	BIWTA	O & M Budget
9	Waste effluents	Vessel Shelters and Ferry crossings' landing sites	Visual inspection that solid and liquid waste effluents are properly managed during maintenance works	Six-monthly	BIWTA	BIWTA	O & M Budget

Sl.	Activity/Parameter	Location	Means of Monitoring	Monitoring Frequency	Responsible Organization		Budget (USD)
					Implement-ed by	Super-vised by	
10	Waste reception facilities	Vessel Shelters and Ferry crossings' landing sites	Visual inspection that waste collection facilities are in use	Six-monthly	Terminal Administration Offices	BIWTA	O & M Budget
11	Workers and community health and safety	Vessel Shelters and Ferry crossings' landing sites	Visual inspection on health and safety issues	Six-monthly	Terminal Administration Offices	BIWTA	O & M Budget
12	Water Quality	Vessel Shelters and Ferry crossings' landing sites	Sampling and analysis	Six-monthly	BIWTA through a nationally recognised laboratory (External)	BIWTA	O & M Budget
13	Accidents	Vessel Shelters and Ferry crossings, landing sites	Visual assessment and Interviews with involved people	As and when happened	BIWTA Administration Offices	BIWTA	SpecialEmergency Budget

Note: There is no contaminated dredgedmaterial within the study area of the project (Bangladesh Regional Waterway Transport Project 1

10.4.2 Standards and Thresholds

Standars for DOE's Environmental Conservation Rule 1997 are presented as Annex-L. Relevant standrs for water, air, noise, etc. are also presented in this section for easy reference. The relevant standards to be followed during the implementation of the Project include Government of Bangladesh Environmental Conservation Rules and international standards provided in the ESIA for assessing the contamination of dredged material.

Wherever the standards are not available for some parameters, for example suspended solids and underwater noise levels during, the threshold limits for those parameters are 20 percent of the baseline concentrations. The threshold limits will be apply from a minimum distance of 100 m from the downstream of the dredging locations. The baseline concentrations and threshold limits will be established by the Engineer based on the water quality data during the beginning of each dry season (dredging season).

Standards and Thresholds for water quality

The physical and chemical parameters recommended for analysis of surface water quality relevant to the proposed project are pH, temperature, turbidity, DO, BOD5, EC, TOC, TDS, TSS, Ca, Mg, Na, K, Cl, F, Br, SO4, NO3, PO4. The monitoring should be carried out in accordance to the DOE surface water standard for irrigation and fisheries, given below in 10.6.

Table 10.6 : Bangladesh Surface Water Quality Standards

Sl No.	Best Practices Based Classification	Parameters			
		Temperature (°C)	pH	DO (mg/l)	BOD5 (mg/l)
1	Water usable for fisheries	25 - 30	6.5- 8.5	5 or more	6 or less
2	Water usable for irrigation	25 - 30	6.5- 8.5	5 or more	10 or less

Source: Environmental Conservation Rule (ECR)’97

Notes:

- In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l
- Electrical conductivity for irrigation water– 2250 mhos/cm (at a temperature of 25°C); Sodium less than 26 percent; boron less than 0.2 percent

The parameters recommended for analysis of groundwater quality relevant to the proposed project are pH, temperature, EC, TDS, Ca, Mg, Na, K, Cl, F, Br, SO4, As, Fe, Mn. The monitoring should be carried out in accordance to the DOE standard for drinking water, given below in 10.7

Table 10.7 : Bangladesh Drinking Water Quality Standards

Parameter	Unit	DOE Standard for Drinking Water
pH	-	6.5 – 8.5
Temperature	°C	20 - 30
Electric Conductivity (EC)	µS/cm	-
Total Dissolved Solids (TDS)	mg/L	1000
Calcium (Ca)	mg/L	75
Magnesium (Mg)	mg/L	30 – 35
Sodium (Na)	mg/L	200
Potassium (K)	mg/L	12

Parameter	Unit	DOE Standard for Drinking Water
Chloride (Cl)	mg/L	150 – 600
Fluoride (F)	mg/L	1
Bromine (Br)	mg/L	-
Sulphate (SO4,)	mg/L	400
Arsenic (As)	mg/L	0.05
Iron (Fe)	mg/L	0.3 – 1.0
Manganese (Mn)	mg/L	0.1

10.5 Institutional Arrangements

An appropriate institutional arrangement is vital for the successful implementation of the EMP for the project. BIWTA is responsible forensuringthat dredging and construction and maintenance period mitigative and monitoring tasks defined the ESIA's EMP arecompletedontimeandinatechnically soundmanner.Monitoring of EMP by BIWTA will require field surveys, analyses and technical reporting to DoEin addition to receiving environmental reports from the contractor as well as theSupervisionand Monitoring Consultants. At present, BIWTA lacks such capability, and therefore, will require a project implementation Unit (PIU) to address EMP and RPF implementation as shown in Figure 10.5.

PIUwould be responsible for all aspects of project implementation including technical, operational and financial management, and overseeing the implementation of EMP. The PIU will be headed by the Project Director (PD). The PIU will include an Environment and Social (E&S) Cell with qualified staff (Table 10.14). This E&S Cell will assist the PD on issues related to environmental and social management and oversee the Dredging Supervision Consultant (DSC) for IWT route maintenance and Construction Supervision Consultants (CSC) for terminals and landing stations for environmental and social management, ESIA consultants (for terminals and landings), and the environmental and social aspects of various activities, studies and future project preparation to be carried out under the project.S& E Cell will oversee contractors and will compile quarterly monitoring reports and annual monitoring reports on EMP compliance, to be sent to the Project Director and also shared with the World Bank, throughout the construction period.The E&S Cell will also provide trainings to the BIWTA field personnel responsible for monitoring of environmental compliance during both construction and O&M phases of the project.In addition, BIWTA will establish a permanent Environmental, Social and Climate Change Unit in its institutional structure, which will ensure the long term sustainability, climate resilience and climate sensitivity of project investments as well as other activities across the organization.

Table 10.8: Description of PIU Staffand Consultants for E & S Cell

Sl. No.	Position	Number	Periods/Duration (Person months)
1	Project Director (PD), BIWTA Staff	1	84 (7 years)
2	Deputy Project Director Environment, BIWTA Staff	1	84
3	Deputy Project Director Environment, BIWTA Staff	1	84
4	Senior Environmental Consultant	1	84
5	Senior Social Consultant	1	84
6`	GRM officer	1	84

The PD shallbe of the rank of Deputy Director and have a minimumdegree related to environmental science/engineering and have experiences of more than 15 years in dredging The DPDs have a minimumdegree related to environmental science/engineering and Social scienceEach of the DPDs shall have experiences of more than 10 years in dredging Operation and Dredge material management work. The environmental and Social Consultants shall have relevant masters' degrees with minimum 10 years of experience in their relevant fields. The GRM officer shall have relevant masters' degree with minimum 10 years of experience in the relevant field.

Dredging Supervision Consultants will be responsible for supervising the contractors for the implementation of EMP.For this purpose, the DSC will appoint international and national environmental and social specialists, to ensure the EMP implementation during the project period. They will supervise the contractor for the EMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of effects of these measures. Proposed staff with number and duration is presented in Table 10.9.

The DSC shall have a minimum Master degree related to environmental science/engineering and have experiences of more than 10 years in dredging OperationandDredge materialmanagement work. The environmental and Social Specialists shall have relevant masters' degrees with minimum 10 years of experience in their relevant fields.

Table 10.9 **:** Description of Dredgding Supervision Consultants

Sl. No.	Position	Number	Periods/Duration (Person months)
1	Environmental specialist (International)	1	42
2	River ecologist (National)	1	84

3	Environmental Specialist (National)	1	84
4	Social and community specialist	1	84

Contractors are also required to appoint one environmental health and safety officer (EHS), oneAquatic Ecologistand one Social and community liaison officers for the implementation of EMP in the field (Table 10.10). The contractor will also be responsible for communicating with and training of its staff in the environmental/social aspects.

The EHSshallhave a minimumbachelor degree related to environmental science/engineering and have experiences of more than 10 years in environmentalandOHSmanagement work in construction. The Aquatic Ecologist and Social Officers shall have relevant masters' degrees with minimum 5 years of experience in their relevant fields.

In addition to the above personnel, the contractor shall designate one his crew member as Environmental Site Manager for each dredging equipment.

During implementation of the project, the contractor will carry out continuous surveying and will prepare a monthly work plan projecting the specific activities, dredge locations and volumes to be carried out in the coming month, based on the updated survey data. As part of this monthly plan, the contractor will include a Detailed Updated Contractor's EMP, which shall specify any relevant updates or modifications to the above-mentioned site-specific plans, to account for changes in location, scope or methodology of river channel / ferry crossing / vessel shelter maintenance activities. For example, if new geographic areas need to be dredged or if dredging volumes exceed available capacity for disposal in the pre-specified disposal areas as shown in Figure 10.1, the monthly plan shall propose new locations and all relevant mitigation and management requirements, in accordance with the criteria specified in this EMP and the detailed plans outlined above. The monthly work planwill be submitted to the DSC for approval prior to the contractor initiating activities that month.As part of this review, the DSC's Environmental Expert shall review and approve the Detailed Updated Contractor's EMP component of the monthly work plan. if in the future the geographic area of the contract is modified by BIWTA through a contract variance, the contractor will be responsible for preparing a site-specific Contractor's Environmental Management Plan (CEAP) and following all applicable ECoPs and any other measures as specified in the additional EMP to be carried out for this added geographic scope.

Table 10.10**:** Description of Contractor's Staff

Sl. No.	Position	Number	Periods/Duration (Person months)
1	Environmental Health and Safety Specialist	1	84
2	Aquatic Ecologist	1	84
3	Social and Community Liaison Officer	1	84

External Monitoring and Evaluation Consultants will be engaged by the PIU to conduct external and independent monitoring and evaluation of the EMP and RAP implementation. The main purpose of the external monitoring will be to ensure that all the key entities including E&S Cell and contractors are effectively and adequately fulfilling their designated role for EMP and RAP implementation and that all the EMP and RAP requirements are being implemented in a timely and effective manner (Table 10.11).

The Monitoring and Evaluation Consultantsshallhave a minimum Master degree related to environmental / Social sciences and have experiences of more than 10 years in relevant fields.

Table 10.11 **:** Description of M & EConsultants

Sl. No.	**Position**	**Number**	**Periods/Duration (Person months)**
1	EMP Implementation Specialist	1	20
2.	Environmental Specialist	1	20
2	Monitoring and Evaluation Consultants (Social)	1	7
3	Ecological Monitoring Specialist	1	20

Other study consultants: The Project will also hire several other consultants to carry out studies such as ESIA studies for future proposed investment activities; collection of baseline data on biodiversity at sensitive locations and implementation of a biodiversity conservation program; sustainable long-term maintenance of river terminals, landings and other BIWTA assets; techniques to minimize dredging and other maintenance needs through application of river training schemes.

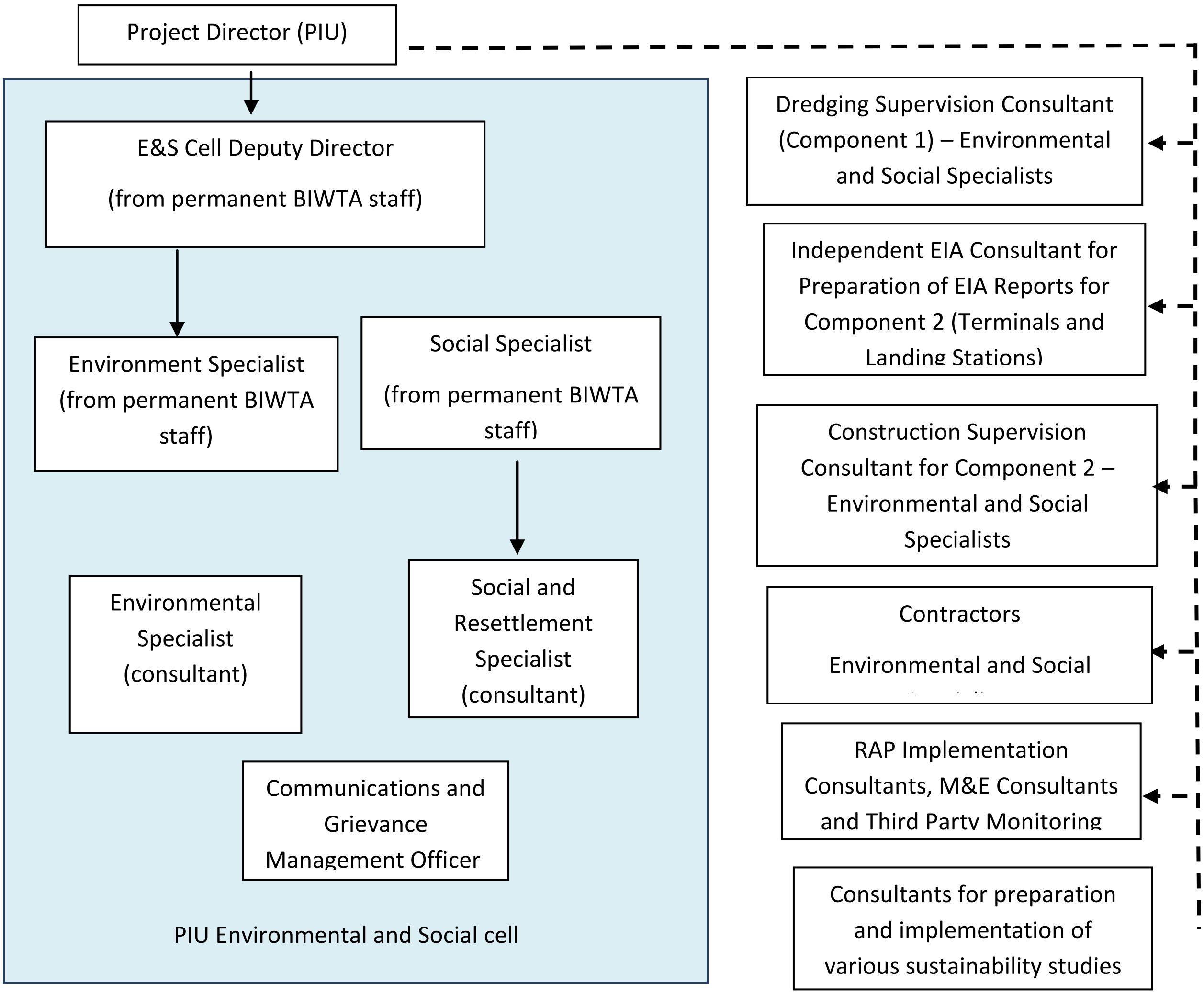

Figure 10.5: Institutional Structure for Environmental and Social Management of the Project

Grievance Redress Mechanism (GRM): The Project will establish a Grievance Redress Mechanism (GRM). GRM will receive and act upon complaints from citizens or organizations in relation to any occurrences for which the Project is directly responsible. The GRM will be managed by PIU at Bangladesh Inland Water Transport Authority.

A three-tier bottom up GRC will be established in this Project. First, there will be GRCs at the local level, hereafter called Local GRC (union/municipality level); and second, GRC at the District level and thirdly at project unit level to ensure transparent and accountable process of reviewing, resolving, and responding to grievances. These GRCs will be established through gazette notifications from the Ministry of Inland Water transport Authority. The APs will be informed through public consultation that they have a right to have their grievances redressed by the local committees as well as by the project management. The local GRCs (at the union/municipal level) will hear the grievances first. Only unresolved cases will be forwarded to the next tier – District Level GRC. Cases with all proceedings are placed with the District level GRC. BIWTA District level senior official (selected by the PD), with assistance from other officials review them. If found necessary, field investigation is carried out and the resolutions are given within 4 weeks of receiving the complaints. Unsolved cases will be forwarded to the project level GRC for further review and resolution.

10.6 Reports

10.6.1 Reports by Contractor

The Contractor shall prepare the following site specific reports

Site Specific Environmental Management Plans;

Construction Environmental Action Plans (CEAPs);

Advance monthly plan for dredging and disposal , and

Monthly progress report with location of dredging and disposal sites;

10.7 Site Specific Environmental Management Plans

The Contractor as per EMP guide lines will prepare site specific EMP and get it approved by the Environmental Consultantof E&S Cell within forty-five (45) calendar days after the date of the Letter of Acceptance. Any dredging operation shall not begin until the site specific EMP has been approved.

10.8 Construction Environmental Action Plan (CEAP)

The Contractor shall prepare a 'Construction Environmental Action Plan' (CEAP) demonstrating the manner in which he will comply with the requirements. The Contractor shall submit the CEAP to the Engineer for his approval within forty-five (45) calendar days after the date of the Letter of Acceptance. Any construction operation shall not begin until the CEAP has been approved by the Engineer.

The plan will include a series of management plans:

- Site specific dredging management plan. The plan shall include (i) the control measures to be put in place at each location in order to comply with EMP thresholds and requirements to minimize benthic and aquatic disturbances, as well as noise, air pollution, and other impacts during the dredging process – based on ecological sensitivity and presence of contamination; (b) all exact locations and management provisions for dredged material placement, for both on land and in river placement, based on the actual anticipated dredge volumes and locations as per updated the most recent survey data. The locations shall include the pre-specified locations from Figure 10.1 and Table 10.2 and Table 10.3, where applicable. For any additional/new areas requiring dredging for which the pre-identified locations are not feasible, additional sites shall be proposed following the criteria specified in this EMP; and (c) Documentation to be maintained and provided to the Engineer on environmental management for the dredging activity
- Site specific pollution prevention and control (water, air, noise) plan for each construction and disposal area;
- Site specific waste disposal and effluent management plan for each work site and workers camp;
- Site specific drinking water supply and sanitation plan for each work site and workers camp;
- Occupational health and safety plan and training programs;

- Site specifictraffic management plan, for both river and on land, for each work site;
- Emergency Response Plan and Early Warning System;
- HIV-AIDS Preventive Management Plan and training programs;
- Complaints logging system and response plan, and
- Standard Operating Procedures for pollution spills, and management of fuels and hazardous goods.

The payment towards the preparation and implementation of CEAP will made in instalments in a proportion equal to the percentage of the overall work completed by the contractor during that particular period.

In case that the Contractor fails to comply with the requirements of the EMP and approved CEAP, and the monitoring results suggest contamination beyond standards and thresholds, the Employer may take any of the following the following actions.

(i) Stop the Contractor's work until the contractors rectify or remediate any environmental damages caused by noncompliance in a time frame agreed by the Engineer; and/or newly monitored results became satisfactory. No additional payment or time extension will be granted for the work delay caused by this work suspension.

(ii) Stop the Contractor's overall payment (not limited to amount towards CEAP) until the remediation works are completed, and/or newly monitored results became satisfactory.

(iii) Directly undertake required counter measures and/or monitoring activities. The costs which the Employer incurs shall be deducted from the payment to the Contractor. Any deduction shall be subject to the Engineer's determination.

10.9 Advance Monthly Work Plan for Dredging and Dipsoal

During implementation of the project, the contractor will carry out continuous surveying and will prepare a monthly work plan projecting the specific activities, dredge locations and volumes to be carried out in the coming month, based on the updated survey data. As part of this monthly plan, the contractor shall specify any relevant updates or modifications to the site-specific plans given in CEAP, to account for changes in the locations of dredging and dredged material placement. The monthly work plan will be submitted to the Engineer for approval prior to the contractor initiating activities that month. As part of this review, the Engineer's Environmental Expert shall review and approve the Detailed Updated Contractor's EMP component of the monthly work plan.

Monthly progress reports with location of dredging and disposal sites

The Contractor will submit monthly repor including progress achieved in respect dedging and disposal of dredge spoil. The Contractor Shall Submit sample copy of the monthly progress report 30 days in advance to the Engineer's Environmental Expert for review and approval.

The Contractor shall submit the monthly progress report in 10 copies with in the first week of every month starting from the month of commencement date until issuance of Hand-Over Certificate of the assignment. The report after the DSC's comments and Contractor's correction, shall be submitted to the Environmental Consultant in both hard and soft copy.

Quarterly monitoring report

The M&E Consutant will prepare quarterly monitoring reports and submit to the Environmental Consultant of E&S Cell.

Annual Audit Report

To ensure tranferecy and EMP compliance, Annual adit report will be prepared by an independent third party consultant of the project.

Report by M & E Consultant

The M & E consultant will prepare Quarterly and Annual Report to ensure EMP compliance. For effective environmental compliance to EMP obligations M & E Consultantswill also ensure the following obligations.

- Timely reporting of documents (as defined in EMP and monitoring plan)
- Number of non-compliances observed by supervision consultant
- Availability of environmental specialists with contractors, supervision consultant and BIWTA
- Number of inspections carried out by supervision consultant per month
- Number of trainings imparted to stakeholders/other capacity building initiatives
- Number of accidents related to Project
- Number of grievances received
- Number of grievances resolved.

10.10 Budgets

10.10.1 BOQ of Contractor

No separate payment shall be made for fulfilling the requirements of EMP except as specified Table 10.12. For items not specified here, all costs shall be deemed to be included in the unit rates and/or lump sum prices of the various other items in the Bill of Quantities.

Table 10.12 : Bills of Quantities for EMP

Item No.	Items of Work	Unit	Quantity
1	Preparation and implementation of Construction Environmental Action Plan	Lump sum	
2	Provision of EHS Officer, Aquatic Ecologist and Social Officer	Years	7
3	Providing and maintenance of survey equipment for spot measurements	Lump sum	
4	River bed sediments quality: sampling and analysis of river bed sediments quality(see Section 6.3 of EMP)	Nos.	500
6	Surface water quality: sampling and analysis of river water and waste water discharges quality (see Section 6.3 of EMP)	Nos.	500

10.10.2 Overall EMP Implementation Cost

The total cost for the environmental and social management and monitoring activities has been estimated to be USD 14.9 million (**Error! Reference source not found.**.Of this amount, USD 5.6 million has been included under Component 3 of the project; the remaining amount of USD 9.3 million is included in other project components, as shown in Table 10.13**.** The total administrative budget for RPF/RAP/ARAP implementation under this project has been worked out as US$. 3.8Million.

Table 10.13**:** BudgetCost Estimates for Environmental Management and Monitoring of the Project

	Description	Amount, million USD	Project Component (See Table 5)
	Contractor's Budget (for development and implementation of management plans, staff, training, etc.	1.0	Component 1: IWT
	Sediment, water, soil, air and noise quality monitoring during construction (quarterly for 6 years)	0.5	
	DSC Environmental and Social Staff	1.0	
	CSC Environmental and Social Staff	1.0	Component 2: Terminals
	Contractor's Budget (for development and implementation of management plans, staff, training, etc.)	1.5	
	Sediment, water, soil, air and noise quality monitoring during construction (quarterly for 6 years)	0.5	
	Administrative budget for RPF activities	3.8	
	Study, development of action plan, and capacity building of BIWTA to ensure effective and sustainable long-term maintenance of river terminals, landings, other BIWTA assets Origin destination survey of inland waterways along Dhaka-Chittagong corridor, including understanding which supply chains to promote, and logistics gaps for development	0.5 0.35	Component 3: Institutional Capacity Development and Sustainability
	Social NGO to support BIWTA on implementation of Social Management Plans / RAPs for specific investments	0.2	
	Third party M&E consultant for social safeguards (including midterm and ex-post evaluations of RAP implementation)	0.25	
	Third party M&E consultant for environmental safeguards	0.25	
	Environmental NGO/firm to: (a) carry out additional baseline data collection on biodiversity at sensitive locations; and (b) develop and implement biodiversity management programs including habitat enhancement and protection for key species	0.5	
	Implementation of additional EMP programs (such as management of dredge spoils, biodiversity conservation, capacity building support to establish the permanent Environmental, Social and Climate Change Cell, etc.)	2.0	
	PIU Environmental staff	1.5	
	TOTAL	**14.9**	

11 SOCIAL MANAGEMENT PLAN

11.1 General

This chapter reflects on Environmental and Social Management Issues including institutional capacity development of the executing agency and other line agencies institutional arrangement, grievance redress mechanism etc.

11.2 Resettlement Policy Framework (brief summary)

Most of the terminals are on GoB land, but proposed launch terminal facilities will require approximately **2.093** ha land acquisition. The proposed 06 vessel shelters are planned to be constructed on public land to avoid any negative impacts on the population near project sites. At most of the project locations, land belongs to BIWTA. This land is used for common purposes such as Ghats for boats, by the nearby communities. There are Persons without title to the land on the BIWTA land with shop and residences. Places of worship are built on BIWTA Land. BIWTA has built shops and leased them to shop keepers. This will lead to loss of livelihoods. At some locations access to common property resources such as Burial grounds will get restricted due to the present interventions. At some locations access granted to cultural practices such as immersion of ashes of the dead in rivers at certain ghats, will be impacted. Further access infrastructure such as roads will cause impacts as the present roads are narrow and they need to be widened for optimizing the capacity of the facilities built.

As per the ESIA, there are no small ethnic communities; indigenous people, at the project locations.

The key social impacts due to project interventions are Land acquisition and subsequent resettlement, Loss of Livelihoods, Inconvenience and nuisance during construction, Loss of access to CPRs and Likely increase in transport costs

For each of these sub-projects an RAP will be prepared, where required during the planning and design stage. The following social management measures are proposed in the Resettlement Policy Framework (available under separate cover, and summarized briefly here) for:

- Development and adopting a Resettlement Policy Framework (RPF) to be used for all sub-projects under this project. This RPF should serve as a guide for further SIA studies and for preparation of RAPs under this project.
- Integrate the rehabilitation of livelihoods into design of terminals and other infrastructure facilities. Designs are to consider the following:
- Livelihoods: such as integrating shops and vendors
- Facilities for women such as: separate counters, waiting areas, sanitation, seating arrangements
- Facilities for disabled

- Arrangements to continue cultural practices
- Design and general arrangement to be ready for impact identification and resettlement plan preparation
- Alternate temporary transit arrangements before resettlement
- Resettlement Policy Framework with clear entitlements
- Grievance Redressal Mechanism
- Community Engagement in planning and implementation
- Gender Mainstreaming Plan
- Disclosure: disclosure of resettlement plans

The primary objective of this RPF is to improve the standard of living of the affected population. The other objectives of this RPF are to; a) Ensure the principles of Social Justice is adhered to at all times, b) Avoid or minimize any negative impacts on the communities, c) If land is required for project facilities, then same may be purchased under Willing Buyer-Willing Seller norm, d) Assist affected population in improving their living standards, income earning capacity, and production levels, etc., e) Encourage and enable community participation in planning and implementing project components and f) Provide assistance to affected communities in redressing their grievances.

This RPF addresses social issues such as Land Procurement, Community Engagement, Special Attention to Women and Other Vulnerable Groups and Grievance Redressal.

This RPF specifies procedures for a) Buying Land under Willing Buyer and Willing Seller concept and registration and mutation of records and b) for land Acquisition. When land needs to be acquired as per the Land Acquisition Act 1894, the RPF has set the procedures to be followed by project. Compensation norms are set ensuring that the properties (land, structure, and non-structured assets) to be affected by the project will be compensated at their full replacement cost determined by a legally constituted Resettlement Sub-committee (RSC) as per structure and mandated outlined in the RAP. The payment of compensation and other assistance, target replacement of productive assets and restoration of loss of income and workdays by the relocated households, especially the vulnerable households will be ensured by this committee. Compensation and other cash assistance will be paid through bank bills (cheques) payable to Bank accounts opened by the affected persons eligible for compensation and assistance under RAP. The Bank account will be in the joint name of husband and wife as the case may be. Compensation under law (CUL) will be paid through two different channels as per provision of RAP. CUL will be paid by Deputy Commissioner mandated for acquisition of land for the PMU while PMU will directly pay the remaining as per requirement of the RAPs directly to the project affected persons. PMU with the help of the project consultants will advise, assist, and monitor the affected persons receiving compensation and other cash assistance for better use of the money.

Regardless of their tenure status to the lands used for project component, the project affected persons/ households will be eligible for compensation and assistance. All PAPs irrespective of their title will be entitled to compensation and assistance based on loss and impact categories identified through census survey in respect of the policy guidelines adopted for the project. Nevertheless, eligibility to receive compensation and other assistance will be limited by the cut-off date. The absence of legal title will not bar PAPs from compensation and assistance, as specified in the entitlement matrices. An Entitlement Matrix has been prepared for the project on the basis of field study and consultation with government officials as a part of preparing the resettlement policy framework. A person could be eligible for compensation/entitlement in more than one category of losses and in more than one mouza. DCs will pay CCL for each mauza separately for one person whose lands/assets have been acquired in more than one mauza. A resettlement policy framework has been prepared as a standalone document.

11.3 Dredge Material Disposal Plan

Composition of the dredged material is dominated by sand followed by silt and clay. The following table provides options for disposal of non-contaminated dredged material. On-land disposal of the dredged material will be last option provided there are no additional adverse impacts on the adjacent land and on the community's livelihood. According to the dredged material disposal plan there are four options to deposit dredged material preferably in the river particularly scour hole.

Options for disposal of dredged material (in order of preference)	Description/ Intervention	Additional applicable criteria
Option-1: in-river disposal	• In the river bed • Scour hole of depth <5m • Erosion vulnerable area	*Exceptions*: ecologically sensitive areas, mud flat, reed lands, important bird areas, or along chars or confluences
Option-2: on-land disposal	Existing stake yard of the sand traders (if identified near the dredging site)	vii. Close to the river bank. viii. Close to the dredging location (within 2 km, includes the river bank) ix. Encumbrance-free land x. No adverse impact on income and livelihood of individual or community xi. Non-agricultural fallow land
Option-3 - on-land disposal	Government Land/waste land	
Option-4 - on-land disposal	• Lease land from the private • Lease Land from the Community	

		xii. No impacts to cultural heritage vi. Not within 100m of beels/ marshy areas /reed land/mud flat/IBA

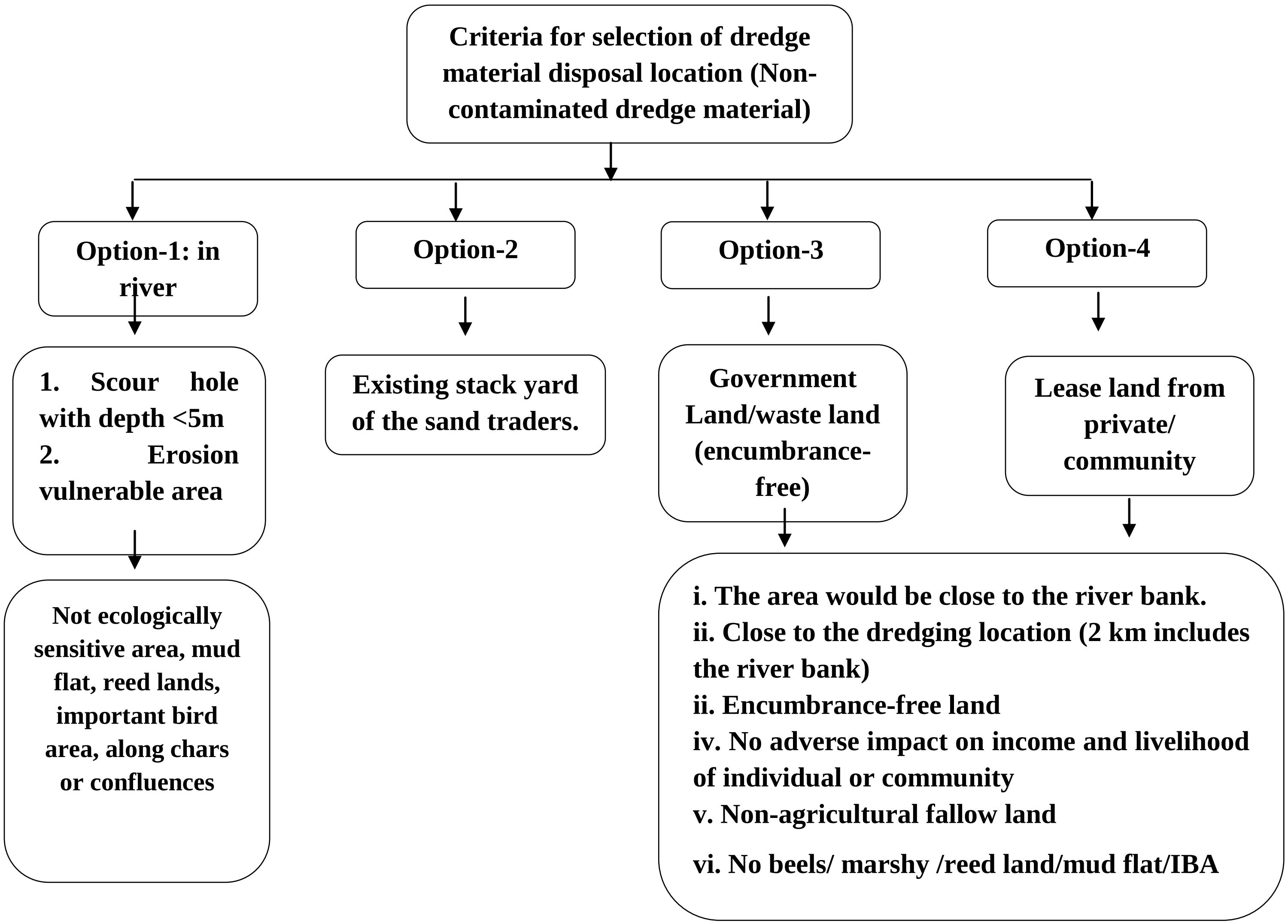

Figure 11.1 **: Criteria for selection of dredge material disposal location**

A comprehensive dredged material disposal plan is prepared and annexed with ESIA (Annex-K)

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11.4 BIWTA requirements to oversee dredging and dredge disposal activities

BIWTA will have the following core responsibilities with respect to environmental management of dredging and dredge disposal activities under the project. The contractor's responsibilities are detailed under the separate chapter which is chapter 12: Contractor's EMP.

- Overall accountability for implementation of all aspects of the EMP
- Ensuring all necessary legal and regulatory requirements are met, including renewal of environmental clearance certificate and any other applicable requirements
- Hiring and overseeing the work of the Dredging Supervision Consultant (DSC) on environmental and social management and monitoring ,including: reviewing monthly monitoring reports, following up proactively with the DSC to clarify issues raised and to discuss and agree on penalties or remedial actions where required, etc.
- Monitoring and supervising the contractor's operations as required, to supplement and verify the work of the DSC
- Provide final approval to site-specific Contractor Environmental Action Plans (under advice of DSC)
- Hire and oversee the work of the third party independent environmental monitor
- Enforce penalties on the contractor and oversee remedial measures in cases of non-compliance
- Carry out ongoing stakeholder consultations and grievance management
- Quarterly reporting to the World Bank on environmental management
- Establish a permanent E,S and Climate Change Cell within the permanent organizational structure
- Implement the biodiversity conservation program, including finalizing TORs and hiring consultants, overseeing their work to develop a comprehensive program proposal, and facilitating the implementation of that program as required, including through liaison with other relevant line ministries and forming partnerships with external stakeholders. The TORs for the biodiversity conservation program are presented in Annex L
- Additional activities as required to ensure full compliance with all requirements of the ESIA, EMP, and RPF

11.5 Capacity Assessment of BIWTA for Environmental and Social Management

Capacity building for effective implementation of the environmental and social safeguard requirements is a key element of the EMP **as well as RPF**. Capacity building for environmental and social safeguard management will need to be carried out at all tiers of the project, including BIWTA, PIU, supervision consultants, and contractors. At the dredging/construction site, supervision consultant will take the lead in implementing the capacity building plan, though the contractors will also be responsible to conduct trainings for their own staff and workers. The various aspects that are covered under the capacity building will include general environmental and social awareness, key environmental and social sensitivities of the area, key environmental and social impacts of the project, EMP requirements, OHS aspects, and waste disposal. PIU may revise the plan during the

Project implementation as required. During the maintenance phase of the Project, these trainings will continue to be conducted by BIWTA for all relevant maintenance personnel and community.

The existing organizational structure of BIWTA was approved by the Government in 1982. With few changes at different times, BIWTA has been performing responsibilities with this 33 years old structure. But significant and qualitative changes have taken place in the meantime: river morphology, transport demand, transport pattern, technology, challenges etc. Most important is that the existing structure does not include environment, climate change and information technology in its regular work flow.

Since approval of the existing organizational structure in 1982 following changes have taken place:

- Conditions of rivers deteriorated so the navigability.
- Annual volume of dredging was 350,000 cum atv that time as against 5 million now.
- Presently 21 inland ports and almost 400 landing stations as against 7 ports and about 100 landing stations.
- Presently 21 dredgers, only 8 during early 1980s.
- About 3,000 inland vessels used to operate at that time as against more than 10,000 vessels as in December 2013.
- Dimensions and capacity of vessels increased significantly.
- Private sector has become more participative than it was in that time.

A total number of 3,978 employees were approved for BIWTA in 1982. With few changes this number was increased to 4,288. With the increased participation of private sector in port operation toll collector, toll guard, pontoon lascar etc have become redundant. On the contrary Planning Department, Dredging Department, Civil Engineering Department and Traffic Department have not been organized according to required number of personnel.

Most important aspect is that at present there exist no unit or cell in BIWTA for EIA or SIA and BIWTA is yet to introduce e-tendering or e- governance. Poor conditions prevail in Planning Department and Dredging Department. Most recently BIWTA initiated an effort to reorganize. During consultation, it has been gathered that only additional requirement of departments was considered. Redundancy was not identified. Planning Department put forward proposal for strengthening department with additional employees with a section responsible for SIA / EIA. Similarly Dredging Department estimated capacity in accordance with future dredging program.

So far BIWTA paid no attention to develop professional efficiency and skill of its employees. There exist no target nor any defined area for undertaking training programs. In 2012 BIWTA appointed a Consultant with the objective of determining strategy for preparation of a Training Calendar as well as to assess actual training need and prepare / develop a training module for human resource development for the officials. The Final Report was submitted in May, 2012 with an annual training calendar of 40 weeks of different disciplines along with module. But this was not implemented.

Environmental Impact Assessment was included in the calendar but not focused according to actual requirement.

Proposed Institutional Arrangements For the purpose of managing the necessary Environmental and Social safeguards compliance issues associated with Project activities, the PIU shall have an Environmental and Social Cell headed by a Deputy Director, an Environment Specialist and a Social Specialist, and individual consultants employed under the Project for environmental, social and communications support. The Environmental and Social Cell shall be fully responsible to coordinate with Project activities and ensure the compliance of inclusion, safeguards and communications requirements in planning and implementation of Project interventions following the legal and policy framework of the GoB and the Bank. The Environmental and Social Cell shall also coordinate the launching of the grievance management system for the project, and will also oversee implementation of value-added sustainability activities under Component 3 of the Project which go beyond risk management. In addition, to ensure the long term sustainability of project investments and to mainstream climate resilience and climate sensitivity across the organization, the Project will support the establishment and initial capacity building of a permanent Environmental, Social, and Climate Change Unit (ESCCU) within BIWTA's permanent organigram. The Environmental and Social Cell within the PIU will provide training to the permanent unit, and will integrate permanent unit staff once appointed into the ongoing management of the Project. In particular, preparatory studies for a potential follow on investment project, as well as diagnostic, modeling and planning studies on climate change in the IWT sector, will be closely overseen by the new permanent Unit, with in coordination with the PIU's Environmental and Social Cell.

Institutional Structure for Environmental and Social Management of the Project:

Institutional Structure for Environmental and Social Management of the Project is represented in below the Figure 11.2

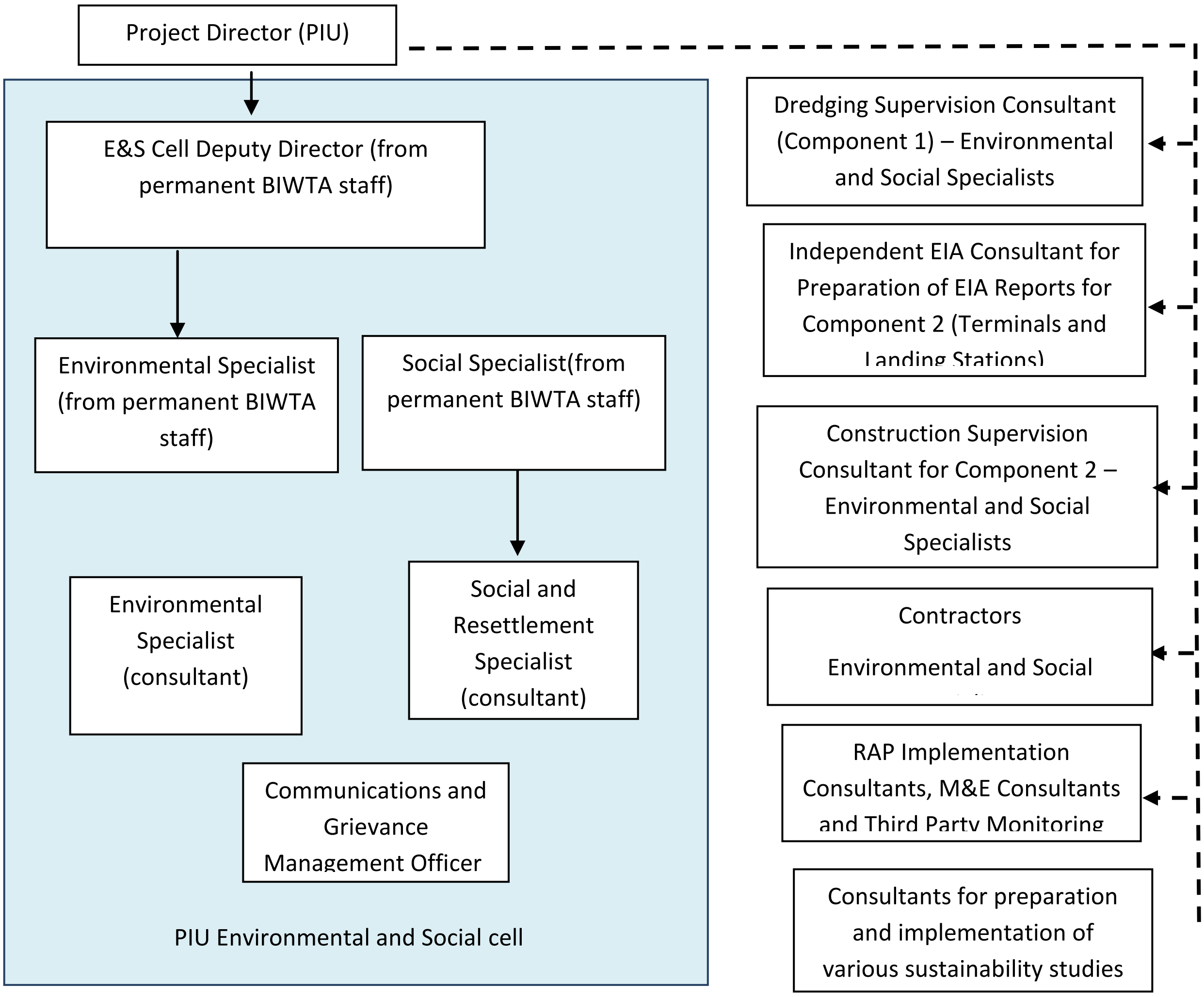

Figure 11.2 Institutional Structure for Environmental and Social Management of the Project

Institutional Strengthening Program

Following institutional strengthening and capacity building programs are proposed for PIU of BIWTA for strengthening their capacity in EMP implementation.

Step A: Creation of Environmental and Social Safeguard Unit within BIWTA

The detail of this is presented in section 10.5 (institutional arrangements)

Step B: Capacity building initiatives involving oriented trainings for the staff

Table 11.1: A tentative summary of the training requirements are presented below

Contents	Participants	Responsibility	Schedule
General environmental and socio awareness; Environmental and social sensitivity of the project influence area; Key findings of the EIA; Mitigation measures; EMP; Social and cultural values of the area; Community issues; Awareness of transmissible diseases Social and cultural values.	Selected staff of BIWTA, DSC, and Contractor	BIWTA with support from DSC	Before commencement of the project
EMP; Waste disposal; OHS	BIWTA Project team; all contractor staff / laborers at site	Contractor, with support from DSC	Before commencement of the project
Road/waterway safety; Defensive driving/sailing; Waste disposal; Cultural values and social sensitivity.	Drivers, boat crew	Contractor, with support from DSC	Before commencement of the project
Camp operation; Waste disposal; OHS; Natural resource conservation; Housekeeping.	Camp staff	Contractor, with support from DSC	Before commencement of the project
Restoration requirements; Waste disposal.	Restoration teams	Contractor	Before commencement of the project

Step C: Engagement of External Monitor for Independent reviews

BIWTA will engage External Monitors during dredging and construction period to measure the effectiveness and outcome/impact of EMP, as stated earlier. The External Monitors will submit the quarterly reports throughout the contract time, impact evaluation report at the end of each year and finally a completion Report at the end of contract period.

Step D: Formation of Grievance Redress Committee

The detail of this is presented in 9.8 (Grievance)

Step E: Establishment of an Environmental Management System in BIWTA

BIWTA is committed to ensure that its operations will not create adverse environmental impacts. In this regard, the BIWTA will need to establish and effectively operate an appropriate Environmental Management System (EMS). It is intended to serve as a basis for discussion between the lending agencies and the BIWTA to work out an appropriate EMS acceptable to both parties.

11.5.1 Documentation

The PIU with assistance from supervision consultants and contractors will produce the following environmental reporting documentation on a quarterly basis:

- Environmental Monitoring Reports: The environmental monitoring reports will include environmental mitigation measures undertaken, environmental monitoring activities undertaken, details of monitoring data collected, analysis of monitoring results particularly the non-compliances, recommended mitigation and corrective measures, environmental training conducted, and environmental regulatory violations observed. The environmental monitoring reports will be submitted quarterly throughout the life of the performance based contract for route maintenance.
- Project Completion Environmental Monitoring Report: One year after completion of dredging, the PIU will submit a Project Completion Environmental Monitoring Report which will summarize the overall environmental impacts from the Project to all the co-financiers.

11.5.2 Engagement of External Monitors

BIWTA will engage External Monitors during dredging and construction period to measure the effectiveness and outcome/impact of EMP, as stated earlier. The External Monitors will submit the quarterly reports throughout the contract time, impact evaluation report at the end of each year and finally a completion Report at the end of contract period.

11.5.3 Institutional Capacity Development and Sustainability Measures

Institutional Capacity Development and sustainability programs have planned as part of the Component 3 of overall Project. The total budgeted costs of these measures are US$50 million. A series of activities are proposed under this component that will support BIWTA's overall enhancement of its management systems and human resources capacity for modern, efficient, and high quality management of the IWT sector in line with international standards. This in turn is critical for the long-term sustainability of the investments supported through the project, as well as the sector's ongoing attractiveness to users, its potential for green innovations in support of national climate mitigation targets, and its resilience to changing conditions including those posed by climate change. Activities to be supported include: (i) the development of River Information Systems to help BIWTA improve data collection for the planning, maintenance and development of IWT, as well as enhance climate resiliency of the IWT sector in Bangladesh by creating a more systematized baseline understanding of river hydrology and navigational implications, and provision of a Traffic Monitoring System for passengers and cargo; (ii) improvement of Human Resources capacity for better management of the IWT sector through upgrading and modernizing the IWT Deck and Engine Personnel Training Centre (DEPTC)) into a regional IWT Training Center with open access to all users in the Region and the world; (iii) commissioning of a study to propose an institutional structure and reforms needed to develop an effective Search and Rescue organization; (iv) support for environmental and social sustainability, climate change resiliency, and "greening" of IWT; (v) a project preparation facility to finance feasibility, surveys, design and safeguards studies for continuous sector development; and, (vi) support for the Project Management Unit including the hiring of key staff and procurement of selected systems needed for implementation of the Project.

11.6 Grievance redresses mechanism (GRM)

Objective of the GRM

The Project will establish a project level Grievance Redress Mechanism (GRM) which will be implemented by Project Implementation Unit (PIU) at BIWTA with an aim to respond to queries or clarifications about the project, resolve problems with implementation and addressing complaints and grievances. The GRM will focus on corrective actions that can be implemented quickly and at a relatively low cost to resolve identified implementation concerns before they escalate to the point of harm or conflict. GRM will serve as a channel for early warning, helping to target supervision to where it is most needed and identify systemic issues.

The GRM will directly focus on and seek to resolve complaints (and requests for information or clarification) that pertain to outputs, activities and processes undertaken by the Project, i.e., those which (i) are described in the Project Implementation Manual; (ii) are funded through the Project (including counterpart funds); and (iii) are carried out by staff or consultants of the organization, or by their partners and sub-contractors, directly or indirectly supporting the project. It is envisaged that such cases would fall under (but are not limited to) the following categories:

- request for information, comment or suggestion, e.g., request for clarification as to the delay in reimbursing expenses of participants in a given training event;
- violation of rights or non-performance of obligations, e.g., complaint by consultant or firm whose contract is suspended as a result of presumed poor performance or non-delivery of agreed-upon outputs;
- grievances or offenses involving a violation of law, e.g., allegations of corruption; and
- complaints against project staff, members of project committees, consultants, and sub-contractors involved in project implementation

GRM will be implemented in two phases: 1) Phase 1 to support safeguards implementation, 2) Phase two of GRM will cover all components and overall project implementation. A formal grievance redress process for phase two will be outlined in the project's operational manual and a protocol will be set up and distributed to project staff and implementers. The project level protocol will build on experience of the initial GRM protocol which supports implementation of the safeguards explained below.

It is envisage that the Project Implementing Unit (PIU) will have a dedicated person who can oversee the preparation of the guidelines and rollout of the project GRM. At lower levels of the project, existing project staff can be assigned for grievance redress functions. Communities can also be trained to undertake grievance redress activities, through complementary mechanisms such as Grievance Handling Committees.

Scope of GRM

In the first phase the project will focus on establishing protocol and procedures for GRM related to safeguards as required per Bank policies. Bank-financed projects that trigger the OP 4.12 on Involuntary Resettlement require projects to establish a GRM in order to collect grievances related to the resettlement process which applies to this project. The scope of such GRM is relatively narrow, as it only solicits complaints from project beneficiaries that are affected by project activities and covered by dedicated Resettlement Action Plans (RAPs) thus the project protocol will be extended and expanded later to cover all project related grievances throughout project cycle.

In phase two, the project-level GRM will not only aim to address social but also environmental, financial management, procurement and other issues and will build on grievance system practices set up to meet requirements of OP 4.12. It will also build on existing informal and traditional structures of grievance redress—such as village committees and local user groups involved in delivery of the project and may be a cost-effective and a more accessible approach to grievance redress. However, its impartiality would need to be carefully examined before relying on traditional systems. Given that poor and marginalized communities often face the most obstacles in accessing and using GRMs, throughout the design process special attention must be given to integrating design features that make GRMs participatory and socially inclusive.

Phase one of the GRM under Safeguard Issues and Establishment Grievance Redress Committee (GRC)

In the first phase of the GRM, the proposed GRM will be supported by establishment of Grievance Redress Committees which are expected to be effective in resolving grievances related to compensation and relocation aspects. If aggrieved, it is expected that affected people will first approach the local grievance mechanism before taking the issue to other forum. All affected persons will have full and free access to GRCs.

The Grievance Redress Committee will be established at: the local level, hereafter called Local GRC (union/municipality level); and second, GRC at the District level and thirdly at project level to give room for grievances to be fairly reviewed and resolved. These GRCs will be established through gazette notifications from the Ministry of Shipping (MoS). The APs will be informed through public consultation that they have a right to have their grievances redressed by the local committees as well as by the project management. The APs can also call upon the support of the implementing NGO (INGO) engaged to implement the RAP to assist them in presenting their grievances or queries to the GRC. Other than disputes relating to ownership right under the court of law, the GRC will review grievances involving all resettlement assistance, relocation and other support. The local GRCs (at the union/municipal level) will hear the grievances first. Only unresolved cases will be forwarded to the next tier – District Level GRC. Cases with all proceedings are placed with the District level GRC. BIWTA District level senior official (selected by the PD), with assistance from GRM dedicated staff will review them. If found necessary, field investigation will be carried out and the resolutions will be given within four weeks of receiving the complaints. Unsolved cases will be forwarded to the project level GRC for further review and resolution. Grievances will be redressed within a specified date of lodging the complaints. GRC decisions will be on a majority basis and will be disclosed and available for review by the stakeholders. If any disputant is unhappy or dissatisfied with the decision of the GRC at any level, he/she may file cases in the court.

The GRC will record the details of the complaints and their resolution in a register, including intake details, resolution process, and the closing procedures. PMU designated consultant / staff will maintain the following three GRM Books:

Opening Book: (1) Case no., (2) Date and channel of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main objection (loss of land/property or entitlements), (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.

Resolution Book: (1) Serial no., (2) Case no.,(3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments, (11) Number of days to resolve the grievance

Closing Book: (1) Serial no. (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

Report: Summary of number and type of complains, resolution time and level.

Grievance resolution will be a continuous process during subproject implementation and overall project implementation. The GRC and PMU will keep records of all resolved and unresolved complaints and grievances (one file for each case record) and make them available for review. The GRC will also prepare periodic reports on the grievance resolution process and publish these on their websites. PMU will consolidate reports from the GRCs on GRM and post in their website. A grievance Redress flowchart is presented in **Error! Reference source not found.**

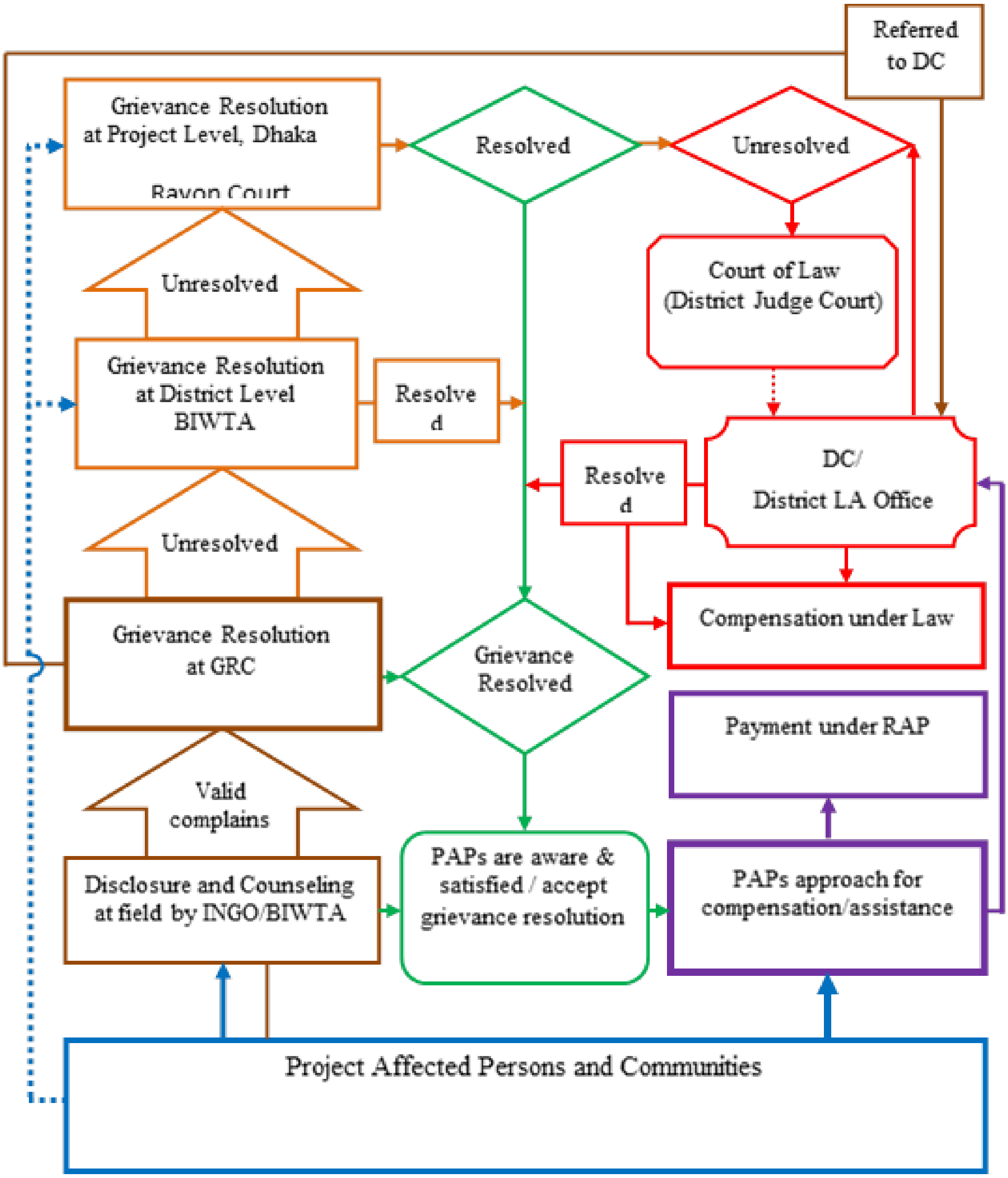

Figure 11.3: Grievance redress flow chart

Step 1	The RAP Implementing Agency (IA) on behalf of BIWTA informs PAPs and counsels them on land acquisition and resettlement policy, compensation and entitlement modalities, entitlement packages, and eligibility and process to obtain the entitlements. PAPs with clear understanding approach DC and EA for compensation under law and assistance under RAPs as applicable. PAPs with confusion and valid complaints on land acquisition and resettlement

	process and entitlements approach GRC for resolution.
Step 2	The implementing agency assists the aggrieved PAPs to produce a written complaint to the convener of GRC with stories, expectations and any parties. The agency counsels the aggrieved persons on the mandate and procedure of grievance resolution. GRC scrutinize the case records and sort out cases to be referred to the DC or the court of law and those to be resolved in GRC. Hearing is organized on cases with merit at the GRC secretariat or at Union Parishad Offices at local level and resolution is given by the GRC in 4 weeks of receiving the complaints. Aggrieved PAPs satisfied with the resolution approach the Executing Agency (EA) for resettlement assistance under the provision of the RAPs. The agreed resolution is forwarded to PMU for approval by the PD before processing entitlements for the entitled person. In case the resolution is not acceptable to the aggrieved person, he/she approaches the District level GRC through the local level GRC convener with assistance from the implementing agency for further review.
Step 3	Cases with all proceedings are placed with the District level GRC. BIWTA District level senior official (selected by the PD), with assistance from other officials review them. If found necessary, field investigation is carried out and the resolutions are given within 4 weeks of receiving the complaints. Aggrieved PAPs satisfied with the resolution approach the EA for resettlement assistance under the provision of the RAPs. The resolution will be sent to the Convener's office at local level GRC to communicate to the aggrieved persons for acceptance. The resolution accepted by the aggrieved person is then approved by the PD. In case the resolution is not acceptable to the aggrieved person, he/she approaches the District level GRC to produce it before the PMU (Project level GRC) for further review.
Step 4	Cases with all proceedings from local level and District level GRC are placed with the Project Director, where the Project Director with assistance from the Deputy Project Director/Senior Level Officials review to resolve the grievance in view of the merits and redirect the case records to the District Level GRC with written resolutions within 4 weeks of receiving the complaints. Aggrieved PAPs satisfied with the resolution approach the EA for resettlement assistance under the provision of the RAPs. The resolution will be sent to the Conveners' office of the local level GRC to communicate to the aggrieved persons for acceptance. The resolution accepted by the aggrieved person is then approved by the PD. Aggrieved PAPs may opt to approach to the Court of Law, if the resolution at

	project level is not acceptable to him/her.
Step 5	The resolution accepted by the aggrieved persons at any level (Local GRC, District or PMU) is approved/nodded by the Project Director and forwarded back to the Conveners' office keeping records at his/her office. Based on the approved grievance resolution, the implementing agency processes his/her entitlements and assists EA in arranging payment.
Step 6	PIU will keep track record of filed and resolved grievances and oversee response time

Phase two – Establishment of Implementation Arrangements for Setting up Project Level GRM

Experience from the phase one of GRM implemented to support social and environment safeguards will be used to extend the protocol and inform the design of project wide GRM. The project PIU will need to identify groups of users that are likely to use the GRM and assess the resources—human, financial, and technological—that are available (and required) for the GRM to function effectively while establishing the protocol to support all project components and implementation. PIU will need to develop standard operating procedures and flow charts to detail how the grievance redress process will unfold within the project's operating structures and how it will be monitored and reported on. More specifically;

- Assign a dedicated GRM officer at the PIU (e.g. drafting operating procedures, guidelines and manual, and stand-alone information for GRM staff and users); and assign grievance redress responsibilities and train staff at the local level to handle grievances
- Raise awareness of the availability of the GRM through project-related events and by posting information about the GRM in public locations / project sites(e.g. via project boards)
- The communications strategy should aim to reach out to poor and marginalized groups and communication materials should be translated into local language
- Accept grievances through a variety of locally-appropriate channels (e.g., in-person, phone – set up toll free number, email);
- Register all grievances (e.g., ensure that all complaints lodged through local authorities are logged and tracked, and that data on resolutions is made public)
- Follow a clear and transparent procedure of complaint investigation (e.g., field visits, inspection of contractors and/or local project implementation teams, discussion with relevant service providers, etc.)
- Take a remedial action within a specified amount of days
- Monitor and evaluate grievance-related data

Budget for Environmental and Social Management

The following table provides estimated costs for environmental and social management of the project, which have been allocated under the project funds.

Table 11.2: costs for environmental and social management of the project, which have been allocated under the project funds

	Description	Amount, million USD	Project Component
	Contractor's Budget (for development and implementation of management plans, staff, training, etc.	1.0	Component 1: IWT
	Sediment, water, soil, air and noise quality monitoring during construction (quarterly for 6 years)	0.5	
	DSC Environmental and Social Staff	1.0	
	CSC Environmental and Social Staff	1.0	Component 2: Terminals
	Contractor's Budget (for development and implementation of management plans, staff, training, etc.)	1.5	
	Sediment, water, soil, air and noise quality monitoring during construction (quarterly for 6 years)	0.5	
	Administrative budget for RPF activities	3.8	
	Study, development of action plan, and capacity building of BIWTA to ensure effective and sustainable long-term maintenance of river terminals, landings, other BIWTA assets Origin destination survey of inland waterways along Dhaka- Chittagong corridor, including understanding which supply chains to promote, and logistics gaps for development	0.5 0.35	Component 3: Institutional Capacity Development and Sustainability
	Social NGO to support BIWTA on implementation of Social Management Plans / RAPs for specific investments	0.2	
	Third party M&E consultant for social safeguards (including midterm and ex-post evaluations of RAP implementation)	0.25	
	Third party M&E consultant for environmental safeguards	0.25	
	Environmental NGO/firm to: (a) carry out additional baseline data collection on biodiversity at sensitive locations; and (b) develop and implement biodiversity management programs including habitat enhancement	0.5	

	Description	Amount, million USD	Project Component
	and protection for key species		
	Implementation of additional EMP programs (such as management of dredge spoils, biodiversity conservation, capacity building support to establish the permanent Environmental, Social and Climate Change Cell, etc.)	2.0	
	PIU Environmental staff	1.5	
	TOTAL	**14.9**	

12 CONSULTATION AND DISCLOSURE

12.1 Overview of consultation process

Consultation with various cross sections of the people is essential for better planning and implementation process of the project. People are to be meaningfully consulted at the initial stage of the project to obtain their knowledge and experience about the baseline information, potential impacts and probable mitigation measures. The proposed project Consultation and Participation (C&P) is a process through which stakeholders influence and share control over development initiatives, and the decisions and resources that affect or benefited them. It is a two way process wherein the project owner, policy makers, beneficiaries and affected persons listen to each other and discuss their views and concerns in the project planning and implementation process. Consultation & participation increase the level of support of the stakeholders to the project activities which can speed up processing and reduce challenges during implementation. Meaningful consultation hence improves the effectiveness, relevance, and sustainability of development activities in the long run. The consultation process in this project is guided by the World Bank's safeguard policies OP 4.01 and OP 4.12. The policies give high priority to public consultation and participation and encourage incorporation of community's views in design and implementation of a socially and environmentally compliant project. These policies stress on ensuring that the affected persons and beneficiaries have not only been consulted but that their opinion are acknowledged and accounted for in project designs. The Government of Bangladesh (GOB) also has some acts and policies in line with this requiring consultation with project affected people.

Two national level stakeholders workshops were held in Dhaka. The first one, at the scoping stage of the study, was at CIRDAP auditorium, Dhaka on 14 October 2015 to disseminate project information and seeking opinion/views of the people from various cross sections including Executing Agency (BIWTA), World Bank, other line agencies, private sectors, launch owners, elite groups, etc. The second one, on the full draft safeguards package, was held on March 30 at BRAC Centre, Mohakali, Dhaka, and like the first national stakeholders workshop it was also attended by people from various sectors including Executing Agency (BIWTA), World Bank, other line agencies, private sectors, launch owners, elite groups, etc.Regional level stakeholders workshop was held at Ashuganj (Brahman Baria) at R J Tower & Resort on 17 November and Lahar hat (Barisal) on 18 November with local sand traders, Upazila Administration, Local Government Institutions, ferry ghat/terminal lease holders, water vessels owners and workers, etc. Apart from these a series of consultation meetings and focused group discussions were held at different locations along the project routes and launch/ferry terminals, proposed dredging locations, and storm vessels shelters. Separate discussions were held with physically challenged/disabled people and women, small businessmen at ferry ghats, etc. about their views on existing facilities in the terminals and vessels and scope of improvement of these facilities. A total of 32 consultation meetings and 29 focused group meetings were held until up to April, 2016 along the project routes and designated sites.

Date and venue of the meetings were disclosed to the community through publishing in the daily newspapers (Bengali and English version), public announcements such as miking, announcement in the mosque, etc. prior to consultation meetings and group discussions. Personal contact with the stakeholders in this regard has been effective. Local government institutions were also used to disseminate information among the people about the consultation meetings and group discussion.

12.2 Stakeholder Identification

A stakeholder is a person, group or institution that has an interest in an activity, plan or program. It can be affected by the organization's actions, objectives and policies. Not all stakeholders are one and the same in every case. It also includes intended beneficiaries and intermediaries, winners and losers, and those involved or excluded from decision-making processes. Categorization of the keystakeholders of the Project mentioned in Table 12.1

Table 12.1: Categorization of the key stakeholders of the Project;

Stake holders	Responsibility	Influence	Proximity	Dependency	Represen tation	Policy and Strategic Intent
Direct	Project beneficiaries, Affected population (Lease holders, Land owners), River Transport workers, Passengers, fishermen,	Government, Non government organizations	Fishermen, Farmers, tourists, and all river users	Fishermen, river users, Ghat Owners, Launch, Ferries and other Vessels	IWM, BITWA,	GOB, Donner
Indirect	local businessmen, local government representative and other line	Executive agency (EA),	Deputy Commissioners (DCs) and their supporting agencies, Local government	Local government, Consultants, NGOs.	Non governm ent organizat ions, media,	Implementin g Non-Government Organization (NGOs) and Independent

	agencies.				etc.	External Monitor.

12.3 Details of consultations

Disclosure, consultation and participation in the project processing are required to ensure that adequate and timely information is made available to the beneficiaries and affected people. It enables opportunities for the stakeholders to voice their opinions and concerns and participate in influencing decision making and project processes. The Bank operational policy requires meaningful consultation meetings to be carried out throughout the project cycle and timely disclosure of relevant and adequate information is processed. All relevant views of affected people and other stakeholders need to be considered in decision making, such as project design, impact assessment, mitigation measures, sharing of development benefits and opportunities, and implementation.

Therefore, the ESIA team organized Two national level workshops, two regional workshops, 32 consultation meetings and 29 FGDs which were held up to April, 2016 at different locations along the project routes with various levels of occupational groups irrespective of gender including businessmen, vulnerable and disabled people, etc.

The stakeholders' consultations meetings were held at or near launch/ferry terminals, proposed vessels shelter sites, potential location of dredging, etc. for information dissemination as well as to obtain stakeholder's perception and views; their expectation and concern about the project interventions, possible impacts and mitigation measures. Consultation meetings were held at national, regional and local level to address various levels of stakeholders and incorporate their opinion in project planning process.

First National workshop:
A first (scoping stage) National workshop was held on 14 October 2015 at CIRDAP International Conference Centre, Dhaka with a view to disseminate information relating to project routes & locations, magnitude of the project interventions, social and environmental baseline & probable impacts, etc. and to obtain opinion/suggestion from the various levels of stakeholders in project planning process. The participants at workshops were invited through, invitation letters, personal contacts, emails, etc. The workshop was chaired by honorable Minister, Ministry of Shipping (MoS), Mr. Shajahan Khan, MP as the chief guest. Secretary from the MoS Mr. Shafique Alam was also present at the workshop. Representatives from World Bank, BIWTA, BIWTC, Department of Environment (DOE), development organizations, NGOs, research organizations, private sector, media and community level stakeholders participated at the national workshop. They raised their concern about the project interventions, provided suggestions in terms of selection dredging locations, development of facilities in the launch/ferry terminals and water vessels, etc. which were duly addressed and recorded by the project authority. There were power point presentations from the consultants on technical, environmental and social issues and the participants took part in the open discussion.

Md. Saidur Rahman, Superintend Engineer, BIWTA, Dredging department said that Char Nurul Islam is a part of the project and the area is very much unpredictable, siltation rate is too high, water velocity is very high during tide, river bed always changes, so Char Nurul Islam can be taken into account during ESIA study. Md. Alfazuddin, Deputy Director (Survey), BIWTA emphasized on Bank protection and river control plan under the study. A K M Rafiqul Islam, Deputy Director, DOE said that identification of ecologically critical areas (ECA) within project routes/locations should be done. He added that wet land and water bodies should not be filled up by dredged materials and a disclosure of the ESIA at website for comments and suggestions would be effective. Shajadur Rahman, Superintend Engineer, BIWTA said that a good co relation needs to be assessed for river-bay/estuary in terms of aquatic life during dredging interventions. Dr. Shamal Chandra Das, Executive Engineer, BWDB wanted to know the criteria of selecting project influenced area even and in case of tributaries and distributaries. It was disclosed that for tributary and distributary, 1 km influenced area in either side of the river has been considered.

Figure 12.1: Participants of first national workshop

Regional workshop:

One regional workshop was held at Ashuganj on 17 November with participation of the Upazila administration; Upazila Chairman, Union Parishad Chairmen from riverside unions, BIWTA officials, representatives from Upazila level DAE, local elites, boatmen's association, sand business dealers and community members, workers of the water vessels as well as consultants from ESIA study team. A regional level consultation meeting was held at Laharhat, Barisal for the same purposes. People were informed about such regional level workshop and consultation meetings through notice published in the daily newspapers (One Bengali and one English), informing the local government representatives, personal contact, etc. prior to arrange workshop/consultation meetings. The key concern of the regional workshop and consultation meetings was to identify specific dredging locations, which has been incorporated in management of dredged material disposal, in a separate section of this assessment. Two sand stake yards have been identified adjacent to the river and sand business men have been communicated through FGD and the workshop. Peoples' opinion was sought in the workshop about the project interventions, potential benefits, use of dredged materials in development purposes, etc. Opinion and views of the people were noted and incorporated in the ESIA study report.

Figure 12.2: Regional Stakeholder workshop at Ashuganj

Figure 12.3: Regional Stakeholders consultation meeting, Laharhat Ferry Ghat, Barisal

A total of 233 people (219 male and 14 female) were present in three national and regional level workshop/consultation meetings. Apart from these, 813 people (766 male and 47 female) participated in the local level 25 consultation meetings. The 29 focused group discussions (FGDs) covers disabled people, women, sand traders, mobile vendors, shop owners, etc. at ferry ghats, launch terminals, etc. A total 296 people (211 male and 85 female) from various occupation groups were consulted in the FGDs.

Table 12.2: Number of participants in National and regional level workshop/consultation meetings

Workshops/ Consultation meetings	Venue	Date	Participants	
			Male	Female
National Workshop	CIRDAP International Conference Center, Dhaka	14 October 2015	122	05
Regional Workshop (Ashuganj)	R.J Tower Hotel & Resort, Ashuganj, Brahmanbaria	17 November 2015	67	09
Regional Consultation (Barisal)	Laharhat Ferry Terminal, Barisal	18 November 2015	30	00
		Total (233)	219	14

<u>Local level consultation meetings along the project routes:</u>

The participants of the meetings were informed through personal contact, miking in the mosque, local government representatives, etc. about the venue and time of the meetings. In the meetings people were welcomed to raise their voices on issues relating to necessity of dredging, management of dredged materials, existing facilities in the terminals and water vessels, etc. All the meetings were held in participatory approach ensuring both way communications. Environmental and socio-economic aspects of the project and management of dredged material disposal including specific locations were discussed at the meetings. The meetings also concentrated over dredging requirement and dredge materials management. Female, disabled and vulnerable stakeholders were encouraged to participate at the meetings and their feedbacks are duly noted and presented in the next section of this chapter. A total of 32 stakeholder consultation meetings were conducted particularly on social issues during study.

Figure 12.4: Meeting at Gopinathpur, of Sreenagar Union Raipura Upazila of Narsingdi

Figure 12.5:Meeting with UP Chairman and others at Sreenagar Union of Raipura Upazila, Narsingdi

Figure 12.6: Meeting at Karimpur, Narsingdi Sadar

Figure 12.7: Meeting at Narsingdi Jute Mill area

Figure 12.8: Meeting at Ashuganj Ferry Terminals

Figure 12.9: Meeting at Batakandi Bazar, Comilla

Figure 12.10: Meeting at Munshiganj Launch Ghat

Figure 12.11: Meeting at Jinjira Battala, Dhaka

Figure 12.12: Meeting ar Harina Ferry Ghat

Figure 12.13: Meeting at Moju Chowdhury Ghat, Laksmipur

Figure 12.14: Meeting at Baro Station Tek, Mul head, Chandpur

Figure 12.15: Meeting at Bhairab Bazaar Launch ghat

The Table 12.3 represents the consultation venues, date and times and the numbers of male and female (total 877) participants at the meetings..

Table 12.3: Consultation schedule and participants attended in local level consultation meetings

S.N.	Venue	Date & Time	Numbers of male Participants	Numbers of Female Participants
1.	Location: Sadar Ghat , Ward No – 37, Thana : Kotwali, District: Dhaka.	17.09.2015 10 AM	31	3
2.	Location: Aganagar Ward No - 05, Thana: Keraniganj, District: Dhaka.	17.09.2015 12 PM	48	3
3.	Location: Jinjira Bottola Union: Jinjira, Thana : Keraniganj, District: Dhaka.	17.09.2015 2 PM	21	3
4.	Location: Munshiganj Launch Ghat Ward No – 03 Thana: Munshiganj Sadar, District: Munshiganj.	18.09.2015 10 AM	58	6
5.	Location: Munshiganj Ferry Ghat , Thana : Munshiganj Sadar, District: Munshiganj.	18.09.2015 12.00 PM	42	3
6.	Location: Narin Pur Ward No - 04, Thana: Titas, District: Comilla.	18.09.2015 3 .00 PM	19	4
7.	Location: Batakandi Bazaar Ward No - 03, Thana : Titas, District: Comilla.	18.09.2015 5.00 PM	60	3
8.	Location: Bhairab Bazaar Launch	20.09.2015	39	0

S.N.	Venue	Date & Time	Numbers of male Participants	Numbers of Female Participants
	Ghat Ward No - 01, Thana: Bhairab, District: Kishorganj.	10. 00 AM		
9.	Location: Ashuganj Ferry Ghat Ward No - 03, Ashuganj, District: Brahmanbaria.	20.09.15 12 .00 PM	38	1
10.	Location: Shatnol Launch Ghat Ward No- 05, Thana : Matlab Uttar, District: Chandpur.	01.10.2015 12.30 PM	19	2
11.	Location: Harina Ferry Ghat, Ward No- 13, Thana: Chandpur, District: Chandpur.	01.10.2015 4 .00 PM	23	0
12	Location: Harina Ferry Ghat (Fisherman), Ward No- 13, Thana: Chandpur, District: Chandpur.	01.10.2015 5.00PM	47	4
13.	Location: Boro Station Mul Head, Ward No- 07, Thana: Chandpur, District: Chandpur.	02.10.2015 11.00AM	15	2
14.	Location: Boro Station (Camp Office), Ward No- 07, Thana : Chandpur, District: Chandpur.	02.10.2015 12.30 PM	15	2
15.	Location: Char Bhairabi, Ward No – 06, Thana: Haimchar, District: Chandpur.	02.10.2015 6 .00 PM	39	2
16.	Location: Moju Chawdhury Ghat, Ward No- 20, Union: Chor Romoni, Thana : Lakshmipur.	03.10.2015 12.30 PM	20	1
17.	Location: Boyar Chor, Chairman Ghat (Fisherman), Union: Horini, Thana: Hatia, District: Noakhali.	04.10.2015 10.30 AM	17	3
18.	Location: Chairman Ghat, 1 No Horini, Thana : Hatia, District: Noakhali.	04.10.2015 12.30 PM	29	2
19.	Location: Tojumuddin Launch Ghat, Ward No-05, Thana: Tojumuddin, District: Bhola.	04.10.2015 1 .00 PM	15	4
20.	Location: Kaliganj Launch Ghat, Ward No-04 Ulania, Thana: Mehendiganj, District: Barisal.	06.10.2015 12.00 PM	9	0
21.	Location: Sreenagar Upazila:	19.11.2015	26	0

S.N.	Venue	Date & Time	Numbers of male Participants	Numbers of Female Participants
	Raipura District: Narsingdi	12.00 PM		
22.	Location: Bagoir, Union: Sreenagar Upazila: Raipura District: Narsingdi	19.11.2015 02.00 PM	21	2
23.	Location: Karimpur, Upazila Narsingdi Sadar, District: Narsingdi	19.11.2015 04.00 PM	24	0
24.	Location: Gopinathpur, Upazila Raipura, District: Narsingdi	19.11.2015 03.30 PM	33	0
25	Location: Narsingdi Jute Mill gate Narsingdi	20.11.2015 10.00 AM	10	0
26	Location Uttar Mogdhara Launch Ghat, Sandwip, Chittagong	26.12.2015 10.30 AM	22	0
27	Location: Kalapania Ghat, Sandwip, Chittagong	26.12.2015 2.30 PM	11	0
28	Location : Tomurudding Launch Ghat, Hatiya, Noakhali	28.12.2015 10.30 AM	21	0
29	Location : Tomurudding Launch Ghat Bazaar, Hatiya, Noakhali	28.12.2015 12.30 PM	18	0
30	Location; Nolchira Steamer Ghat, Hatiya, Noakhali	28.12.2015 3.00 PM	21	0
31	Monpura Launch Ghat, Bhola	29.12.2015 11.30 AM	19	0
		Total	830	47
		Grand Total	**877**	

Second national workshop, March 30 2016:

A public consultation event was held on March 30th, 2016 at the BRAC Centre in Dhaka on the Environmental and Social Assessment studies for the Proposed Bangladesh Regional Waterway Transport Project. The purpose of the event was: (a) To share findings and recommendations of EMP, EMF & RPF with the stakeholders, (b) to share and seek feedback on the proposed mitigation measures, (c) to involve the stakeholders in the project planning process, as per the Government of Bangladesh and World Bank requirements and standards. Bangladesh Inland Water Transport Authority (BIWTA) and Institute of Water Modeling (IWM), consultant for the Environmental and Social Assessment study, publicized the event through popular daily newspapers and through sending invitations to the attendees by means of invitation cards, emails and phone calls during March 23-28, 2016.

The event was attended by senior government officials of the Shipping Ministry and representatives from relevant government departments including BIWTA, BIWTC, DoE, WARPO, BWDB, Development Partners, NGOs, Research Organizations, Private Sector, Print Media and Electronic Media. Zikrur Reza Khanam, Additional Secretary, Ministry of Shipping addressed the workshop as the chief guest while BIWTA Chairman Commodore M Mozammel Haque presided over the workshop. There were power point presentations from the consultants on technical, environmental and social issues and the participants took part in the open discussion.

Figure 12.16: Participants of second national workshop

Consultation meetings held along the branch of Upper Meghna River (Route-9):

World Bank, BIWTA and IWM officials visited the proposed identified sites for dredge disposal. The Objective of the field visit was to assess the selection process of proposed sites for disposal of dredged material. More specifically to assess availability of land and community's consent at three selected sites (1. Doribela Nagar (UP: Saifulla Kandi), 2. Selimabad (UP: Selimabad) and 3. Nala Dakkhin (UP: Nala Dakkhin) in Bancharampur and Homna Upazilla) located along 6 km stretch of Upper Meghna River (Branch) where the river is too narrow for disposal within the river bed.

During monsoon, the banks of Titas (Branch of Upper Meghna River) swell up to 1 kilometer at all 3 locations. The private land identified at propsed location are close to the river banks, no more than 500 meters for location 1 & 2, and up to 1 kilometer at location 3. The project carried out rapid assessment and held consultations with the local communities, including the land owners in early March'16. The team interacted with identified land owners at location 1 and 3. The meeting with the owner at location 2 (Selimabad) could not be organised. At all the 3 locations, the proposed dredging activities seem to have a broad community support. Interaction with people, located in the nearby market areas at location 2, indicates that they seemed to be aware of the project activites and extended their support.

At locations 1 and 3, the owners expressed their willingness to give their land for disposal provided they are permitted to use the dredged materials for land filling. They indicated that they would settle with a simple agreement along these lines with BIWTA and did not require financial compensation. This approach seems feasible as the entire Bancharampur and Homna upazilla is a low-laying area. Availability of land at high elevation suitable for habitat or commercial establishment is limited. Opportunity to use the dredged material free of cost will enhance the utilization of the land. However, both these locations are inaccessible from road. There may be a need to identify other locations. The current sites are small in size - 40 decimals to 70 decimals at the maximum (the largest is the one at Nala Dakkhin, about 70 decimals). These are sufficient only, at best, for 2 consecutive years for disposal of the dredge materials. Thus, in the subsequent years, other sites have to be found. There are existing private dredge disposal sites run by sand traders on the river banks and many of the operators are likely to accept the proposed modality for taking the material. It is also important to consider that the dredging sites in the river might move to other locations during the project's duration and disposal sites will need to be identified close to the dredging sites.

Another point observed was of that water in Titas (Branch of Upper Meghna River) was found much less polluted and soil sediments in the river bed seem to contain high concentration of organic materials. IWM took soil sample from the river bed in Local 3 (Nala Dakkhin) for laboratory tests and the test results are given in the Annex C.

	
Figure 12.17: View of the Location 1 (Saifullahkandi)	Figure 12.18: Proposed dredging site at Location 2 (Selimabad): right in the middle of agricultural paddy field
	
Figure 12.19: Filling up of low laying areas with dredge matriels by private operators at Location 2 (Selimabad)	Figure 12.20: Low laying area at Selimabad (potential dredge materials disposal site)
	
Figure 12.21: Proposed site at Location 3 (Nala Dakkhin). The road runs along the site	Figure 12.22: Group discussion in the nearby market (The bearded person with a stick is the land owner) at Location 3 (Nala Dakkhin)

12.4 Feedback on consultations

During consultation meetings people were requested to give their opinion/views about the project interventions particularly requirements of dredging and management of dredged materials, existing facilities in the terminals and water vessels for the people especially old aged, women and physically challenged/vulnerable groups. Consultation meetings were conducted in a participatory approach and people expressed their views in the meetings. The concern of the consultation participants were mainly focused on improvement and extension of terminals, safety & security of passengers, impact on livelihood, dredging and environmental issues including management of dredged materials. Location-specific People are now known about project interventions and potential impacts and mitigation measures including dredged material management, probable facilities to be provided for the passengers and others ghat users. Feedback from each of the consultation meetings are presented in Table 12.4

Table 12.4: Outcomes of the local level consultation meetings

SL. No.	Venues of Meeting	Outcomes of Consultation meetings
1.	Sadar Ghat, Dhaka	Around 30,000 businessmen depend on this ghat. Approach road is narrow. Water is very polluted at this point. Toilets facilities in the terminals and water vessels are not good enough for the female. But there is wheel chairs and patient bed to carry the disabled passengers into the launch. During Eid ceremony one Doctor sits in the terminal to provide emergency medical services to the passengers, if required.
2.	Aganagar Ghat, Dhaka	There is no launch terminal, water is polluted and around 1,000 businessmen depend on this ghat. Dredging is necessary on urgent basis. Development of this ghat can increase business opportunities.
3.	Jinjira Bottola, Dhaka	Depth of the river is not enough and water is polluted extremely. Lots of businessmen do their business through the river. Lots of products are supplied from this area all over the Bangladesh. A large numbers of boatman carry people from Jinjira to Sadarghat and Gudaraghat of Dhaka city. Dredging is required and development of Ghat is essential to promote business opportunities here.
4.	Munshiganj Launch Ghat	There are about 300 boats and 200-250 boatmen are associated with this ghat. Most of the people are involved in business and day laboring. Approximately 1,000 business institutions/shops have been found in and around the launch Ghat. About 20,000 people live along the riverside. Char has been arisen in the Shitalakhya and Dhaleshwari river estuary. Dredging is needed to maintain navigation of the river. The waste material of dredging need to move away from the ghat so that they cannot come again to the river. The dredging should be done during the winter season.
5.	Munshiganj Ferry Ghat	There are not so many activities seen in this ferry ghat. Around 100 businessmen depend on this ghat. Water is polluted due to the cement factories. Polluted industrial waste directly goes to river. Dredging is

		required and take the dressed materials away from the ghat as it is mostly contaminated.
6.	Naranpur, Comilla	People have welcomed the project. If the ghats are maintained properly, more people will be travelling through the river routes. Toilet facilities and safety/security are necessary to improve for the river users/ passengers.
7.	Batakandi Bazar	There are no ghats in this area. People desired one Ghat in this area so that businessmen and local people will be benefitted. There are lots of seasonal crops in this area and it is really expensive to transport through the road. River erosion is also a major problem in this area. Dredged material may be used for improvement of river bank.
8.	Bhairab Bazaar Launch Ghat	. During the winter time, it is hard to transport goods to Chittagong and Dhaka. Dredging of the river route of Shurma, Doulatkhan and Chatak is urgent. Development of ghat is urgent as well. There is no signaling system here but it is very important to establish a signalling system.
9.	Ashuganj Ferry Ghat	Near about 1,500-2,000 laborers depend on this ghat for their livelihood. They have a good communication with India through this ghat to carry their goods. The ghat is well known for the transportation of different goods and products, Many mills & factories have been built around the Ghat, as a result all the chemical impurities of the factories directly go to the river. It is basically the cargo port. Dredging is necessary and Businessmen want to buy dredged materials. It is also discussed in the regional workshop here that the dredged materials may be used to develop a 6 km connecting road from Ashuganj to Nabinagar. There were also options to improve river bank and deposit dredged materials in a suitable location so that people can take it for raising play ground, yards of community properties, etc.
10.	Shatnall Vessel shelter	Constructing the vessel shelter will change the livelihood of the people living in the adjacent villages/ communities if it is used all the year round. People welcomed this project. Present launch ghat is really small and there is no jetty and passengers waiting room. River erosion in this area is also a major problem.
11.	Harina Ferry Ghat (Common people including passengers)	There are about 8,000-10,000 people living on this river embankment. Ferry moves to Harina and Alur bazaar from this ghat. A lot of raw materials are transported regularly through this ghat. Dredging is urgently necessary here. Due to massive river erosion, ghat has been changed 7 to 8 times. There is no jetty also. Project should a plan to develop the ferry terminals and necessary facilities in this ghat for the passengers.
12.	Harina Ferry Ghat (with businessmen & Fishermen)	Around 700 people are depending on fishing in this area. If the river transport and security are improved, their livelihood will be changed in positive way. Ghats and connecting routes are needed to develop. Dredging is also required. Dredged materials may be used for rural road development and dyke improvement.
13.	Chandpur	This is one of the most important ghats in Bangladesh. People can move

	launch Ghat	to Dhaka, Barisal or Chittagong from Chandpur by water transport. Everyday about 120-150 launches move through this ghat. There are approximately 1,000-1,200 business units/shops around this ghat. Every day about 20,000-25,000 people passes through this ghat. The depth of river is well enough. Facilities for women and disabled people in the launch ghat and water vessels needed to be improved.
14.	Boro Station Mul Head , Dakatiya	If the vessels shelter is constructed here, business activities and tourism will be increased. Regular maintenance of the vessels shelter is important. It can also be used as terminal all the year round.
15.	Sreenagar, Raipura, Narsingdi	The participants welcomed the project and stated that dredging is an urgent requirement in the area. There are some sand businessmen in the area, who will be involved during dredge material disposal during implementation of the project according to project requirement.
16.	Char Bhairabi	There is no government land at the river bank to deposit the dredged materials. There is no passenger shade and electricity supply in this area. A vessel shelter at the opposite side of the ghat will lead to change the livelihood of the community people.
17.	Moju Chowdhury Ghat	There are about 500-700 permanent shops and 300 temporary shops depends on this ghat. Hilsha fish is available here. Development of this ghat is really important. Dredging is necessary and businessmen love to buy the dredged materials.
18.	Boyar Char, Chairman Ghat (Fisherman Community)	There are 1,500 fishermen live here and they are dependent on the river. A lot of fishes are supplies from here to the entire Bangladesh by water ways. River sand quality is much better in this region. The land is cultivated as double crops in this area. Such as paddy, wheat, maize, sugarcane, vegetables etc. River transport cannot move without high tide so, dredging is essential.
19.	Chairman Ghat (Owner Association)	Approximately 15,000-20,000 fishermen live in this area. There are about 600 business units around this place. About 2,000-2,500 homestead surrounding the Ghat. There is abundance of Hilsha fish. Now this Ghat is remained as unused for 20 hours. Dredging is necessary to maintain navigation. Improvement of the ghat is also necessary.
20.	Bagoir, Sreenagar union, Raipura upozila, Narsingdi	The locals welcomed the project as dredging is an urgent requirement in the area. There are wet lands (20-30 acres) and fellow lands under private ownership. The owners will happily comply if the project wants to use sand filling from dredged material to increase heights of their low lands.
21.	Tajumuddin launch Ghat	Everyday 400-500 people use this route. Most of the passengers go to the Dhaka and Chittagong. The people move from here to Char Jahir Uddin, Char Mozammel, Kolatoli, Monpura and other s ghats in the region.People even come from 15 km away to use this Ghat. In this area there are no other means of communications without water ways. Dredging is essential nearer to this ghat to maintain navigability of the river. River erosion threat is a common issue here. Navigability of the

		river is too low.
22.	Karimpur, Narsingdi Sadar, Narsingdi	The respondents of this consultation meeting welcomed the project as dredging is a unique requirement for river navigation in the area. But there are no large stake yards to be designated for drdged materials in the area. Most of the free space are private property with the size of 10-20 decimals.
23.	Gopinathpur, Raipura, Narsingdi	They stated that there are free land areas in Sreenagar mouja, but the land belongs to private owners. The owners will cooperate for their own benefit.
24.	Kaliganj Launch Ghat Vessel Shelter	All of the ships from Chittagong to Dhaka and Barisal use this route. There is no jetty in the ghat which is really essential. Dredging is urgently required in the 3 km area up to Gobindopur Char. The present condition of Ghat should be improved as early as possible. If the Ghat is improved, there must be a chance of increasing business sector. A vessel shelter can be made in the "Village Asha" adjacent to the launch Ghat of Ulania bazaar.
25	Laharhat launch terminal	The participants at the Laharhat consultation meeting were concern about facilities in their terminal and signalling system. The local religious leader, river transport workers, BIWTA staff, representatives from gypsy community and local shop owners participated at the meeting. They urgently demanded piling and approach road to the terminal. About 10,000 passengers use this terminal every day, which increases up to 50,000 during Eid and other festive seasons. But there is no signalling system; the locals urgently requested for installation of signalling system at this busy terminal. The locals also pointed out erosion problem and requested to ensure river bank protection schemes to the area from the project.
26	Location Uttar Mogdhara Launch Ghat, Sandwip, Chittagong	The participants of the Uttar Mogdhara Launch Ghat expressed happiness with the project interventions and they welcomed the project. The local passengers, BIWTA staff, river transport workers participated at the meeting. It is very important ghat for the transportation system of this area .But there is only two steamer/trawler(Small engine based water transport) service in a day which is really insufficient. Because of that people depend on speed boat service which is expensive and unaffordable to the local people but they are bound to use speed boat service. This is a busy ghat but there are no any facilities for the passengers. There is a passenger waiting room but that is far away from the ghat. There is no navigation problem around the ghat. People want more water transports for their easier communication facilities. A lot of people are depending on this ghat for their daily earnings. People suffer more during the festival period due to minimum transport facilities. This is an important ghat to maintain the communication especially with the Chittagong city. River erosion is another problem of this ghat. Thousands of people use this ghat everyday.

27	Location: Kalapania Ghat, Sandwip, Chittagong	The respondents of this consultation meeting welcomed the project as dredging is a unique requirement for river navigation in the area. Ghat owner, passengers, ghat workers and local businessmen participated in this consultation meeting. In this ghat river erosion is common problem. In every year river erosion occurs here. It is remarkable that there is neither any structure of ghat nor any passengers' facilities at all. Water transport is depending on the high and low tide, otherwise transport cannot run through the river during low tide. Only two or three water transport including a speed boat are providing the transportation service one in a day during the period of high tie.. There is no launch service. Small engine trawler and speed boat is only water transport. By this ghat people can movde to Chittagong and Char Laxmi(Noakhali). People demand the protection of the riverbank, dredging, ghat facilities and more water transportation facilities. According to their opinion it makes their life easier. Flood is common during the rainy season in every year.
28	Location : Tomuruddin Launch Ghat, Hatiya, Noakhali	People warmly receive the project information and welcome the project urgently. Tomurudin Launch ghat is an important ghat for the Hatiya especially for the economic activities. But this ghat is not fulfilling all required facilities. There is a ghat but they cannot use that ghat because of the navigation problem of river. There is a 'under water char" in front of the ghat, so heavier water transport cannot move to the ghat. There is a small good looking ghat structure but jetty is not useable. Dredging is urgently required in front of the ghat. There also a passenger witting room with the sanitation facilities but it is not close enough to the ghat. In every year accident occurred in river because of natural causes. So, they demand there to construct a vessel shelter. Only one launch move from here every day. Without this launch service there is other transportation service. People almost move to fight to use this only launch service everyday. In the period of festival people use this service dangerously. It is remarkable that People of Hatya, Monpura, Tojumuddin, Doulatkhan and many other chars/islands depend on this launch service being operated from Tomurudding Launch Ghat. So, people demand more water transport service, ghat facilities and vessel shelter at Hatiya.
29	Location : Tomuruddin Launch Ghat Bazaar, Hatiya, Noakhali	Tomuruddin launch ghat bazar was established on the based on tomuruddin launch ghat. Local businessmen, traders, facilitated people and ghat workers were participated at the consultation meeting. They demand to increase the ghat facilities. According to their opinions, the economy of Hatya is largely depending on this ghat. Thousands of people are depend on this ghat for their daily earning. So, the development of this ghat can make a vital role to run the economic development of hatiya.

30	Location; Nolchira Steamer Ghat, Hatiya, Noakhali	There is no any structure at ghat area for facilitating passengers. Water vessels to carry people or goods are very insufficient. Only one engine boat is available here. Using this ghat for goods and passengers transportation. People demand civic facilities at the Ghat including passenger waiting room, jetty, etc. About 2000-3000 people use this ghat everyday. There is river erosion tendency in the ghat in every year. Navigation is quite okay and therefore dredging is not required. About 30 small shops are being operated here. Almost thousands of people depend on this ghat for their livelihood.
31	Monpura Launch Ghat, Bhola	Local people, businessman, ghat workers have participated at meeting. This ghat is important for the economy of Monpura. There is no structure at ghat area for facilitating passengers. River erosion severely occurs here in every year. People demand the riverbank protection for stabilizing the river bank. This is only one ghat that is being used for the launch services. Other than launch service there is no any water transport facilities therefore people demand more water transport facilities for this ghat. About 2000-3000 people use this ghat everyday. About 40 small shops are located here where at least 40-50 families are getting livelihood support.

Focused Group Discussions (FGDs)

A total of 29 focused group discussion (FGD) meetings were conducted throughout the project routes and selected locations with passengers and various occupational groups. The groups were selected based on project impacts with special emphasis on vulnerability, disability and obstructions relevant to using water transportations and female groups and other worker groups. Among the meetings, 7 were conducted only with female respondents, 19 were conducted with male occupational groups and there were presence of both male and female respondents in 3 meetings. Among the total 29 meetings, four meetings were held with disabled people (male and female) in the launch terminals.

Figure 12.23: FGD with physically disabled people at Laharhat

Figure 12.24: FGD with physically disabled people at Ashuganj;

Figure 12.25: FGD with disabled people ate Sadarghat, Dhaka

Figure 12.26: FGD with sand businessmen, Boulpara, Narsingdi

Figure 12.27: FGD with Gipsy community at Laharhat, Barisal

Figure 12.28: FGD with female group at Ashuganj

Focused group meetings were held with various occupational groups including female groups, disabled people, gipsy, shop owners, mobile vendors, students, etc. Some physically disabled people were identified near the terminals, who mostly use the water transport to go here and there. Some of them are beggars by occupation but stay in and around the terminals. Four FGD meetings have been conducted in various locations with physically challenged/disabled people. A total of 211 male and 85 female respondents participated in the 29 FGD meetings from which 40 disabled people (27 male and 13 female). Feedback from FGDs are incorporated in the next section of this chapter.

Table 12.5: FGD Venue Date and Participants:

Sl.	Venue/ Upozila/District	Date	Participant Group	Male	Female
1	Sadar Ghat, Kotwali, Dhaka	17.09.15	Boatmen	11	0
2	Aganagar, Keraniganj, Dhaka	17.09.15	Shopkeeper	08	0
3	Jinira Bottola, Keraniganj, Dhaka	17.09.15	Shopkeeper	12	00
4	Launch Ghat, Munshiganj	18.09.15	Passenger	0	9
5	Ferri Ghat, Munshiganj Sadar, Munshiganj	18.09.15	Shopkeeper	08	0
6	Narin Pur, Titas, Comilla	18.09.15	Housewives	0	6
7	Batakandi Bazar, Titas, Comilla	18.09.15	Shopkeeper	13	0
8	Launch Ghat, Bhairab, Kishorganj	20.09.15	Passenger	10	0
9	Ferry Ghat, Ashuganj, Brahmanbaria	20.09.15	Laborer	12	0
10	Satnol Launch Ghat, Matlab Uttar, Chandpur	1.10.15	Shopkeeper	10	0
11	Harina Ferry Ghat, chandpur, Chandpur	1.10.15	Fishermen	12	0
12	Harina Ferry Ghat, Chandpur, Chadpur	1.10.15	Shopkeeper	11	0
13	Boro Station Mul Head, Chandpur, Chandpur	2.10.15	Housewife	0	08
14	Boro Station, Chandpur, Chandpur	2.10.15	Vendor	09	0
15	Char bhairabi, Haimchar, Chandpur	2.10.15	Passenger	10	0
16	Moju Chawdhury Ghat, Char Romoni, Lakshmipur	3.10.15	Student	0	10

Sl.	Venue/ Upozila/District	Date	Participant Group	Male	Female
17	Boyar Char, Hatia, Noakhali	3.10.15	Fishermen	11	0
18	Charman Ghat, Hatia, Noakhali	4.10.15	Launch and Ferry Worker	9	0
19	Tojumuddin Launch Ghat, Tojumoddin,Bhola	4.10.15	Passenger	0	11
20	Kaliganj Launch Ghat,Mehendiganj,Barisal	6.10.15	Launch and Ferry Worker	12	0
21	Sadar Ghat , Ward No – 37, Kotwali, Dhaka	13.11.15	Physically Disabled	07	06
22	Ashuganj Cargo Terminal Ashuganj, Brahmanbaria	14.11.15	Boatmen Community	11	0
23	Ashuganj Rail Station, Ashuganj, Brahmanbaria	14.11.15	Physically Disable (Male)	8	0
24	Ashuganj Rail Station, Ashuganj, Brahmanbaria	14.11.15	Physically Disable (Female)	0	7
25	Sand Businessmen of Ashuganj Ashuganj, Brahmanbaria	15.11.15	Sand Businessmen	08	0
26	Ashuganj Cargo Terminal Ashuganj, Brahmanbaria	15.11.15	Physically Disabled (Passenger)	06	02
27	Sand Businessmen of Ashuganj Ashuganj, Brahmanbaria	15.11.15	Sand Businessmen	08	0
28	Laharhat Ferry Ghat, Bondar Thana, Barisal	18.11.15	Bede community (Gipsy)	0	19
29	Barisal Launch Ghat, Barisal Sadar, Barisal	18.11.15	Physically disabled	05	07
			Total	211	85
			Grand total	296	

FGD Feedback:

The FGDs concentrated on specific groups and they had specific expectations from the project. peoples from various cross sections have opined on their own ways about the project interventions, positive or negative impacts, existing facilities and their expectations form the project, etc. The sand traders at Ashuganj, Raipura and Narsingdi are welcoming the project as the project means more business to them. The locals also supported their opinions as these areas need dredging for river navigation. The shops and business owners at project sites are also looking forward to the project as it will increase passengers, which will be positive for their business. The female respondent groups complained about sanitation system at the launch terminals and ferries. They demanded better sanitation system, separate counter, waiting area and resting zones for female passengers maintaining privacy. The disabled persons mostly stated that they do not use river transport system as the entrance and exit from the vessels are not suitable to disabled passengers. In case of accidents, they are at life risk as there is no other way than swimming out of the rivers. Although some terminals have wheel chairs, they are mostly used to take sick passengers to the vessels. There is no sanitation facility specially designed for disabled people even for long distance traveling in the vessels or terminals.

Table 12.6: Detail of FGD activities

SL.	**Group**	**Number of Group**	**Number of participants**			**Opinion Of Participants in Focus Group Discussion**
			Male	***Female***	***Total***	
1	Shopkeeper	06	62	0	62	Shopkeepers opined in favor of the project but they want to see the launch ghat improved with more facilities such as toilets, sufficient space for shops on a designated area so that they will be bound to shift their structure frequently. They expressed that the project will increase their business opportunities and new venture of business will be open after completion of the project.
2	Launch Passenger	05	37	11	48	There is no sufficient facility for the passengers particularly female, old aged disabled peoples in the terminals and water vessels. They face many difficulties when they cross the river on boat or travel by launch. They want proper safety and security in terminals and water vessels. It is mentionable that the present scenario is very

SL.	Group	Number of Group	Number of participants			Opinion Of Participants in Focus Group Discussion
			Male	*Female*	*Total*	
						pitiable and not sufficient to use mass people.
3	Physically Disabled	04	27	13	40	There is no special facility for the disabled people in the launch terminals and water vessels. But they want separate place in ghat and launch terminals for their easy movement. Wheel chair and bed facilities are available only for patients and for emergency situation. There are no doctors permanently on duty. Disabled persons want proper safety and security in terminal and launch as well. Disable persons do not know the facilities about river transports. Most of the people think that road transport is easier than river transport especially for the disables persons as they cannot swim. They want separate space/seat for them in the launch/ferry and easy riding facility such as smooth way, wheel chairs, etc. If such facilities are provided for the disable people then they may comfortably use the river transport.
4	Fishermen	02	23	0	23	Fishermen communities are mostly living along the river or within one km from the river. They want modern signalling system and safety and security during fishing. Some time they are to face trouble from pirates or even some political persons/Mastans who made them bound to pay money for fishing. They welcomed the project but requested to keep in mind about fish moving routes, season and fishing areas during dredging so that their livelihoods will not be disturbed.
5	Launch and Ferry worker	02	21	0	21	Launch and ferry workers expressed their views in favour of the project. They are concern about dredging and signalling system in the river routes as there are some incidents of collision among the water vessels. Improved signalling system may decrease

SL.	Group	Number of Group	Number of participants			Opinion Of Participants in Focus Group Discussion
			Male	*Female*	*Total*	
						accidents. They want sufficient personal protective equipment (PPE) for their safety in the launch and other water vessels. PPE can also be available for the passengers.
6	Housewives	02	0	14	14	Females particularly housewives of the project routes move here and there by launch along with husband or even only with children for their needs. Safety and security, separate space for them in the launch terminals and vessels, separate ticket counter, etc. are their needs.
7	Mobile Vendors	01	09	0	09	Usually mobile vendors deal in the ferry/ launch ghats as well as in water vessels. They always move from one ghat to another and sell their goods. They need safety and security in the ghats as well as in the transport. Sometime they face trouble by the policemen and guard of the ghats and vessels.
8	Day Labor/ Cooli	01	12	0	12	Day laborers of the ghat and water vessels carry luggage and goods of the passengers. They are not paid by launch owners or terminal lease holders, But they have some time association for their own interest. They want safety and security in the ghats and launch/ferry.
9	Boatmen Community	02	22	0	22	Boatmen are engaged to carry goods and passengers from distant places to the launch terminals and vessels. They have welcomed the project and suggested for dredging in some particular locations. They need a specific location to anchor their boats in the adjacent area of the launch ghats.
10	Student	01	0	10	10	Students are usually going to school/college by the launch in some areas along the routes. They want safety and security particularly for the female students in the terminals and vessels. They also demanded development of

SL.	Group	Number of Group	Number of participants			Opinion Of Participants in Focus Group Discussion
			Male	*Female*	*Total*	
						the ghats and improvement of health and hygiene facilities in the terminals and water transports.
11	Sand Businessmen	02	16	0	16	Sand business is very popular all along the project routes. As per dredging requirements a huge quantity of dredged materials will be available at Narsingdi area. The sand businessmen of this area expressed their positive views to buy sand through the proper authority. They have suggested deposit dredged materials in a suitable location so that it will not go back to river and people can use it for community purposes
12	Gipsy (Bede) Community	01	0	19	19	There are two Gipsy (Bede) communities all along the project routes from which one group at Laharhat was consulted in FGD to know their views about the project. Although they will not be directly impacted by the project but they have expressed their positive views about the project. They wanted better facilities in the launch terminals and water vessels in terms of health and hygiene and safety & security.

12.5 Information disclosure, stakeholder engagement and Consultation

This chapter incorporates details of information disclosure to the public consultation sessions held with different stakeholder groups through print and electronic media, official documents and websites. The focus group discussions were with stakeholders who were likely to be affected by the implementation of the proposed project whereas the organized stakeholder consultations included other stakeholders representing the government institutions, NGOs, professionals and water sector organizations.

12.5.1 General

The purpose of public consultation meetings was to invite comments and detailed suggestions on any environmental and social issues considered relevant by the people living in the area of the Project corridor. The public consultation programme is an essential part of the environmental and social assessment process and has been undertaken both formally and informally throughout the study to ensure that the knowledge, experience and views of stakeholders and the general public are taken into account during the EIA activity. The information shared and recorded has, where relevant, been applied to justify planning, dredging, alignment, and timing changes, in order to reduce predicted negative effects. This approach satisfies statutory consultation requirements of DOE.

During the consultations, communities' suggestions and concerns have also been noted apart from opinions on the proposed venture and the key associated activities. The key objectives of the consultations carried out for the Dhaka Chittagong Inland Water Transport Corridor Project include the following:

i. Build up awareness among the local people and community members about the project, its nature and implementation process.
ii. Facilitate the stakeholder to identify the problems and prospects of the project and conflict of interest among the groups.
iii. Learn about the present socio-economic conditions of the study area
iv. Learn about people's participation on the impact of proposed interventions.
v. Obtain people's suggestions on the enhancement measures of the positive impact; and
vi. Identify solutions to the apparent problems related to the project and ideas on mitigating the negative impacts.

12.5.2 Consultation Methodology

A total of 32 public consultations and 29 Focus Group Discussions were conducted at 60 different locations which were within the project influence area along the proposed river routes. Using a simple questionnaire format, benefits and disadvantages of the project, various environmental and social issues as impact, mitigation measures during the dredging period, were discussed. The main focus was to dig out information on how does dredging and maintenance of work of the project can impact the surrounding environment and to get people's perception about this project. The participant's opinions and comments were spontaneous and the facilitators had the full cooperation of participants.

Information Provided

Part of the consultation process involved disseminating factual information regarding the Project, with the aim of developing positive and constructive relationships with stakeholders and decreasing the likelihood of incorrect perceptions.

Information Recording and Responsibility

The Consultant assigned a dedicated secretary for each consultation, whose responsibility was to record participant comments and submit a report. The Consultant provided answers of most of the queries and concern arose by the participants and specifies actions to be taken. Each consultation had minutes recorded and attendance taken with signatures.

Stakeholder Consulted

Stakeholders include all those who affect and are being affected by policies, decisions or actions within a particular system. Stakeholders can be groups of people, organizations, institutions and sometimes even individuals. In case of the proposed Project, the stakeholders include the people living within the Project area particularly those who reside within and in the immediate vicinity the project area. The stakeholders identified and consulted during the present EIA include communities to be benefitted and/or affected by the Project, local leaders, community members and other local representatives.

Figure 12.29: Community Consultation Meetings at different locations along the project influence area

12.5.3 Summary of Comments by Participants

The summary of the issues raised and suggestions forwarded by the stakeholders during the consultations have been summarized in Table 12.7 below. Also given in the table is the proposed action to address the concerns raised.

Table 12.7: The issues and suggestions forwarded during Community Consultations (FGDs)

Environmental and Social Aspects	Description of Views and Concerns	Action Plans
Overall	River bank erosion, water logging, flooding and salinity intrusion are the main community concerns in the project influence area.	Mitigation measure should be taken up at the earliest with the active involvement of the local community.
Erosion	Dredging is very problematic as it will induce more river bank erosion to extreme extent. On varying scale river erosion destroys homestead and cultivable land	River bank protection is included in the report
Flooding	Frequency increasing, more areas inundated for a long period	The proposed interventions will address these issues
Water logging	water logging takes place due to lack of proper drainage system and sometimes embankment obstructs flow of water, cultivation is hampered	Site selection for disposal of dredge materials in consultation with inhabitants. Dredge materials disposal will avoid existing drainage system.
Surface water pollution	The surface water is polluted at some locations due to effluent release from the nearby industries, dumping of municipal and domestic wastes in the river.	EMP will include measures to minimize such impacts. Monitoring will also be carried out.
Air and noise pollution	Local communities could be adversely affected by such pollution.	EMP will include measures to minimize such impacts. Monitoring will also be carried out.
Fish availability	Dredging activity will affect fish migration and reduce its cultivation	Dredging operation will be conducted in such manner so that turbidity and sediment concentration do not exceed standard limit. Dredge material disposal will avoid important fish habitat, spawning ground and the operation will be restricted to required area only.

Environmental and Social Aspects	Description of Views and Concerns	Action Plans
Illegal dredging	Illegal dredging causes the river bank erosion to extreme extent at some places along the project area.	Enforcement of law by DOE and BIWTA as well as affacted people are to identify the offenders and inform low enforcing authority for appropriate measures.
Disposal of dredge materials	Dredge materials are released in the river which is not beneficial.	In stream disposal will prevent river erosion. Care will be taken not to avoid sensitive area.
Navigation route improvement	Siltation in the main channel and submerged char land is problematic for navigation which needs to be dredged to improve the navigation route.	Problem area will be identified and drdged to improve navigability.
Navigation Safety	Navigational signs and lights are either inadequate or non-functioning.	Adequate navigation aids will be inplace before commencement of dredging operation.
Monitoring of Charland	Monitoring of charland is required.	Char land will be monitored as per monitoring plan.

12.5.4 Summary Key Informant Interview (KII)

Mr. Enam al Haque, Founder, Bangladesh Bird Club

Comments: The chars and mudflats of the Lower Meghna estuary are of global importance as many of the global critically endangered birds winter here. For example, the tiny Spoonbill Sandpiper that breeds in one of the most remote places on earth, in the Russian Far East along a narrow strip of coastal tundra hugging the frigid ocean travels each year nearly 5,000-mile migration to tropical mudflats in Bangladesh, and a few other sites in Southeast Asia. Only 120-200 pairs of adult spoonbill sandpipers are known to survive. If the mudflats in the Lower Meghna estuary are impacted by the deposition of dredged materials of for dredging activities or if the birds are disturbed during their wintering here then their survival will be in question.

Improving the navigation route is important for the economy of the nation but at the same time utmost care has to be taken that the habitat is not disturbed or affected.

Mr. Mukit Mazumdar, Chairman, Prokriti-O-Jibon Foundation (=Nature Foundation)

All habitats are important for the wildlife but the Lower Meghna is unique and has to be protected at any cost. No disturbance or any activity that puts the mudflats and the habitat altered that affects the migratory birds will be tolerated.

Dredging may not be done close to the chars or mudflats nor any dredged material is to be deposited on the mudflats or chars. It will be good if the Lower Meghna estuary is completely declared by the government as protected.

The migratory birds utilize the mudflats and chars usually till March and if dredging is planned after March in the estuary it may not disturb the migratory birds but again that time of the year is important for the hilsa fishes, so we have to be very careful.

Md. Istiak Uddin Ahmad, Country Representative, IUCN-Bangladesh

Improving the navigation route for inland water transport is important and necessary for the country. However, the EMP and the BMP should look into every aspect so that the environment particularly the Lower Meghna estuary, the hilsa fishery and other critically endangered species and sensitive habitats are not affected.

The DOE will definitely look into the EIA/EMP however; monitoring has to be conducted diligently and remedial measures taken immediately.

Disclosure Requirements

Once finalized, the EIA report and Bengali translation of its executive summary will be disclosed to the public and will also be available on the official website of the BIWTA. EIA will also be sent to the WB InfoShop.

13 CONCLUSIONS AND RECOMMENDATIONS

13.1 Conclusions

The ESIA reveals that there will be both negative and positive impacts due to the proposed drdging operation, construction of vessel shelters, provision of navigation aids and landing facilities at the ferry crossings.

The positive environmental impacts of the Project are development of all weather navigation routes for transportation of passengers and cargo not only within the country but also to the neighbouring countries and generation of employment oppurtunities during construction operation and maintenance stages as well as induced economic growth and activities.

The major negative environmental impacts of the project are loss of benthic flora and fauna, obstruction to navigation traffic, loss of land, alteration of habitat, health, hygiene and sanitation of construction workers, public nuisance, blocking of natural drainage, noise and air .

An EMP has been formulated to mitigate the negative impacts during various phases (pre-dredging/construction, during dredging/ construction and Post dredging/O&M) of the Project to acceptable levels. Also public consultations, including consultation workshops at regional and national level have been organized in addition to preparation of resettlement policy framework as per World Bank guidelines to address resettlement and compensation issues.

To ensure that these enhancement and compensation measures are implemented correctly and negative impacts avoided, the EMP along with adequate budget is to be included in the contract documents of the Project with a separate line item on environmental management in the BOQ. The main monitoring parameters include monitoring of dredging and dredge material disposal, biological monitoring and enhancement, environmental quality monitoring (air, noise, surface water, river bed sediment), health and safety, etc. Most of the potential impacts are short-term that can be avoided or mitigated by adopting mitigation measures and relevant ECoPs.

To keep the project influence area environmentally friendly, BIWTA should ensure that the Contractor prepare site specific EMPs including Emergency response plan, Oil Spill Contingency Plan and Workers Health and Safety plan and Environmental Pollution Abatement and Mitigation Measures Plan, regular and effective monitoring of environmental quality parameters as indicated in this ESIA report.

Based on the assurance of minimal disturbance to the natural environment and implementation of

EMP in every step of the project activities, the propoded dredging and vessel shelter activities can proceed and DOE may issue necessary environmental clearance to such a nationally important project. BIWTA should follow the guidelines illustrated in the EMP and other legal and administrative requirements to carry out the activities for improvement of navigation.

Large volume of spoils will be generated due to dredging and related activities. The dredged spoil is to be disposed safely and productive manner with minimal or no damage to environment. This dredged earth can be utilized for port yard development.

13.2 Recommendations

The implementation of the project is suggested to proceed following the recommended mitigation measures as outlined in the EMP. The EMP shall be included in the bid document of civil works and need to become part of the civil works contracts. The timely implementation of EMP will reduce negative impacts. The ESIA is a living document and will need to be updated prior to starting the intervention by BWTA to reflect any significant changes in the project scope of work with recommended mitigation measures or to respond to the regular environmental monitoring results, collection and analysis of detailed bio-physical and environmental data.

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15 ANNEXURES

Annex A: Approval of TOR for EIA by DOE

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, E-16 Agargaon
Dhaka-1207
www.doe.gov.bd

Memo No: DoE/Clearance/5547/2016/ 79 Date: 29/02/2016

Subject: Exemption from IEE and Approval of Terms of Reference for EIA of Bangladesh Regional Inland Water Transport Project 1 (Chittagong-Dhaka-Ashuganj Corridor) of Bangladesh Inland Water Transport Authority (BIWTA).

Ref: Your Application dated 01/02/2016.

With reference to your letter dated 01/02/2016 for the subject mentioned above, the Department of Environment hereby gives exemption from IEE and approval of TOR for Environmental Impact Assessment (EIA) in favour of Bangladesh Regional Inland Water Transport Project-1 (Chittagong-Dhaka-Ashuganj Corridor) of Bangladesh Inland Water Transport Authority (BIWTA) subject to fulfilling the following terms and conditions.

I. The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said Project in accordance with this TOR and following additional suggestions.
II. The EIA report should be prepared in accordance with following indicative outlines:

Executive Summary
1.0 Introduction
- 1.1 Background
- 1.2 Rationale of the Project
- 1.3 Objective of the Study
- 1.4 Scope of Study/Work
- 1.5 Approach and Methodology
- 1.6 The EIA Team
- 1.7 Structure of the Report/Report Format

2.0 Legal, Policy and Administrative Framework
- 2.1 Introduction
- 2.2 Relevant National Policies and Legislations
- 2.3 Compliance with DOE EIA Guidelines

3.0 Project Description
- 3.1 Introduction
- 3.2 Project Objective
- 3.3 Project Options
- 3.4 Interventions under Selected Options
- 3.5 Project Plan, Design, Standard, Specification, Quantification, etc.

4.0 Environmental and Social Baseline
- 4.1 Meteorology
  - 4.1.1 Temperature
  - 4.1.2 Humidity

5.0 Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)
- 5.1 Environmental Sensitivity Investigation
- 5.2 Environmental Asset
- 5.3 Environmental Hot Spots
- 5.4 Likely Beneficial Impacts
- 5.5 Community Recommendations
- 5.6 Alternate Analysis

6.0 Environmental and Social Impacts
- 6.1 Introduction
- 6.2 Impact on Water Resources
  - 6.2.1 Pre-Construction Phase
  - 6.2.2 Construction Phase
  - 6.2.3 Post-Construction Phase
- 6.3 Impact on Land and soil Resources
  - 6.3.1 Pre-Construction Phase
  - 6.3.2 Construction Phase
  - 6.3.3 Post-Construction Phase
- 6.4 Impact on dredging material
  - 6.4.1 Pre-Construction Phase
  - 6.4.2 Construction Phase
  - 6.4.3 Post-Construction Phase
- 6.5 Impact on Agriculture Resources
  - 6.5.1 Pre-Construction Phase
  - 6.5.2 Construction Phase
  - 6.5.3 Post-Construction Phase
- 6.6 Impact on Fisheries including
  - 6.6.1 Pre-Construction Phase
  - 6.6.2 Construction Phase
  - 6.6.3 Post-Construction Phase
- 6.7 Impact on Eco System
  - 6.7.1 Pre-Construction Phase
  - 6.7.2 Construction Phase
  - 6.7.3 Post-Construction Phase
- 6.8 Socio Economic Impact
  - 6.8.1 Pre-Construction Phase
  - 6.8.2 Construction Phase
  - 6.8.3 Post-Construction Phase
- 6.9 Impact on Hydro-Morphology
  - 6.9.1 Pre-Construction Phase
  - 6.9.2 Construction Phase
  - 6.9.3 Post-Construction Phase
- 6.10 Impact on Dredging Material Transportation and Navigation
  - 6.10.1 Pre-Construction Phase
  - 6.10.2 Construction Phase
  - 6.10.3 Post-Construction Phase
- 6.11 Cumulative Impact
  - 6.11.1 Pre-Construction Phase
  - 6.11.2 Construction Phase
  - 6.11.3 Post-Construction Phase

6.12 Impact on Air quality, Noise & Social Safeguarding
6.12.1 Pre-Construction Phase
6.12.2 Construction Phase
6.12.3 Post-Construction Phase
7.0 Public Consultation and Disclosure
7.1 Introduction
7.2 Objectives of Public Consultation and Disclosure Meeting
7.3 Approach and Methodology of Public Consultation and Disclosure Meeting
7.4 Public Consultation Meetings (PCMs)
7.5 Public Disclosure Meetings (PDMs)
8.0 Environmental Management Plan and Monitoring Indicators
8.1 Introduction
8.2 Mitigation Plan
8.3 Enhancement Plan
8.4 Contingency Plan
8.5 Compensation Plan
8.6 Monitoring Plan
8.7 Monitoring Indicators
9.0 Cost Estimation for Environmental Mitigation Measures and Monitoring
10.0 Conclusions and Recommendations

III. Without approval of EIA report by the Department of Environment, the project authority shall not be able to open L/C in favor of importable machineries.
IV. Without obtaining Environmental Clearance, the project authority shall not be able to start the physical activity of the project.
V. The project authority shall submit the EIA report along with a filled-in application for Environmental Clearance in prescribed form, the applicable fee in a treasury Chalan, the no objection certificates (NOCs) from the local authority, NOCs from forest department (if it is required in case of cutting any forested plant, private or public) and NOC from other relevant agencies for operational activity etc. to the Head Office of DOE in Dhaka with a copy to the Dhaka/Chittagong Regional Office, Dhaka/Chittagong

29.02.2016

(Syed Nazmul Ahsan)
Director (Environmental Clearance. c.c)
Phone # 8181778

Director (Planning)
Bangladesh Inland Water Transport Authority (BIWTA)
Dredging Department, BIWTA
BIWTA Bhaban
141-143, Motijheel C/A, Dhaka-1000.

Copy Forwarded to :

1. PS to Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
2. Director, Department of Environment, Dhaka/Chittagong Regional Office, Dhaka/Chittagong.
3. Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

Annex B: ToRs of the ESIA

Govt. of the People's Republic of Bangladesh

Ministry of Shipping

Bangladesh Inland Water Transport Authority

Terms of Reference
for
Environmental and Social Impact Assessment study for the Dhaka-Munshigonj-Gajaria-Chandpur-Chittagong River Route, Munshiganj-Demra-Ghorashal route, and connecting routes to Barisal, and Ashuganj
Six proposed vessel shelters to be located along the aforementioned river routes
Ferry crossing routes between: a) Chandpur and Shariatpur; b) Lakshmipor and Bhola; and c) Beduria and Laharhat

August 2015

Terms of Reference for Environmental and Social Impact Assessment study for the:

- **i) Dhaka-Munshigonj-Gajaria-Chandpur-Chittagong River Route, Munshiganj-Demra-Ghorashal route, and connecting routes to Barisal and Ashuganj[20]**
- **ii) Six proposed vessel shelters to be located along the aforementioned river routes; and**
- **iii) Ferry crossing routes between: Chandpur and Shariatpur; Lakshmipor and Bhola; and Beduria and Laharhat**

1. Introduction

Bangladesh is a riverine country with some 700 rivers, streams and canals with a total length of about 24,000 km. Approximately 6,000 km are navigable during the monsoon (wet) period for different size vessels, shrinking to about 3,900 km in the dry periods. While the larger rivers are up to 50m depth in places and the lower Meghna (the main trafficked route on the Dhaka Chittagong Corridor) is generally 10-25m depth, navigation is hindered by very shallow depths on bars, especially in the delta area, at the confluences of the major rivers and their tributaries, river bends and mouths.

Navigation routes in Bangladesh are categorized as Classes I through IV depending on their advertised depths. The Government has identified 65 main river navigation routes that are essential to passenger and freight transport within Bangladesh. Of these, 12 have been clearly identified as high priority. A study to prioritize the remaining 53 routes is underway under the World Bank-supported Bangladesh Trade and Transport Studies Recipient-Executed Trust-Funded (RETF) project.

The Dhaka-Chittagong corridor is the main trafficked route for inland water transport (as for roads and railways) and carries approximately 80 percent all Inland Water Transport (IWT) traffic. Realizing the importance of this corridor and the need to fully utilize all transport modes to reduce demand on roads, the Government has prioritized the improved development and maintenance of the Class I routes and linked Class II and III routes along this corridor. The main trunk route is about 300km, of which it is initially estimated that about 40km currently require dredging and channelization to maintain the advertised depth for the existing traffic. Another 110-130km of linked routes is part of this corridor, of which about 33-50km requires constant maintenance.

The proposed Bank financed project aims to pilot a new approach to (i) maintenance of the Dhaka-Chittagong corridor and two key connecting routes (described below), (ii) maintenance of three priority ferry crossings along these corridors, and (iii) construction

[20] Refer to Annex 2 for detailed listing of routes.

and maintenance of an estimated five vessel shelters along the corridors for use during cyclones/storms.

Specifically, the proposed project will utilize a performance based contracting scheme to carry out the above activities. The contractor(s) will hold long term (proposed 6 year) maintenance contracts, and will be paid principally based on demonstrated maintenance of specified river depths. The contractors will determine the specific dredging or other river maintenance methodologies and equipment to deploy, as well as detailed dredging schedule. The contractors will also be responsible to fix the detailed alignment (and continuously adjust as required based on changing hydrographic conditions), and provide and maintain aids to navigation. BIWTA is in turn expected to be responsible primarily to: verify that performance targets are being met by the contractors (e.g., maintenance of specified depths and compliance with related technical, environmental and social requirements); specify dredge spoils disposal locations and detailed plans to the contractors (including associated environmental and social management aspects); acquire land for spoils disposal where applicable; and manage the onshore dredge spoils deposits including facilitating use of spoils for construction activities, land-filling, and other end-uses as appropriate and based on demand.

The development objective of the project is to increase the capacity, reliability and safety of inland water transport along the Dhaka-Chittagong corridor. The project activities are intended to ensure more private sector involvement in IWT sector and increased number of country boats and vessels as inland transport. The proposed activities might result in significant environmental impacts, if the investment activities are not properly planned, designed, executed, and maintained. Further to that, the project will provide an opportunity to improve the institutional capacity for environmental management, social management, and safety in overall IWT sector.

2. Routes and other activities under the proposed World Bank project

The specific routes to be covered are marked in the satellite maps in Annex 1, and indicated in the table in Annex 2.

In addition, the project includes:

- maintenance of 3 (Three) ferry crossing routes, namely i) Chandpur-Shariatpur; ii) Lakshmipur-Bhola; and iii) Beduria-Laharhat;

- construction and maintenance of 6 (six) vessel shelters for protection from storms and cyclones, at the riverbanks along the IWT routes (locations are marked on the maps in Annex 1);
- upgrading and/or construction of passenger and general river cargo terminals at Shosonghat (Dhaka), Pangaon (Dhaka), Narayanganj, Chandpur, Ashuganj and Bhairab, and upgrading of 14 launch ghats along the IWT routes (The engineering designs of these facilities along with the environmental and social assessment studies will be carried out by the firms separately being hired by BIWTA. However, an environmental and social framework is being developed by the individual consultants hired by the MoS)..

Based on an initial assessment of BIWTA's existing data, the main problem areas where dredging activities are expected to be concentrated are the following: i) the Haldia Channel; ii) on the approaches to Barisal; iii) on the Lower Meghna ferry crossing routes; and, iv) on the Upper Meghna towards Ashuganj. It has been agreed that the river routes along the Dhaka-Chittagong Corridor (including its main branches) will be resurveyed by BIWTA together with World Bank-provided technical assistance to more precisely determine maintenance needs. Based on an initial analysis, it is expected that the combined dredging task of the two proposed contracts shall, depending on the final boundary limits selected, be in the region of 4–6 million cubic meters annually.

4. Objectives

The main objective discussed in this TOR is to carry out comprehensive EIA and SIA studies, including EMP and Social Management Framework (SMF), in accordance with World Bank and national requirements, for two proposed contract packages of dredging / route maintenance and associated dredged material management along the aforementioned priority IWT routes and three river ferry crossings included in the proposed World Bank project, as well as construction and maintenance of an estimated five vessel shelters along the routes. (Documents owned by the Implementing Agency and Requirement of GoB and World Bank).

The consultant will not be responsible for full EIA and SIA of the proposed upgrading and construction of passenger and general cargo river terminals or launch ghats, as these would be developed under a separate design-build contract under the project, and as such the contractor will finalize the required EIA and SIA studies including site specific management plans for each during implementation. Nonetheless, the consultants shall provide backup support to the preparation of an Environmental Management Framework (EMF) and SMF (and Resettlement Action Plan for the first year project) covering these investments, which are the primary responsibility of the MoS's individual environmental and social consultants supporting this project. In particular such support would include supporting field baseline data collection efforts in the proposed locations of the river terminals and launch ghats, and support to initial (screening stage) community discussions / consultations on these facilities, under guidance and direction of the MoS individual environmental and social consultants. The EIA and SIA studies covered under this TOR will also need to integrate elements of the separately prepared EMF and SMF for the river terminals and ghats. The consultant is not responsible for the core content of the EMF and SMF for river terminals and ghats, but close coordination with the MoS environmental and social consultants – and some support to them on baseline data collection and stakeholder consultations for the areas of overlapping scope -- will be required in finalizing the deliverables, since the deliverables are inter-related and need to be presented as a coherent single Environmental and Social Assessment package for World Bank approvals. Nonetheless the MoS consultants will be primarily responsible for ensuring the effective integration of river terminal and launch ghat related elements into the final deliverables.

Except where otherwise mentioned, the specific studies referred to below (EIA, SIA, SMF, etc.) are the studies for the two contract packages for IWT and ferry crossing dredging/route maintenance and associated dredged material management, rather than the studies (frameworks or full assessments) associated with the river terminals and launch ghats.

5. Scope of Services

Separate EIA/EMP and SIA/SMF study reports shall be prepared according to the World Bank Safeguard Operational Policies and national requirements. The consultant shall also ensure that the environmental clearance from the Department of Environment shall be obtained prior to commencement of any physical works. The major activities to be carried out will include the following.

At present it is assumed that there will be two performance based contracts to carry out the river maintenance activities along the aforementioned routes, divided geographically: Contract 1 would include the northern portion of the study area (including areas depicted in Sheets 1 and 2 of Annex 1, and potentially some or all of Sheet 3).Contract 2 would focus on the southern portion of the study area (including areas shown in Sheet 4, and possibly some or all of Sheet 3). The delineation of areas to include under Contracts 1 and 2 will be determined based on the dredge volumes estimated on the basis of updated survey efforts currently underway, and might be different from that indicated above. The survey efforts will encompass all areas listed in Annex 2, starting with those marked “priority’.

The EIA and SIA studies (including corresponding site specific EMP and RAP) will cover in detail all project areas which would be covered under bid packages corresponding with year-one works (assumed to be Contract 1 only). The EIA and SIA studies will also need to cover all project areas to be included in a later bid package or packages (assumed to be Contract 2) a higher level, and indicate the work remaining to be done to complete the assessment process.

Survey work and preparation of bidding documents for Contract 2 will be slightly staggered. Once available, it will therefore require an updating of the EIA and SIA/SMF studies, and preparation of an addendum or second volume EMP and RAP containing site-specific measures for that area of influence.

5.1 Screening and scoping.

The project is classified as category A according to World Bank OP 4.01 on Environmental Assessment. The consultants will review available information on the project and project area, and carry out an initial environmental and social screening of the project area and proposed interventions in order to facilitate defining the study area, understanding the project, scoping the full EIA and SIA assessments to be undertaken, and prepare detailed work planning. The screening and scoping task shall include collection and review of relevant laws and policies on environmental and social considerations, available secondary source information on the project area and environmental and social management aspects related to the proposed activities, as well as an initial site visit to project area and initial TOR stage consultations and discussions with stakeholders (to include local communities, as well as institutional actors, NGOs, etc.). In particular, the initial discussions/consultations with local communities and other stakeholders should discuss potential on-shore dredge disposal options and major considerations in defining specific locations, such as land acquisition issues, environmental sensitivities, and potential demand for end-uses of spoils by local communities such as for construction / land-filling, agriculture, brick making, etc. as per the physical characteristics and environmental quality of the spoils. Screening/scoping stage consultation activities shall also include a workshop to be held in Dhaka, convening institutional-level stakeholders as well as NGOs and other interested parties. This event shall be publicly announced and carefully documented. The screening and scoping process will also be guided by independent individual EA and SA consultants being contracted separately under the Bangladesh Trade and Transport Facilitation Recipient-Executed Trust Fund, being managed by Ministry of Shipping.

Based on the information collected, field observations and findings of initial stakeholder discussions and consultations, prepare (1) an inception report, and (2) a Screening and Scoping report. These shall include:

1) Inception report
    - Initial definition of study area
    - Initial Identification of important environmental and social features, potential impacts, as well as potential environmental and social benefits / enhancements, including especially with respect to potential onshore uses of dredge spoils by communities, all of which to be further studied as part of the full EIA and SIA
    - Compilation of all available historic information on the following for all the routes in the project area (as inputs to help guide the survey efforts):
        - Sediment accumulation over 5-year period
        - old survey charts
        - bathymetric charts and baseline data
        - flow data
        - current profile information
        - shoals and locations

    - buoy positions (current)
    - water level gauges, dock stations and reference data
    - satellite images – georeferenced
    - high and low water levels
    - baseline charts and dates
  - Proposed table of contents for the full EIA and SIA studies
  - A proposed work plan including detailed timeline for completing the EIA and SIA, including a stakeholder engagement plan for additional consultation activities related to finalizing the studies

2) Screening and scoping report
  - Updated definition of study area, based on site screening and initial consultations
  - Updated Identification of important environmental and social features, potential impacts, as well as potential environmental and social benefits / enhancements, including especially with respect to potential onshore uses of dredge spoils by communities, all of which to be further studied as part of the full EIA and SIA
  - Policy, Legal and Administrative Framework
  - Applicable World Bank Safeguard Policies to the Project
  - Final outline of EIA and SIA studies to be carried out (i.e. an update to the present TORs and full outline, taking into account any adjustments deemed necessary based on the screening and scoping process)
  - Records of screening/scoping stage consultations (at both local and institutional levels) on the draft TOR and proposed study outline, including attendees and their affiliations, summary of what information was shared, summary of feedback provided by different stakeholder groups, and indication of how it will be taken into account in the course of the study.

5.2 Definition of Study Area.

Specify the boundaries of the study area for the assessment, based on the anticipated project influence area. This would include, for example: the full lengths of the waterways themselves (including islands, chars and shoals within the waterways as well as riverbed and banks), the river basins/catchments upstream and downstream of the waterways, floodplain and drainage areas and patterns, areas of potential influence of existing and planned river ports, landings, terminals, vessel shelters, ferry crossings, and dredge spoil dumping locations along the waterways (including roads leading to on-land spoil dumping sites that would be used by locals to haul spoils to secondary markets), areas of ecological importance along the waterways such as any parks/reserves/forests, current and planned areas being irrigated by or otherwise using waters from the waterways, roads leading to the spoil disposal sites, etc. The study area description should indicate the approximate areas where dredging is likely to be required, based on available hydrographic and morphological data and information from BIWTA. High resolution images, as well as findings of the screening and scoping assessment, will be used for demarcation of the study area.

5.3 Project Description.

Describe the project and provide information on the full scope of activities to be carried out under the project, including but not limited to the following (information to be obtained from BIWTA, as well as through literature review and interviews with key experts in dredging and river channelization, as required):

Required minimum depths and widths to be maintained for each route and ferry crossing, estimated dredge volumes on a monthly and annual basis to maintain specified depths and dimensions, and locations of expected required dredging and/or other river maintenance activities along the IWT routes and at ferry crossings (show on map); *(This will be provided by BIWTA)*

Description and concept design / layout of vessel shelters, as well as their proposed locations (show on map); *(Concept designs and preliminary specifications, as well as general proposed locations, will be provided by BIWTA. The EIA/SIA process will feed into the process of finalizing these specifications and proposed locations based on relevant environmental and social considerations.)*

Description of alternative methodologies, and the equipment and material requirements, manpower requirements, etc. for each, for dredging and/or other river maintenance options available to the contractor for maintaining the specified required depths of IWT routes and ferry crossings; *(List of methodologies will be provided by BIWTA. Other listed information can be easily researched and compiled by the EIA/SIA team through secondary sources.)*

Location, layout, extent / capacity, design specifications, manpower requirements, energy/fuel requirements, major supplies and their volumes, wastes to be generated, etc. of all temporary or permanent facilities or infrastructure required by or connected with the project (including for example: the vessel shelters and associated dikes/levees, floating platoons, and on-shore facilities for vessel passengers; dredge spoil disposal sites and associated infrastructure, any on-land worker camps, embankment and revetment works if applicable, structural control or river training measures if applicable, etc.); *(This information will be provided by BIWTA to the extent available. Some specifics may not be available as they will be determined / finalized by the contractor, within the scope of the specifications set forth by BIWTA. The project description will therefore contain whatever information is available.)*

Description of potential dredge spoils disposal options and designs (both on-land and in-river / in-ocean), and specifications for each; (*BIWTA will provide specifications and concept designs for on-land spoils disposal facilities. Preliminary designs cannot be finalized without inputs from the EIA/SIA team, based on findings on sediment quality and potential levels of contamination, stakeholder preferences and preliminary analysis of secondary market demand for spoils, etc.)*

Explanation of the contracting modality (e.g. performance based contracts), number and division of contracts (if multiple), and contract duration (assumed 6 years, TBC) for maintenance of the waterways and ferry crossings and construction and maintenance of the vessel shelters. Explanation of the division of roles and responsibilities of the contractor vs. BIWTA and/or other government or nongovernmental actors during the life of the contract, in particular with respect to the identification, construction, management and closure of dredge spoils disposal sites, as well as any other associated facilities or activities connected with the project. *(This information will be provided by BIWTA.)*

Provide maps at appropriate scales to illustrate the general setting of project-related development sites, as well as surrounding areas likely to be environmentally or socially affected. These maps shall include topographic contours, as available, as well as major features in the vicinity such as surface waters, roads, villages/towns/settlements, industrial areas / EPZs, ports and terminals, road networks, parks and reserves, and political boundaries. Also provide, as available, maps to illustrate existing land uses in the surrounding areas.

5.4 Policy and administrative framework, including applicable Safeguard Policies.

Outline the applicable environmental and social policies, regulations or other requirements that apply to the proposed project. This includes applicable national requirements (including ECR 1997 and others), World Bank safeguard policies and EHS Guidelines, and any applicable international conventions or treaties that Bangladesh is a signatory to. Indicate why each listed policy, regulation or other requirement is applicable, and how it will be complied with by the project.

5.5 Description of the Environment (Baseline assessment).

Assemble and evaluate baseline data on the environmental characteristics of the study area. Information should be presented with chainage wise information along the two sides of the waterways and/or within the river course, where possible. The baseline should focus in particular on areas (both in river and on land) around or near the approximate zones where dredging or other activities to maintain the designated river depth are expected to take place (e.g., problem areas along the river routes where siltation is significant), as well as candidate areas or zones for dredge spoils disposal, and areas of influence of vessel shelters and ferry routes. If resettlement sites and livelihood restoration options are considered to support displaced populations or economic activities (such as in locations of future dredge disposal sites or vessel shelters), the baseline should cover also the physical, biological and socio economic conditions of the proposed areas for resettlement and livelihood restoration. At least high level information should also be provided covering and characterizing the full/broader study area.

The baseline assessment should draw from both secondary and primary information sources, and identify any critical aspect which needs special consideration during design and implementation of the maintenance dredging activities. Environmental and social baseline data should be drawn from secondary sources followed by primary data collection for the wet season. Primary data for dry season will be collected with the initiation of dry season and integrated into the draft EIA at that point.

The assessment should furthermore cover both existing conditions as well as a characterization of the trends / ongoing changes to baseline conditions which are likely to affect the project area during the period of the respective performance based IWT contracts, and which will occur irrespective of the project (for example, climate change effects; anticipated regional development/urbanization and associated land use changes; morphological trends along the routes, especially in the Sandwip Island / other islands and chars in the Meghna River delta region; changes to river traffic volumes and patterns, etc).

The consultants shall support the primary baseline data collection for the EMF for river terminals and launch ghats on select parameters as well, as guided by the individual environmental consultant hired by MOS. This would not entail additional study parameters but rather an inclusion of specific sampling or survey points at the locations of these proposed investments, in support of the EMF screening process. The areas of influence are overlapping so this would be carried out in an integrated fashion with the baseline assessment for the IWT routes and ferry crossings.

Baseline assessment should cover in particular the following parameters:

(a) Physical environment, including but not limited to:

a. topography and delineation of watersheds and floodplains;
b. climate / meteorology (rainfall, wind, waves and tides),
c. surface and ground water hydrology, including annual and seasonal peak discharges, recurrence intervals and flood levels for various peak discharges (including at minimum for 5, 10, and 100-year flood events as well as historic maximum discharge), annual and seasonal low-flow discharges and recurrence intervals including historic minimum discharge, depth of water table, etc.
d. river morphology, including erosion and sedimentation / sediment deposition patterns, currents and bathymetry
e. Coastal hydrology, including coastal morphology, wave movements, tidal influence area and saline incursion,
f. characterization of soils/sediments both within the river and on shore,
g. geology
h. Hazard vulnerability; vulnerability of area to flooding (including with climate change projections), storm surge, and earthquakes

i. Sampling and analysis of ambient air quality and noise;

j. Physical and engineering properties of sediment layers (silt, clay and sand) on the riverbed, including calculation of sand curves, for every 15km of river in areas where dredging may be required

k. Chemical and biological properties of sediments (silt, clay and sand) on the riverbed as well as on riverbanks, in areas which may require dredging and where spoils may be deposited (including the presence of contaminants, pollutants or heavy metals such as PCBs, POPs, hydrocarbons, and heavy metals such as arsenic, cadmium, mercury, etc).21

l. Surface and groundwater quality, in particular including all major ions, TSS, TDS, DO, BOD, NO_3, pH, etc., as well as existing/projected waterborne pollution discharges and receiving water quality[22]; Baseline pollution load on land and in khals/beels or other water bodies close to the IWT river channels where spoils brought ashore may be eventually deposited, depending on preliminary market analysis of possible spoils uses (see section (c) below)[23]

(b) Biological environment, including but not limited to:

a. characterization of natural habitats and any critical natural habitats (including any parks, reserves and sanctuaries, areas proposed for legal protection, or other areas of known biodiversity value);

b. identification of aquatic, benthic and terrestrial flora and fauna, including any rare or endangered species (include IUCN Red List status of any listed species) or other species of conservation significance;

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[21] The consultant shall be responsible for collecting, subcontracting laboratory analysis as required, and analyzing/interpreting sediment quality data, and should be coordinated if possible with hydrographic surveys of the routes being undertaken by BIWTA. Chemical composition analysis should include analysis of the presence of pollutants or contaminants such as PCBs, POPs, and select heavy metals. The specific list of parameters to be tested shall be proposed by the consultant based on scoping-stage review of the types of industries present, and common pesticides used, in the watershed, especially along or near the riverbanks. In developing this list, the consultant shall refer in particular to the sections on dredging in the World Bank Environmental, Health and Safety (EHS) Guidelines for Ports, Harbors and Terminals (http://www.ifc.org/wps/wcm/connect/9e558c00488556ebbaf4fa6a6515bb18/Final%2B-%2BPorts%252C%2BHarbors%2Band%2BTerminals.pdf?MOD=AJPERES&id=1323152828015), and shall also take into account the testing capacity available nationally. The list shall be agreed with BIWTA and the World Bank in advance of initiation of testing. The consultant shall also research and review any additional available secondary source information.

[22] As with sediment sampling, water quality sampling should also be coordinated with the hydrographic survey efforts being conducted by BIWTA. Parameters to test should also include heavy metals and POPs which are considered likely to be present in the river based on scoping-stage review of the major industries present, and types of pesticides used, in the watershed and especially along the riverbanks.

[23] Some field sampling may be required for this, but secondary data and local stakeholders should also be consulted to determine the types of pesticides generally used in project areas and related management practices; industries and other sources of pollution in the project area; etc.

c. ecology of any species of conservation significance or concern (either for ecological or socioeconomic reasons), such as breeding/spawning behaviors and seasons, migratory patterns, food sources, predators, sensitivity to pollution or human activities (water, air, light, noise, overfishing, etc), and identification of any specific areas or zones of importance for ecosystem functions of key species such as areas of feeding, breeding, calving, and spawning of these species, including related seasonal parameters for each;

d. Primary data collection on aquatic/benthic and terrestrial biodiversity covering both wet and dry seasons, to supplement existing secondary source information as needed (Dry season data may be added in subsequently following completion of the first draft).

(c) Socio-cultural environment, including but not limited to:

a. land use (including current crops and cropping patterns, population in the floodplain, etc.);

b. transportation networks;

c. planned development activities;

d. present land ownership and occupation;

e. land tenure and land titling;

f. present water supply and water uses (including current distribution of water resources), and control over allocation of resource use rights;

g. current activities and uses of the routes and riverbanks, including volume and composition / types of vessel traffic, commercial and recreational uses, etc.

h. public health, especially water-related human health issues; present and projected population and demographics and community structure;

i. fisheries and farm/industrial outputs and inputs;

j. present and projected employment by industrial category; distribution of income, goods and services; recreation; etc.;

k. presence of any indigenous / tribal peoples and their customs and livelihoods, and/or other vulnerable populations

l. community perceptions of the project activities;

m. significant natural, cultural or historic sites or resources;

n. preliminary market analysis into potential uses and demand for sediments deposited on-shore in the areas where dredging is expected to be required.

Based on the baseline data collected, select Valued Environmental and Social Components (VESCs) which are likely to be impacted by the dredging / river maintenance activities (including dumping of the dredged spoils) and/or vessel shelters. The VESCs will be the focus of the impact assessment. Village scoping sessions will be conducted during VESCs selection in the project influence area.

5.6 Determination of the Potential Impacts and Risks associated with the Proposed Project.

This analysis will require in depth interpretation. In this analysis, distinguish between significant positive and negative impacts and risks, direct and indirect impacts, cumulative impacts, and immediate and long-term impacts. Identify impacts and risks that are unavoidable or irreversible, as well as those which can be avoided or mitigated. Specify such avoidance and mitigation measures, and reassess residual impact or risk for each. Wherever possible, describe impacts quantitatively, in terms of environmental and social costs and benefits. Assign economic values when feasible. Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact. Compare the impact with the baseline, as well as with projected future baseline conditions in light of development, land use and natural resource trends taking place in the project area independent of the proposed project activities.

The impact assessment should be organized in sections corresponding with each potential alternative river depth maintenance technique available to the performance based contractor(s) (e.g. different dredging methodologies and techniques, river training activities which may reasonably be deployed by the contractors, etc.), as well as sections corresponding with different dredge spoils disposal options (e.g., in river and on land, and different alternatives to each) and alternative vessel shelter locations. The list of potential river depth maintenance techniques will be provided by BIWTA as an output of the feasibility stage analysis being carried out in parallel. Within each section, the assessment should focus in particular on the identified VESCs. A summary table should also be included highlighting the major environmental and social impacts or risks associated with each alternative discussed, as well as mitigation and management measures for each, and an assessment of residual impact if any. Impact assessment shall also consider the without project scenario. Special attention should be given to:

(a) Environmental impacts on and risks to the aquatic, estuarine and marine environment resulting from: (i) direct effects of different dredging techniques / activities and other potential river depth maintenance activities, including but not limited to changes to water quality (such as through re-suspension of potential riverbed contamination as well as increased turbidity etc.) and related effects on aquatic biodiversity, impacts to the aquatic environment and habitat from in-river disposal of dredge spoils (in particular where sediments are contaminated with hazardous substances); changes to river hydrology and morphology (including downstream of the area of intervention and in sections of the river on either side of the designated IWT route), etc.[24], (ii) occupational health and safety risks and issues; and (iii) indirect and induced effects and associated environmental risks related to increased traffic of cargo ships, barges and passenger ferries along the IWTs and at ferry crossing locations. A sediment dispersion modeling study is to be carried out to simulate the fate of fine sediment associated with dredging (e.g. suspended sediment concentration plumes, deposition rate) and predict the potential impacts of the proposed dredging operations.

(b) Environmental impacts on and risks to the terrestrial environment (including river floodplain) resulting from: (i) direct and indirect impacts of construction and use of vessel shelters, (ii) direct and indirect impacts of on-land dredge spoil disposal sites and eventual re-use of spoils for land-filling, (iii) impacts to operations and physical integrity of existing terminals, jetties and landings, or other infrastructure along or near river banks that may be affected by localized changes to river morphology and/or dredging machinery and equipment; as well as (iv) induced onshore impacts associated with increased IWT and ferry crossing traffic and movement of cargo. Relevant impacts to analyze include in particular: impacts related to on-land disposal and final end-use of contaminated dredge spoils; noise and air quality impacts to important species, local communities or other VESCs (especially near areas of likely frequent dredging, vessel shelter locations, and ferry crossing locations where ships may idle for extended periods); impact on land resources, loss or degradation of habitat; erosion of riverbanks or shoreline and associated impacts to on-shore land uses; modifications to natural drainage patterns and groundwater elevation from spoil disposal and on-shore uses; increase in hunting or harvesting of natural resources near vessel shelter areas, safety risks or impacts to local communities or vessel movement, etc.

(c) Socio-economic impacts on populations in relation with the investments and activities in project area, including but not limited to effects to water-related economic activities (e.g., fisheries, flood plain agriculture, transportation for cargo/passenger movement, tourism / recreation, etc.); health effects (e.g., increased incidence of water-borne and water related diseases); loss of agricultural lands or other land uses; destruction of properties; loss of livelihood or other social disruption; relocation of infrastructures; unplanned settlements; impacts to human health associated with disposal and potential re-use of contaminated dredge spoils, social impacts of noise and air emissions; threat or impacts to cultural and historical sites or artifacts; demographic changes; potential for HIV/AIDS and other sexually-transmitted diseases associated with workforce (as applicable). Also identify the impact due to resettlement and new livelihood options.

(d) Cumulative Impact Assessment of the proposed project activities, and of the

[24] The consultant should refer in particular to dredging sections of the World Bank Group EHS General Guidelines as well as EHS Industry Guideline on Ports, Harbors and Terminals, both available for download at www.ifc.org/ehsguidelines, for additional specific guidance on dredging impacts, and GIIP measures and standards for their minimization and mitigation.

induced effects of the project such as increased traffic on the river, increased availability of sediment for on-land purposes, etc., when taken together with other actual or planned development activities in the project area. Such activities may include, for example, river training or river management / flood protection projects, port or terminal development or expansion projects, development of polders or other coastal / estuarine infrastructure, tourism development, road and bridge development projects, etc. For this analysis, the consultant will identify Valued Environmental and Social Components specifically relevant to the Cumulative Impact Assessment based on inputs from stakeholders, and will assess the potential impacts of multiple development activities on the VESCs.

(e) Potential environmental and social benefits of the project. This notably should include an assessment of dredging spoil demand and markets along the river routes, to develop understanding with the local people on dumping sites and needs/demands for land development along the river routes. Identify and assess the demand for dredged spoil and reservations of the communities on dumping sites and the priority uses of dumped spoils by different groups within the communities.

5.7 Analysis of Alternatives

Analyze alternative approaches to meeting the project objectives from an environmental and social perspective. Include the no-action alternative in the comparison of the various with-project alternatives. Compare and rank also the environmental and social costs and benefits of various technical alternatives to river maintenance. Consider as well alternative locations for dredge spoils disposal (including the potential socioeconomic benefits as well as environmental impacts and risks of on-shore vs. in-river disposal in different locations), as well as alternative siting of vessel shelters.

5.8 Development of an Environmental Management Plan (EMP)

Identify key mitigation and enhancement approaches and prepare the impact specific mitigation measures. The EMP should be organized into sections corresponding with (a) river and ferry crossing depth maintenance activities; (b) dredge spoils disposal; (c) vessel shelter siting, construction and operation/maintenance, and (d) management of induced and cumulative effects (as applicable):

Each alternative river depth maintenance method (dredging technologies or other method such as river training) should have specific mitigation, management and monitoring measures outlined, with roles and responsibilities specified. The monitoring plan should clearly indicate the sampling locations, frequency, sampling methods, and the standards against which those monitored values will be compared.

For dredge spoils disposal, the consultant should outline selection criteria for specific spoil dumping locations (both in-river / in-ocean and on-land) based on principles of minimizing negative environmental and social impacts, maximizing environmental and social benefits, social inclusion, availability of land and concerns of local communities, and local demand / potential secondary market for dredge spoils (such as for construction projects). Propose specific locations for spoils dumping based on these criteria. Dumping location plan shall include area of the dumping spots, depth of dumping spoils, estimated volume of dumping spoils, and locations map of dumping sites with GPS location. The design of dumping sites shall be tailored to the specific baseline conditions of sediment type and quality encountered in each area where dredging will take place, as well as potential end-uses of the spoils. E.g., if baseline assessments indicate that sediment contamination levels exceed permissible limits for human health and safety for a given end-use, the spoils dumping site should include an area where such contaminated spoils can be deposited, isolated, remediated if required, or directed to appropriate end-uses for which contamination levels are acceptable. Different cells or holding areas for different sediment qualities and types (sand, clay, etc) as well as different levels of potential contamination (if applicable) should aim to maximize end-uses and secondary market development.

Since the contractor will be engaged for long term (proposed 6 year) and every year dredging work may be required to maintain the specified river depths, the EMP will also focus the mitigation plan for the subsequent year to address environmental and social requirements associated environmental and social management aspects. The EMP will includes anticipated impacts to be generated, corresponding mitigation measures and a guideline of dredge spoils management.

For vessel shelters, the consultant should outline selection criteria for specific locations and designs based on principles of minimizing negative environmental and social impacts, maximizing benefits, social inclusion, availability of land, and concerns of local communities. Propose specific locations, or alternatively indicate areas that would not be appropriate for vessel shelters, based on these criteria. Outline required mitigation and management measures for their construction and ongoing operation and maintenance.

For any significant identified cumulative and induced effects of the proposed activities, the EMP should outline potential measures which could reasonably be addressed by BIWTA or other entities in the context of the project, including monitoring activities as appropriate.

Estimate the impacts and costs of the mitigation measures and of the institutional and training requirements to implement them. If appropriate, assess compensation to affected parties for impacts that cannot be mitigated. The EMP should include proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures, monitoring, etc. Include measures for emergency response to accidental events (e.g. entry of raw sewage or toxic wastes into rivers, streams, etc).

Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during rehabilitation and operation (eg, emission and ambient levels of pollutants where these may be detrimental to human health, soil erosion, changes in the floodplain, etc). Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to implement the plan. Include a regular schedule of monitoring the quality of surface and ground waters to ensure that mitigation measures are effective. Provide guidance for reporting and enforcement and conducting environmental audits.

Estimate the costing of EMP and define the roles and responsibilities of officials, staff, consultants and contractors of BIWTA on environmental management to ensure full implementation of the EMP. If required, recommend capacity enhancement measures for implementation, and describe in details who will (a) implement the environmental mitigation activities (b) carry out environmental monitoring; (c) supervise environmental mitigation and monitoring; (d) design, implement and apply the environmental management information system (EMIS); and (e) prepare monthly / quarterly progress reports on environmental management.

Review the responsibilities and capability of institutions at local, provincial/regional, and national levels and recommend steps to strengthen or expand them so that the EMP may be effectively implemented. The recommendations may extend to new laws and regulations, new agencies or agency functions, intersectoral arrangements, management procedures and training, staffing, operation and maintenance training, budgeting and financial support.

Prepare stand-alone sections of the EMP pertaining specifically to the performance based contractors (one section for each contract). These sections shall include all requirements and EMP elements that pertain to them, and shall be presented in a format that it can be annexed to bid documents.

5.9 Development of a Social Management Framework

Prepare Social Assessment report and Social Management Framework for activities related to the IWT maintenance activities following the World Bank guidelines on social development and safeguards. In addition to social issues covered under para 5.5. (a) b and c, the SMF will cover the following:

(a) Review policy and acts/ regulations of Bangladesh and the World Bank (OP 4.10, 4.12) in order to identify applicable provisions in the use of land for disposal of dredge materials and suggest ways to fill any gap between Bangladesh and World Bank requirements.
(b) Legal, policy and administrative framework on the basis of review of relevant laws, policies and practices of disposal of dredged material on land.
(c) Methodology to identify encumbrance free land;
(d) A transparent procedure for information dissemination and consultation with land owners for disposal of dredged material;
(e) Describe sequential work flow for the above two points (a) and (b) for disposal of dredged material on land with assigned responsibility and time frame for each activity listed in the work flow. Develop mobile application for real time flow of information of implementation of each activity which will supported with photographs from the site and geo-tagged to enhance transparency and project supervision.
(f) Formats for Memorandum of Understanding for disposal of dredged material on private land.

(g) For investments that will lead to land acquisition and or displacement of people dependent on land, irrespective of ownership, Entitlement matrix to be prepared to restore the livelihood of the affected. Based on which, prepare a Resettlement action Plan including Indigenous People development Plan (for Tribal communities, if required) for the identified sites This will also include a work flow chart and develop mobile application for real time flow of information of implementation of each activity which will supported with photographs from the site and geo-tagged to enhance transparency and project supervision. Stand-alone RAP ensuring that informed consultation have been held along with customized mitigation and implementing mechanism for the RAP (first year program, if required.)

(h) Monthly/quarterly monitoring formats for progress reports.

(i) Review the responsibilities and capability of institutions at local, provincial/regional, and national levels and recommend steps to strengthen or expand them so that the SMF for the project and RAP for the first year may be effectively implemented.

(j) Estimate the cost for implementing the SMF (including RAP for the first year project) that includes capacity building, monitoring and cost towards ICT tools for supervision of SMF.

(k) For subprojects with no land acquisition, a Social Management Plan will be prepared.

(l) All safeguards documents will have a Grievance redress mechanism that is required to be accessible, transparent unbiased and cost/time effective for the complainant.

(m) All safeguards documents including SMF and RAP will integrate gender in all aspect particularly in the stakeholders mapping/ consultation, in the socioeconomic data, in the mitigation measures and in the implementing mechanism.

(n) The SMF and RAP will have, but not limited to, the following, i) a legal framework, ii) a stakeholder consultation strategy that will be followed over the project cycle, iii) an implementing mechanism, iv) disclosure requirements, v) monitoring and evaluation for social and social safeguards issues, vi) capacity building measures, vii) a budget, etc.

5.10 Public Consultations / Stakeholder Engagement and Disclosure.

The Consultant will assist BIWTA in coordinating and executing public consultations and engagement with stakeholders as part of the EIA/SIA and SMF process. The studies will require consultation with groups likely to be affected by the proposed project (including communities, NGOs, IWT and ferry crossing user groups, and government at different levels) on the project objectives, activities, and its environmental and social aspects including potential impacts, risks, and mitigation measures, as well as benefits. Consultation with communities will include, in particular, stakeholders at the locations selected for spoils dumping and for vessel shelters.

Consultations and discussions with stakeholders will begin during the screening and scoping stage, and will continue during the baseline data collection process, as well as when drafts of the EIA/SIA and SMF are available. Consultations on the draft EIA/SIA and SMF should include, among other smaller community meetings and focus group discussions, two or more formal workshop events targeting local, regional and national stakeholders. The modes of invitations for public consultations should include local paper, miking and text message from cell phone. Prior to carrying out consultations on the full draft studies, the consultant will support BIWTA in ensuring that the drafts are made available in a public place accessible to affected groups and local NGOs being consulted. Relevant materials will be provided to affected groups in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. It should be noted that the independent EA and SA consultants being contracted by MoS will also assist with preparation of consultation materials.

The Consultant should maintain a record of all public consultations including formal events as well as focus group discussions, surveys, one-on-one interviews and other methods. Where possible, both written and pictorial / video proof should be provided. All consultation records should indicate: consultation method used to seek the views of affected stakeholders; the date and location of each consultation event, a list of the attendees and their affiliation(s) and contact information; a summary of the information provided and discussed; a summary of feedback provided by participants, and BIWTA's response to the feedback indicating how it will be taken into account.

Each draft EIA/SIA and SMF will be finalized after incorporating the comments from the consultations. The consultant will translate and finalize the executive summary of the EIA to Bengali, as well as the full SIA and SMF, and CSAP(not just executive summary).

The consultant will also support screening-stage consultations for development of the EMF and SMF of the river terminals and launch ghats. These consultations will be led by the separately contracted individual environmental and social consultants under MoS. However, Bengali translation support for discussions with stakeholders, and other logistical support in the field, should be provided if needed by the MoS consultants. Work planning for such needs will be done jointly with the MoS consultants so as to minimize additional effort required. The consultant shall also provide written translation support to the MoS consultants to translate the overall EA Executive Summary being prepared by the MoS Environmental Consultant, which covers the full project scope of works including also river terminals and launch ghats, to Bengali, for public disclosure.

The consultant will also develop the consultation, participation and communication strategy and action plan which will assist BIWTA to meet the interest from a wide range of stakeholders, including international development partners, infrastructure agencies, media, civil society organizations, NGOs, Universities, and Research Centres at national and local level, and local government institutions and communities in the project areas. The action plan will also assist BIWTA in seeking participation of the stakeholders and their cooperation for improved design and develop and follow a spoil disposal plan to maximizing the project benefits. The consultant should develop clear objectives, set specific targets, and identify the activities for execution and tools for evaluation of the strategy. The strategy and action plan will be closely linked to the BIWTA's work program for implementation of the project.

6. Consulting Team composition

Following is an <u>indicative</u> allocation of manpower for the EIA and SIA studies. This is an *initial* estimate only for team and budget planning purposes, and should not be taken as a fixed allocation. The Consultant is free to employ resources i.e. support staff as they see fit to carry out the assignment within stipulated time and meet the requirement of this service.

Table 1: Composition and estimated level of effort required of the environmental and social impact assessment study core team

Sl.	Position	Estimated man months
1	Environmental Expert/Team Leader	6
2	Water Resources Expert/ River Hydrologist	3
	Coastal Hydrologist	3
	Modeler (sediment dispersion)	2
3	Agriculture Expert	3
4	River (Aquatic) Ecologist	6
5	Terrestrial (Floodplain/Char land) Ecologist	3
6	Senior Socio-Development specialist	6
7	Media and Communications Specialist	3
8	Junior Water Resources Professional	6
9	Junior Agriculture Professional	5
10	Junior environmental expert/River Ecologist	10
11	Junior environmental expert / Terrestrial Ecologist	10
12	Junior Socio- Development specialist	15
13	GIS expert	2
14	English-Bangla report translator	1.5
15	Environmental Engineer with	4

Sl.	Position	Estimated man months
	expertise in pollution management	
16	Survey specialist	4

7. Schedule/Duration of the study

The study period is anticipated to run from beginning of September, 2015 until end-March, 2016 (an estimated 7 months), although the bulk of work would be completed by early January 2015.

The assignment shall proceed in a phased manner as outlined in section 5: Scope of Services, starting immediately with baseline data collection and proceeding in a phased manner as key inputs are received from BIWTA, including estimates of dredging requirements and volumes. It is understood that completion of the study within the stipulated timeframe will require timely receipt of required key data inputs from BIWTA as outlined below. If there are delays in receipt of these inputs, the EIA/SIA and SMF timeline may also be correspondingly delayed.

The study period to finalize the EIA and SIA to include all geographic areas which are not part of year-one bid packages will be carried out subsequently, as data becomes available. Presently it is anticipated that all such data will become available by early January 2016, although unforeseen delays may occur, or data may also be available sooner. In this case, the final delivery date for the updated / finalized EIA and SIA including detailed assessments and management plans for all project areas would be correspondingly adjusted.

The detailed workplan to be proposed by the consultants shall lay out the proposed detailed sequencing of these tasks.

8 Reports

After commencement of the studies, separate EIA/EMP and SIA/SMF reports will be submitted in **3 copies** as follows (assuming timely delivery of required inputs from BIWTA, as discussed above):

An inception report, by -September 2015;

A screening and scoping report, including initial findings of environmental and social screening, final definition of project study area, full outline of EIA, SIA and SMF, IEE including detailed full TOR for national environmental clearance, detailed workplan and schedule, and stakeholder engagement/consultation plan for completing the studies will be submitted by end-September 2015.

Separate first drafts of the Environmental Impact Assessment and Social Impact

Assessment/Social Management Framework, Communications Strategy and Action Plan (CSAP), covering the entire project area of influence at a high level, and detailed impact assessment and management planning for all areas for which hydrographic survey data and estimated dredge volumes is available by end-September, will be submitted in 3 (three) copies by November 1, 2015,) prior to disclosure and consultations on the drafts.

Bengali translations of the draft EIA Executive Summary, SMF and SMP/RAP as applicable (full), and overall project EA Executive Summary covering all project investments including river terminals and launch ghats (the last of which is being developed separately by MoS individual environmental consultant) by November 15, 2015.[25]

Interim revised draft EIA and SIA/SMF, and CSAP incorporating feedback from BIWTA and World Bank on the first draft, by November 31, 2015.

The Final Pre World Bank Appraisal Environmental Impact Assessment and Social Impact assessment/Social Management Framework, covering in detail all project areas to be included in year-one bid package(s), and taking into account feedback from consultations, BIWTA and the World Bank,as well as updated to reflect dry season baseline data, will be submitted in 3 (three) copies by January 3, 2016.

Updated/final Bengali translations of the EIA Executive Summary, SMF and SMP/RAP as applicable (full), and of overall project EA Executive Summary (including river terminals and ghats) being developed separately by MoS individual environmental consultant, by January 17 , 2016.

The final comprehensive detailed EIA and SIA/SMF, CSAP updated to include detailed assessments and management plans for all geographic areas covered by year 2 bid package(s), shall be submitted by a date to be agreed later with BIWTA, initially estimated for March 15, 2016.

9. Duties and Responsibilities

BIWTA's Responsibility

The consultants shall work under the supervision of the Project Director, BIWTA, and shall be supported by the Deputy Director (Survey), Department of Hydrography, BIWTA. The specialized departments of BIWTA shall assist the project team as required for the study. For survey and data collection, the consultants shall work with the concerned Executive Engineer under the guidance of the PD of the project. In addition, BIWTA will provide or make available data and records as per existing rule. In particular for this TOR, BIWTA will provide the following data inputs to the consultants, as per the following timeline:

[25] The deadline for translation of the overall EA Executive Summary being developed by the MOS Environmental Consultant (which includes also river terminals and launch ghats) assumes that the English language version of this document is received from the MOS Environmental Consultant by November 5, 2015.

Maps of the IWT routes, ferry crossings, as well as indication of problem areas or zones where dredging or other river maintenance activities are presumed to be required by the contractors, and minimum dimensions and alignment requirements (width and depth, distance from bank line, etc.) for each route and ferry crossing(to be provided immediately);

Proposed locations for the five vessel shelters (to be provided immediately), as well as a concept design and dimensions for the shelters(to be provided by end August) ;

Any information already in the possession of BIWTA about the routes, such as limited/partial time-series data, historical maps, satellite images, existing hydrographic charts and cross-sections, water level data, and flow velocity data, etc. relevant to carrying out the study (to be provided immediately).

Full, recent (2015) hydrographic survey data for the IWT routes and ferry crossings (to be provided by end-September 2015 for everywhere but Sandwip island area, and end-December for Sandwip Island area);

Initial location-wise estimates of expected dredge volumes for the IWT routes and ferry crossings (i.e., amount required to be dredged to re-establish the classified route dimensions) (to be provided on a rolling basis beginning two weeks after the start date of hydrographic survey activities)

A list of potential dredging or other river maintenance technologies and methods which may be utilized by the performance based contractors (to be provided by end August 2015).

The Project Director, BIWTA will ensure that the objectives of the study as detailed in the ToR are achieved within the agreed time schedule and that the recommendations of the project are accepted to GoB. He will in the context of the ToR direct the planning process and work programming supervise the execution of the study and monitor progress according to the said objectives

The consultants will have regular meetings with the BIWTA professional staff and to discuss technical and project management issues. Any unresolved issue technical or otherwise should be taken up with the Chief Engineer, BIWTA. BIWTA will make arrangements for BIWTA officials and the consultants to meet the concerned GoB agencies in Dhaka and the project area to enable the agencies to be aware of the project objectives from its inception and to be involved in adapting their needs, particularly in relation to such matters as land requisition, bank protection, and disposal of dredged material.

Consultant’s Responsibility

The consultant will carry out the study as detailed in `Scope of Works' up to the standard acceptable to the Authority and with the best interest of the Government with utmost care, skill and diligence with sound engineering, administrative and financial practices. The consultant shall be responsible to BIWTA for discharge of responsibilities.

The Team Leader will be responsible to the Project Director, BIWTA for proper and timely execution of all the activities of study mentioned in the ToR of the project. Consultant shall make available all the collected data and results to other agencies concerned (if needed) upon approval of the Authority. Make necessary arrangements for site investigations and data collection as needed to accomplish the assigned task.

Ministry of Shipping's Participation

Ministry of Shipping (MoS) will engage one independent Environmental Safeguard Specialist and one Social Safeguard Specialist to oversee and provide guidance on the EIA/SIA and SMF studies. They will interface with and guide the IWM study team on an ongoing basis to make sure that the resulting studies are fully compliant with applicable environmental and social safeguard policies of the World Bank. They will also facilitate the engagement with the World Bank during the study period to keep them up to date on progress, relay key issues and findings, and be the primary point persons for receiving feedback on draft and final deliverables to communicate to the full consultant team.

Activity and deliverable schedule

Activity and deliverable schedule of the environmental and social impact assessment study of the river routes, three ferry crossing routes, and five vessel shelters under this project is presented in table 2. As noted above, it is understood that completion of the study within this timeframe will require timely receipt of required key data inputs (principally, updated hydrographic survey maps and data, and estimated dredge volumes, for all areas of the study area) from BIWTA in line with the timeframe outlined below. For the second EIA/EMP and SIA/SMF for Sandwip Island area, refer to section 8.2 for initial schedule of deliverables. Detailed schedule for this second set of studies shall be proposed by the consultant in the screening and scoping report.

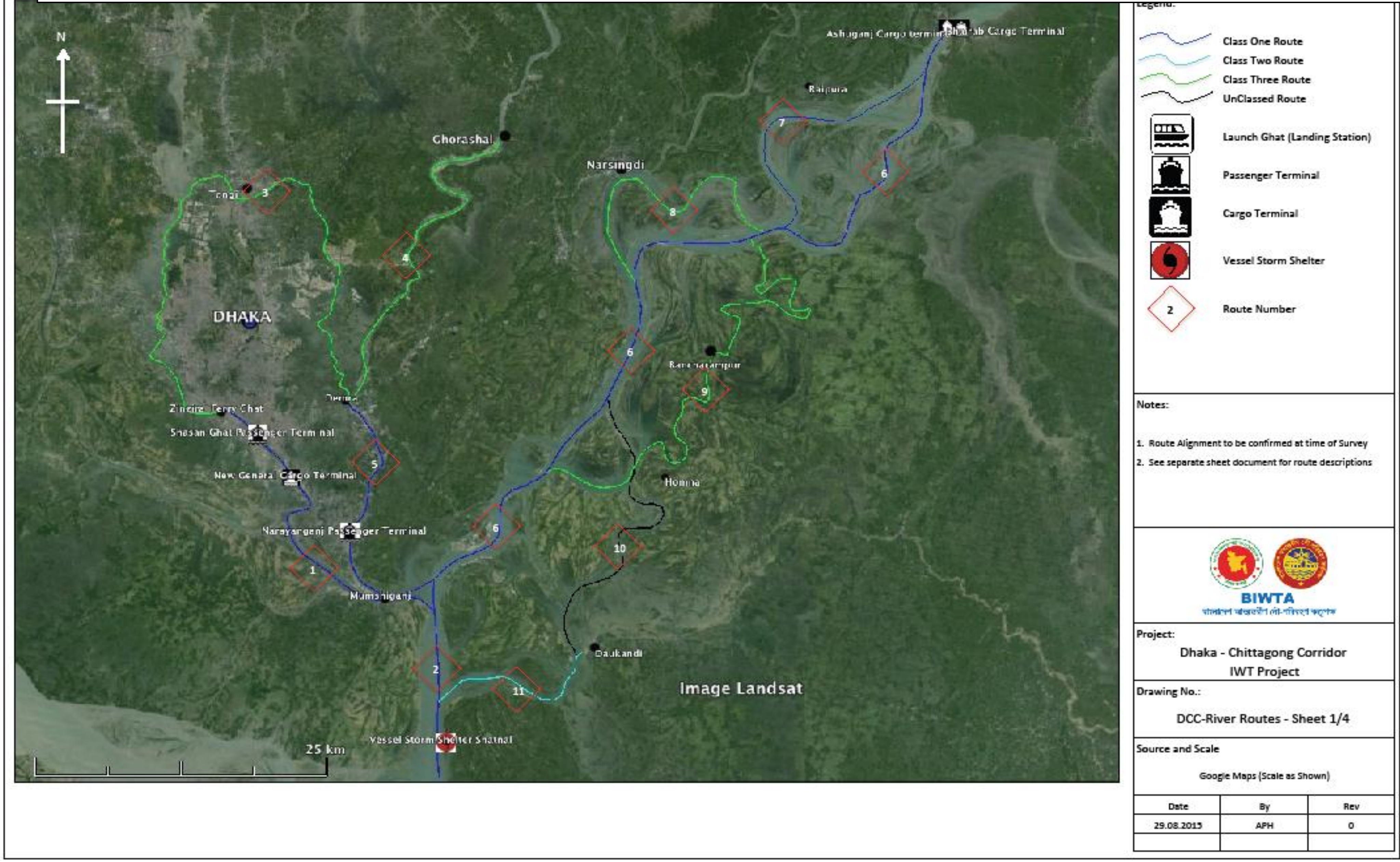
Table 2: Activity and Deliverable Schedule

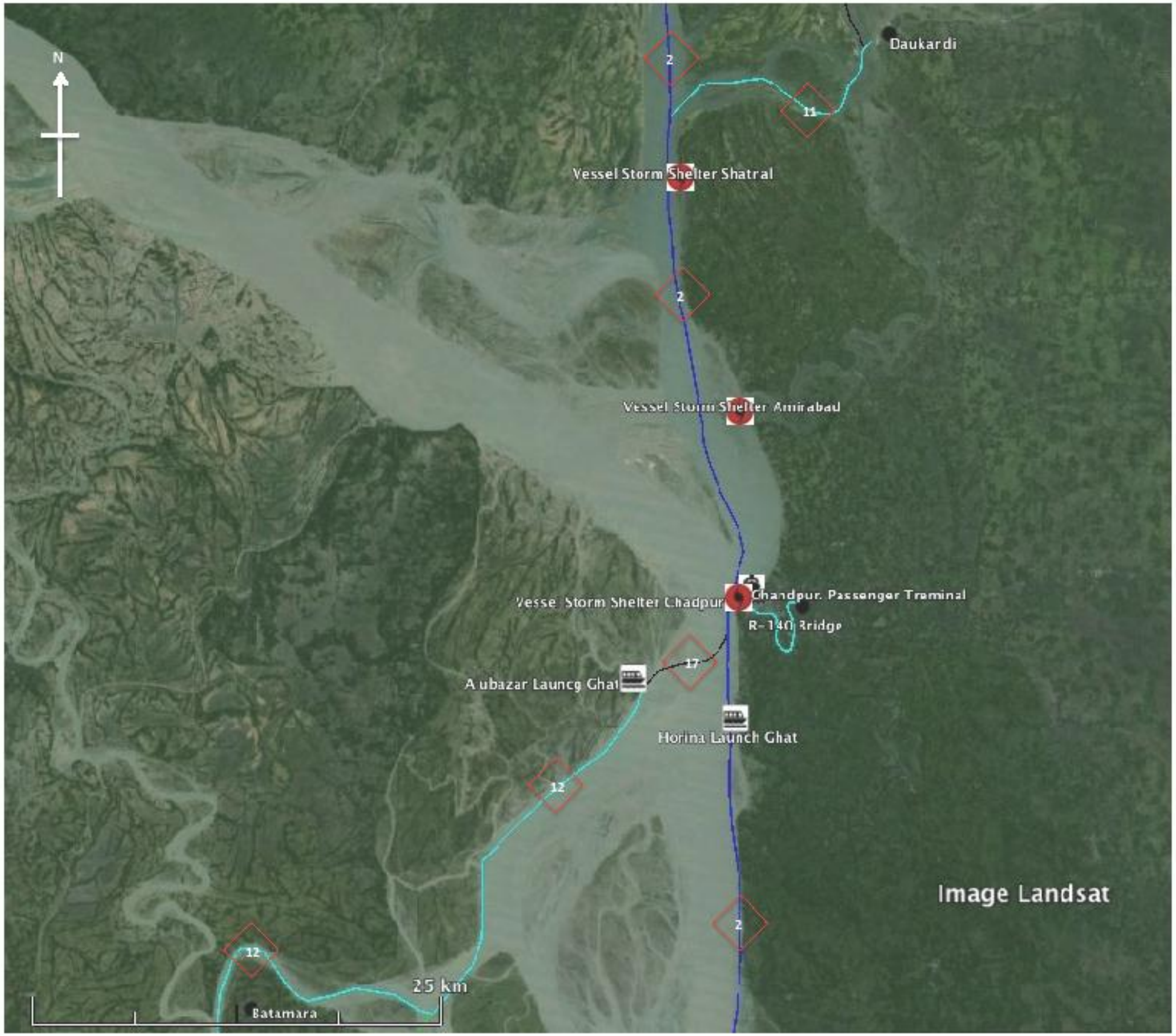
Sl. No.	Activity and Deliverable	Month					
		Sept2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb-March 2016

Sl. No.	Activity and Deliverable	Month					
		Sept2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb-March 2016
1.	Collection of available information from BIWTA including maps of the IWT routes and ferry crossings, indication of problem areas where dredging or other river maintenance activities will be required, proposed locations and concept designs for the five vessel shelters; list of potential dredging or other river maintenance technologies and methods which may be utilized by the performance based contractors; and all other information already in the possession of BIWTA as required for carrying out the study.						
2.	Initial work planning and inception report						
2.	Screening and scoping						
3.	Collect secondary/primary data and establish environmental and social baseline condition (second period to cover dry season, if required)						
4.	Conduct stakeholders' consultations at different stages of the EIA and SIA studies						
	Receipt from BIWTA of hydrographic survey data and estimated dredge volumes (first data delivery in mid-Sept, and then every 2 weeks subsequently through end-Nov.)						

Sl. No.	Activity and Deliverable	Month					
		Sept2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb-March 2016
5.	Environmental and social impact assessment (second bar represents updating to include detailing out assessment for all year-2 bid package areas)						
5.	Prepare environmental management plan and social management framework (second bar is for detailing out management plans for all year-2 bid package areas)						
6	Submission of initial Draft EIA and SIA Reports, including Bengali translations of EIA/SIA and of separately prepared EMF/SMF and ESA Executive Summary						
7	Submission of interim revised draft EIA and SIA reports						
8	Submission of Final World Bank Pre-Appraisal EIA and SIA Reports, including updated Bengali translations of all items listed under (6)						
9.	Submission of Final comprehensive EIA and SIA reports, including detailed planning for year 2 bid package areas.						

Annex 1. Maps of Locations for Project Interventions (*preliminary – BITWA will share will slightly updated versions of these maps with the consultant prior to initiation of work. Specifically, route 3 around the northern part of Dhaka will be removed, and some adjustments to vessel shelter and launch ghat locations will be made.)*





Legend:

- Class One Route
- Class Two Route
- Class Three Route
- UnClassed Route
- Launch Ghat (Landing Station)
- Passenger Terminal
- Cargo Terminal
- Vessel Storm Shelter
- 2 Route Number

Notes:

1. Route Alignment to be confirmed at time of Survey
2. See separate sheet document for route descriptions

BIWTA

Project:

Dhaka - Chittagong Corridor
IWT Project

Drawing No.:

DCC-River Routes - Sheet 2/4

Source and Scale

Google Maps (Scale as Shown)

Date	By	Rev
29.08.2015	APH	0

Annex 2: detailed list of routes, and remarks on prioritization for surveying

Dhaka – Chittagong Corridor *with extensions to Narayanganj, Ashuganj and Barisal* River Routes

Item	River(s)	From	To	Length (km)	Existing (BIWTA) River Class	BIWTA Route Reference	Remarks
Main Dhaka-Chittagong Corridor Route							
1	Buriganga Dhaleshwari and Mehhna	Dhaka (Zinzira River Ghat)	Munshigang	30	1	Part of Route 1	Survey & Subsequent Maintenance Priority
2	Meghna	Munshigang	Chittagong	250	1	Part of Route 1	Survey & Subsequent Maintenance Priority
Narayanganj Extension							
4	Shitalakshya	Gorashal	Demra	35	3		Survey Priority + subsequent upgrade and maintenance to Class 1
5	Shitalakshya and Meghna	Demra	Munshigang	22	1		Survey & Subsequent Maintenance Priority
Ashuganj Extension							
6	Meghna	Ashuganj	Munshiganj	83	1		Survey & Subsequent Maintenance Priority
7	Meghna	Raipura Loop		26	1(?)		Secondary Priority
8	Meghna	Nasingindi Loop		28	3		Secondary Priority
9	Meghna	Bancharampur Homa Loop		58	3		Secondary Priority
10	Meghna	Homna	Daukandi	32	New		Secondary Priority
11	Meghna	Daukandi	Shatnal	17	2		Secondary Priority
Barisal Extension							
12	Meghna and Arial Khan	Approach from Alubazar North of Batamara up-to At Hazar		83	2		Secondary Priority
13	Meghna and Nayabhanga	Approach via Muladi upto At Hazar		40	3		Secondary Priority (forms part of approach from Alubazar)
14	Meghna and Nayabhanga	Appoach via Hijla upto At Hazar		32	2		Secondary Priority
15	Mehhna, Tentulia and Maskata	Approach via Ilisha upto At Hazar		37	1		Survey & Subsequent Maintenance Priority
16	Bishkhali	At Hazar	Jhalokati	30	1		Survey & Subsequent Maintenance Priority
Ferry Crossing Routes							
17	Meghna	Chandpur	Shariatpur		Not Listed		Survey & Subsequent Maintenance Priority
18	Meghna	Lakshmipur	Bhola		Not Listed		Survey and Subsequent Maintenance Priority
19	Tentulia	Beduria	Laharhat		Not Listed		Survey and Subsequent Maintenance Priority

Annex C: Baseline Quality Data (detailed tables on water, sediment, air and noise quality)

Laboratory Test ID, Locations, River Names & Coordinates of the Environmental Sampling (Water Quality, Soil, Benthic and Plankton)

ID.	Location	River Name	Coordinate
1	Harinaghat, Chandpur	Lower Meghna	23° 11´ 44.33´´ 90° 37´ 40.57´´
2	Gozaria, Munshiganj	Upper Meghna	23° 32´ 58.93´´ 90° 34´ 46.03´´
3	Boktabali Ferryghat, Narayanganj	Dhaleswari	23° 36´ 41.37´´ 90° 27´ 26.64´´
4	Araihazar, Narayanganj	Shitalakhya	23° 37´ 23.62´´ 90° 30´ 42.31´´
5	Vairab, Ashuganj	Upper Meghna	24° 2´ 12.59´´ 90° 59´ 15.33´´
6	Sadarghat, Dhaka	Buriganga	23° 42´ 18.78´´ 90° 24´ 30.66´´
7	Near Vasan Char (Chukkhalighat, Sandwip)	Bay of Bengal	22° 20´ 7.40´´ 91° 21´ 58.75´´
8	Near Chairman Ghat (Noakhali)	Lower Meghna	22° 28´ 19.35´´ 91° 1´ 46.77´´
9	Near Beduria Launch Ghat (Sripurdwip, Barisal)	Ilisha River	22° 41´ 18.52´´ 90° 30´ 56.83´´
10	Near Hizla (Mehendiganj, Kaliganj)	Lower Meghna	22° 54´ 43.15´´ 90° 38´ 27.56´´
11	Near Ilisha Ghat (Tulatali Bazar, Vola)	Lower Meghna	22° 43´ 56.14´´ 90° 39´ 24.40´´
12	Near Dawlatkhan Launchghat (Vabanipur Lanchghat)	Lower Meghna	22° 38´ 4.68´´ 90° 46´ 6.41´´

Monsoon Period

Water Quality Test

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ii) D-778 of Analytical Service Cell, BCSIR. 04/10/2015

Attachment: Please find the Analysis Report as an attachment (page-1 of 1).

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Sig, and Name of the Validator
Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

21.10.2015
Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

21.10.15
Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

Form No. QSF-22 Revision No. 07 Revision Date: 02 November, 2014

ISO/IEC 17025:2005 Certified

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ANALYSIS REPORT

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	: ii) D-778 of Analytical Service Cell, BCSIR. 04/10/2015
Lab ID	: A-1087 to A-1088
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and soil testing**, Date: 4 October, 2015
Type of sample*	: Water
Quantity of sample	:6 Litre/bottle (10 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 05/10/2015
Period of analysis	: 05/10/2015 to 18/10/2015
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1087	Surface water (Sample-01)	pH at 25.2^{0}C	7.10	4500-H^+.B
		EC	171 μS/cm	2510.B
		TSS	391 mg/L	2540.D
		TDS	89.2 mg/L	2540.C
		Calcium (Ca)	23.1 mg/L	3111.B
		Magnesium (Mg)	10.6 mg/L	3111.B
		Sodium (Na)	5.90 mg/L	3500-Na B
		Potassium (K)`	3.0 mg/L	3500-K B
		Chloride (Cl^-)	1.63 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	2.42 mg/L	4110.B
		Sulphate (SO_4)	Less than 4 mg/L	4110.B
		Nitrate (NO_3)	Less than 3 mg/L	4110.B
		TOC	10.0 mg/L	5310.B
		Total Phosphate (PO_4)	11.4 mg/L	4500-P C

*The results relate only to the items tested4

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1088	Ground water (Sample-01)	pH at 24.8^{0}C	6.82	4500-H$^+$.B
		EC	425 μS/cm	2510.B
		TDS	254 mg/L	2540.C
		Calcium (Ca)	38.4 mg/L	3111.B
		Magnesium (Mg)	19.5 mg/L	3111.B
		Sodium (Na)	38.6 mg/L	3500-Na B
		Potassium (K)`	4.26 mg/L	3500-K B
		Chloride (Cl$^-$)	6.94 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	1.34 mg/L	3111.B
		Manganese (Mn)	0.07 mg/L	3110.B

21-10-2015

Sig and Name of the Validator

Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical
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BCSIR Laboratories, Dhaka

*The results relate only to the items tested4

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ANALYSIS REPORT

Ref. No. : i) 778 of BCSIR Lab. Dhaka dt. 04/10/2015
: ii) D-778 of Analytical Service Cell, BCSIR. 04/10/2015
Lab ID : A-1087 to A-1088
Name and address of Customer : Md. Rakibul Haque
Director
Environment and Resource Analysis Center Ltd.
464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details : **Prayer for water and soil testing**, Date: 4 October, 2015
Type of sample* : Water
Quantity of sample :6 Litre/bottle (10 bottles)
Packing and marking : Plastic bottle
Date of receipt : 05/10/2015
Period of analysis : 05/10/2015 to 18/10/2015
Visual observation/Remarks : Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1087	Surface water (Sample-01)	Turbidity	337 NTU	Turbidimeter
		DO	6.12 mg/L	---
		BOD_5	1.11 mg/L	5210.B
		Temparature	25. 2^0C	---
A-1088	Ground water (Sample-01)	Temparature	24. 8^0C	---

*Analysis report of soil will be sent leaer.

Sig, and Name of the Validator
Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
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21.10.15
Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
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21.10.15
Counter Signature
(Director)
Dr Husna Parvin Nur
Director
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Dhaka-1205

*The results relate only to the items tested

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Sig, and Name of the Validator	Counter Signature (Research Coordinator)	Counter Signature (Director)
Md. Aminul Ahsan Principal Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

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ANALYSIS REPORT

Ref. No.	: i) 780 of BCSIR Lab. Dhaka dt. 04/10/2015
	: ii) D-780 of Analytical Service Cell, BCSIR. 04/10/2015
Lab ID	: A-1090 to A-1099
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and soil testing**, Date: 1 October, 2015
Type of sample*	: Water
Quantity of sample	:24 Litre/bottle (24 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 05/10/2015
Period of analysis	: 05/10/2015 to 21/10/2015
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1090	Surface water (Sample-02)	pH at 24.7^{0}C	7.30	4500-H$^+$.B
		EC	68.2 µS/cm	2510.B
		TSS	9.60 mg/L	2540.D
		TDS	56.0 mg/L	2540.C
		Calcium (Ca)	6.63 mg/L	3111.B
		Magnesium (Mg)	2.30 mg/L	3111.B
		Sodium (Na)	3.06 mg/L	3500-Na B
		Potassium (K)`	1.21 mg/L	3500-K B
		Chloride (Cl^-)	6.57 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	1.54 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	6.54 mg/L	5310.B
		Total Phosphate (PO_4)	Less than 0.2 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested4

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1092	Surface water (Sample-03)	pH at 25.1^{0}C	6.99	4500-H^+.B
		EC	148 μS/cm	2510.B
		TSS	91.0 mg/L	2540.D
		TDS	78.8 mg/L	2540.C
		Calcium (Ca)	16.0 mg/L	3111.B
		Magnesium (Mg)	4.42 mg/L	3111.B
		Sodium (Na)	5.23 mg/L	3500-Na B
		Potassium (K)`	2.73 mg/L	3500-K B
		Chloride (Cl^-)	1.84 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	3.07 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	1.28 mg/L	5310.B
		Total Phosphate (PO_4)	Less than 0.2 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B
A-1094	Surface water (Sample-04)	pH at 25.1^{0}C	7.12	4500-H^+.B
		EC	54.2 μS/cm	2510.B
		TSS	153 mg/L	2540.D
		TDS	68.4 mg/L	2540.C
		Calcium (Ca)	4.88 mg/L	3111.B
		Magnesium (Mg)	2.08 mg/L	3111.B
		Sodium (Na)	3.19 mg/L	3500-Na B
		Potassium (K)`	1.04 mg/L	3500-K B
		Chloride (Cl^-)	1.06 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	1.07 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	Less than 0.5 mg/L	5310.B
		Total Phosphate (PO_4)	Less than 0.2 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested4

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1096	Surface water (Sample-05)	pH at 25.2^{0}C	7.02	4500-H$^+$.B
		EC	57.5 μS/cm	2510.B
		TSS	53.0 mg/L	2540.D
		TDS	50.4 mg/L	2540.C
		Calcium (Ca)	4.85 mg/L	3111.B
		Magnesium (Mg)	2.26 mg/L	3111.B
		Sodium (Na)	3.33 mg/L	3500-Na B
		Potassium (K)`	1.10 mg/L	3500-K B
		Chloride (Cl^-)	1.18 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	1.17 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	Less than 0.5 mg/L	5310.B
		Total Phosphate (PO_4)	Less than 2 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B
A-1098	Surface water (Sample-06)	pH at 25.1^{0}C	6.95	4500-H$^+$.B
		EC	150 μS/cm	2510.B
		TSS	22.8 mg/L	2540.D
		TDS	90.0 mg/L	2540.C
		Calcium (Ca)	16.7 mg/L	3111.B
		Magnesium (Mg)	4.46 mg/L	3111.B
		Sodium (Na)	5.90 mg/L	3500-Na B
		Potassium (K)`	2.46 mg/L	3500-K B
		Chloride (Cl^-)	1.98 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	4.02 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	0.67 mg/L	5310.B
		Total Phosphate (PO_4)	0.58 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested4

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1091	Ground water (Sample-02)	pH at 25.3^{0}C	6.85	4500-H$^+$.B
		EC	802 μS/cm	2510.B
		TDS	461 mg/L	2540.C
		Calcium (Ca)	29.4 mg/L	3111.B
		Magnesium (Mg)	21.2 mg/L	3111.B
		Sodium (Na)	113 mg/L	3500-Na B
		Potassium (K)`	2.46 mg/L	3500-K B
		Chloride (Cl^-)	111 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	1.19 mg/L	3111.B
		Manganese (Mn)	0.07 mg/L	3110.B
A-1093	Ground water (Sample-03)	pH at 25.1^{0}C	4.70	4500-H$^+$.B
		EC	907 μS/cm	2510.B
		TDS	841 mg/L	2540.C
		Calcium (Ca)	97.2 mg/L	3111.B
		Magnesium (Mg)	14.6 mg/L	3111.B
		Sodium (Na)	93.6 mg/L	3500-Na B
		Potassium (K)`	25.7 mg/L	3500-K B
		Chloride (Cl^-)	86.9 mg/L	4110.B
		Fluoride (F)	29.8 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	0.369 mg/L	3114.C
		Iron (Fe)	3.14 mg/L	3111.B
		Manganese (Mn)	2.57 mg/L	3110.B

*The results relate only to the items tested4

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Certificate No: T-1676

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BCSIR LABORATORIES, DHAKA

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1095	Ground water (Sample-04)	pH at 24.8^{0}C	6.52	4500-H$^+$.B
		EC	1062 µS/cm	2510.B
		TDS	620 mg/L	2540.C
		Calcium (Ca)	151 mg/L	3111.B
		Magnesium (Mg)	54.9 mg/L	3111.B
		Sodium (Na)	29.2 mg/L	3500-Na B
		Potassium (K)`	5.76 mg/L	3500-K B
		Chloride (Cl^-)	11.6 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	0.04 mg/L	3114.C
		Iron (Fe)	1.31 mg/L	3111.B
		Manganese (Mn)	2.60 mg/L	3110.B
A-1097	Ground water (Sample-05)	pH at 25.3^{0}C	6.55	4500-H$^+$.B
		EC	324 µS/cm	2510.B
		TDS	198 mg/L	2540.C
		Calcium (Ca)	19.8 mg/L	3111.B
		Magnesium (Mg)	16.5 mg/L	3111.B
		Sodium (Na)	19.9 mg/L	3500-Na B
		Potassium (K)`	3.71 mg/L	3500-K B
		Chloride (Cl^-)	15.1 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	0.03 mg/L	3114.C
		Iron (Fe)	24.7 mg/L	3111.B
		Manganese (Mn)	1.73 mg/L	3110.B

*The results relate only to the items tested4

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BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1099	Ground water (Sample-06)	pH at 24.8^{0}C	6.65	4500-H$^+$.B
		EC	987 µS/cm	2510.B
		TDS	622 mg/L	2540.C
		Calcium (Ca)	101 mg/L	3111.B
		Magnesium (Mg)	28.8 mg/L	3111.B
		Sodium (Na)	53.1 mg/L	3500-Na B
		Potassium (K)`	5.49 mg/L	3500-K B
		Chloride (Cl^-)	116 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.35 mg/L	3111.B
		Manganese (Mn)	0.50 mg/L	3110.B

21-10-2015

Sig and Name of the Validator

Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

*The results relate only to the items tested4

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 780 of BCSIR Lab. Dhaka dt. 04/10/2015 : ii) D-780 of Analytical Service Cell, BCSIR. 04/10/2015
Lab ID	: A-1090 to A-1099
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and soil testing**, Date: 1 October, 2015
Type of sample*	: Water
Quantity of sample	:24 Litre/bottle (24 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 05/10/2015
Period of analysis	: 05/10/2015 to 21/10/2015
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1090	Surface water (Sample-02)	Turbidity	14.9 NTU	Turbidimeter
		DO	5.30 mg/L	---
		BOD_5	0.95 mg/L	5210.B
		Temparature	24. 7^0C	---
A-1092	Surface water (Sample-03)	Turbidity	32.7 NTU	Turbidimeter
		DO	5.09 mg/L	---
		BOD_5	1.11 mg/L	5210.B
		Temparature	25. 1^0C	---
A-1094	Surface water (Sample-04)	Turbidity	8.06 NTU	Turbidimeter
		DO	5.89 mg/L	---
		BOD_5	1.12 mg/L	5210.B
		Temparature	25. 1^0C	---
A-1096	Surface water (Sample-05)	Turbidity	9.60 NTU	Turbidimeter
		DO	5.61 mg/L	---
		BOD_5	1.58 mg/L	5210.B
		Temparature	25. 2^0C	---

*The results relate only to the items tested

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1098	Surface water (Sample-06)	Turbidity	5.32 NTU	Turbidimeter
		DO	3.66 mg/L	---
		BOD_5	7.65 mg/L	5210.B
		Temparature	25. 1^0C	---
A-1091	Ground water (Sample-02)	Temparature	25. 3^0C	---
A-1093	Ground water (Sample-03)	Temparature	25. 1^0C	---
A-1095	Ground water (Sample-04)	Temparature	24. 8^0C	---
A-1097	Ground water (Sample-05)	Temparature	25.3^0C	---
A-1099	Ground water (Sample-06)	Temparature	24. 8^0C	---

*Analysis report of soil will be sent leaer.

21-10-2015
Sig, and Name of the Validator
Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

21.10.2015
Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

21.10.15
Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Forwarding of Analysis Report

Ref No: i) 794 of BCSIR Lab. Dhaka dt. 08/10/2015

ii) D-794 of Analytical Service Cell, BCSIR. 08/10/2015

Attachment: Please find the Analysis Report as an attachment (page-1 of 1).

3.11.15	3/11/15	3.11.15
Sig, and Name of the Validator	Counter Signature (Research Coordinator)	Counter Signature (Director)
Md. Ahedul Akbor Senior Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 794 of BCSIR Lab. Dhaka dt. 08/10/2015
	: ii) D-794 of Analytical Service Cell, BCSIR. 08/10/2015
Lab ID	: A-1124 to A-1129
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and soil testing** Date: 8 October, 2015
Type of sample*	: Water/Soil
Quantity of sample	: 1 Litre/bottle (9 bottles & Pot)
Packing and marking	: Plastic bottle & Pot
Date of receipt	: 08/10/2015
Period of analysis	: 08/10/2015 to 03/11/2015
Visual observation/Remarks	: Colourless/Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1124	Surface water (Sample-07)	pH at 24.8^{0}C	7.60	4500-H^+.B
		EC	1193 µS/cm	2510.B
		TSS	953 mg/L	2540.D
		TDS	646 mg/L	2540.C
		Calcium (Ca)	45.8 mg/L	3111.B
		Magnesium (Mg)	38.7 mg/L	3111.B
		Sodium (Na)	130 mg/L	3500-Na B
		Potassium (K)`	7.88 mg/L	3500-K B
		Chloride (Cl^-)	459 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	8.04 mg/L	5310.B
		Total Phosphate (PO_4)	29.7 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested4

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BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1126	Surface water (Sample-08)	pH at 25.2^{0}C	7.48	4500-H^+.B
		EC	128 µS/cm	2510.B
		TSS	110 mg/L	2540.D
		TDS	102 mg/L	2540.C
		Calcium (Ca)	16.4 mg/L	3111.B
		Magnesium (Mg)	4.66 mg/L	3111.B
		Sodium (Na)	4.48 mg/L	3500-Na B
		Potassium (K)`	2.09 mg/L	3500-K B
		Chloride (Cl^-)	1.93 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	1.81 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	7.83 mg/L	5310.B
		Total Phosphate (PO_4)	3.15 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B
A-1125	Ground water (Sample-07)	pH at 24.7^{0}C	7.85	4500-H^+.B
		EC	552 µS/cm	2510.B
		TDS	339 mg/L	2540.C
		Calcium (Ca)	51.4 mg/L	3111.B
		Magnesium (Mg)	1.34 mg/L	3111.B
		Sodium (Na)	107 mg/L	3500-Na B
		Potassium (K)`	1.36 mg/L	3500-K B
		Chloride (Cl^-)	18.2 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.63 mg/L	3111.B
		Manganese (Mn)	Less than 0.05 mg/L	3110.B

*The results relate only to the items tested4

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1127	Ground water (Sample-08)	pH at 25.1^{0}C	6.98	4500-H^+.B
		EC	6500 μS/cm	2510.B
		TDS	3398 mg/L	2540.C
		Calcium (Ca)	181 mg/L	3111.B
		Magnesium (Mg)	74.9 mg/L	3111.B
		Sodium (Na)	767 mg/L	3500-Na B
		Potassium (K)`	20.9 mg/L	3500-K B
		Chloride (Cl^-)	1766 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	0.02 mg/L	3114.C
		Iron (Fe)	3.24 mg/L	3111.B
		Manganese (Mn)	2.10 mg/L	3110.B

3.11.15

Sig and Name of the Validator

Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

*The results relate only to the items tested4

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Form No. QSF-22 Revision No. 07 Revision Date: 22 July, 2014

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 794 of BCSIR Lab. Dhaka dt. 08/10/2015
	: ii) D-794 of Analytical Service Cell, BCSIR. 08/10/2015
Lab ID	: A-1124 to A-1129
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and soil testing** Date: 8 October, 2015
Type of sample*	: Water/Soil
Quantity of sample	: 1 Litre/bottle (9 bottles & Pot)
Packing and marking	: Plastic bottle & Pot
Date of receipt	: 08/10/2015
Period of analysis	: 08/10/2015 to 03/11/2015
Visual observation/Remarks	: Colourless/Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1124	Surface water (Sample-07)	Turbidity	905 NTU	Turbidimeter
		DO	5.05 mg/L	---
		BOD_5	2.98 mg/L	5210.B
		Temparature	24. 8^{0}C	---
A-1126	Surface water (Sample-08)	Turbidity	110 NTU	Turbidimeter
		DO	5.10 mg/L	---
		BOD_5	2.98 mg/L	5210.B
		Temparature	25. 2^{0}C	---
A-1125	Ground water (Sample-07)	Temparature	24. 7^{0}C	---
A-1127	Ground water (Sample-08)	Temparature	25. 1^{0}C	---

3.11.15 3/11/15 3.11.15

Sig. and Name of the Validator	Counter Signature (Research Coordinator)	Counter Signature (Director)
Md. Ahedul Akbar Senior Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr. Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr. Qudrat-e-Khuda Road Dhaka-1205

*The results relate only to the items tested

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel: 88-02-8621741; Fax: 880-2-8613022;
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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Forwarding of Analysis Report

Ref No: i) 811 of BCSIR Lab. Dhaka dt. 14/10/2015

ii) D-811 of Analytical Service Cell, BCSIR. 13/10/2015

Attachment: Please find the Analysis Report as an attachment (page-1 of 1).

Ahedul 3.11.15	3/11/15	3.11.15
Sig. and Name of the Validator	Counter Signature (Research Coordinator)	Counter Signature (Director)
Md. Ahedul Akbor Senior Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr. Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr. Qudrat-e-Khuda Road Dhaka-1205

Certificate No: T-1676

Institute of National Analytical Research and Service (INARS)

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BCSIR LABORATORIES, DHAKA

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 811 of BCSIR Lab. Dhaka dt. 14/10/2015
	: ii) D-811 of Analytical Service Cell, BCSIR. 13/10/2015
Lab ID	: A-1175 to A-1182
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and testing**, Date: 13 October, 2015
Type of sample*	: Water
Quantity of sample	:16 Litre/bottle (7 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 14/10/2015
Period of analysis	: 14/10/2015 to 03/11/2015
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1175	Surface water (Sample-09)	pH at 24.8^0C	6.94	$4500-H^+.B$
		EC	147 µS/cm	2510.B
		TSS	202 mg/L	2540.D
		TDS	143 mg/L	2540.C
		Calcium (Ca)	17.1 mg/L	3111.B
		Magnesium (Mg)	5.47 mg/L	3111.B
		Sodium (Na)	4.80 mg/L	3500-Na B
		Potassium (K)`	2.33 mg/L	3500-K B
		Chloride (Cl^-)	1.58 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1 mg/L	4110.B
		Sulphate (SO_4)	Less than 4 mg/L	4110.B
		TOC	7.28 mg/L	5310.B
		Total Phosphate (PO_4)	1.33 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested4

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741, 9664959, Fax: 880-2-8613022;
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Certificate No: T-1676

Institute of National Analytical Research and Service (INARS)

ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস

BCSIR LABORATORIES, DHAKA

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1177	Surface water (Sample-10)	pH at 25.3^{0}C	7.42	4500-H^+.B
		EC	151 µS/cm	2510.B
		TSS	301 mg/L	2540.D
		TDS	117 mg/L	2540.C
		Calcium (Ca)	18.5 mg/L	3111.B
		Magnesium (Mg)	6.60 mg/L	3111.B
		Sodium (Na)	4.40 mg/L	3500-Na B
		Potassium (K)`	2.41 mg/L	3500-K B
		Chloride (Cl^-)	1.41 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	14.7 mg/L	5310.B
		Total Phosphate (PO_4)	1.32 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B
A-1179	Surface water (Sample-11)	pH at 25.2^{0}C	7.36	4500-H^+.B
		EC	139 µS/cm	2510.B
		TSS	327 mg/L	2540.D
		TDS	92.4 mg/L	2540.C
		Calcium (Ca)	22.6 mg/L	3111.B
		Magnesium (Mg)	7.44 mg/L	3111.B
		Sodium (Na)	4.20 mg/L	3500-Na B
		Potassium (K)`	2.33 mg/L	3500-K B
		Chloride (Cl^-)	1.33 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	1.12 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	7.43 mg/L	5310.B
		Total Phosphate (PO_4)	1.17 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested4

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BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1181	Surface water (Sample-12)	pH at 25.2^{0}C	7.55	4500-H^+.B
		EC	132 μS/cm	2510.B
		TSS	109 mg/L	2540.D
		TDS	107 mg/L	2540.C
		Calcium (Ca)	15.6 mg/L	3111.B
		Magnesium (Mg)	4.47 mg/L	3111.B
		Sodium (Na)	4.40 mg/L	3500-Na B
		Potassium (K)`	2.30 mg/L	3500-K B
		Chloride (Cl^-)	1.35 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		TOC	1.28 mg/L	5310.B
		Total Phosphate (PO_4)	0.77 mg/L	4500-P C
		Nitrate (NO_3)	Less than 3.0 mg/L	4110.B

Abdul

*The results relate only to the items tested4

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BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1176	Ground water (Sample-09)	pH at 25.2^{0}C	7.38	4500-H$^+$.B
		EC	1432 µS/cm	2510.B
		TDS	736 mg/L	2540.C
		Calcium (Ca)	44.7 mg/L	3111.B
		Magnesium (Mg)	17.9 mg/L	3111.B
		Sodium (Na)	200 mg/L	3500-Na B
		Potassium (K)`	5.42 mg/L	3500-K B
		Chloride (Cl^-)	169 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.42 mg/L	3111.B
		Manganese (Mn)	0.08 mg/L	3110.B
A-1178	Ground water (Sample-10)	pH at 24.8^{0}C	7.92	4500-H$^+$.B
		EC	829 µS/cm	2510.B
		TDS	450 mg/L	2540.C
		Calcium (Ca)	5.55 mg/L	3111.B
		Magnesium (Mg)	2.00 mg/L	3111.B
		Sodium (Na)	170 mg/L	3500-Na B
		Potassium (K)`	1.66 mg/L	3500-K B
		Chloride (Cl^-)	58.6 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.30 mg/L	3111.B
		Manganese (Mn)	Less than 0.05 mg/L	3110.B

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BCSIR LABORATORIES, DHAKA

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1180	Ground water (Sample-11)	pH at 25.1^{0}C	7.52	4500-H^{+}.B
		EC	730 μS/cm	2510.B
		TDS	395 mg/L	2540.C
		Calcium (Ca)	21.9 mg/L	3111.B
		Magnesium (Mg)	13.0 mg/L	3111.B
		Sodium (Na)	120 mg/L	3500-Na B
		Potassium (K)`	4.21 mg/L	3500-K B
		Chloride (Cl^{-})	44.4 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	0.98 mg/L	3111.B
		Manganese (Mn)	0.05 mg/L	3110.B
A-1182	Ground water (Sample-12)	pH at 25.1^{0}C	7.50	4500-H^{+}.B
		EC	539 μS/cm	2510.B
		TDS	309 mg/L	2540.C
		Calcium (Ca)	19.3 mg/L	3111.B
		Magnesium (Mg)	12.7 mg/L	3111.B
		Sodium (Na)	75.0 mg/L	3500-Na B
		Potassium (K)`	4.37 mg/L	3500-K B
		Chloride (Cl^{-})	17.5 mg/L	4110.B
		Fluoride (F)	Less than 0.5 mg/L	4110.
		Bromide (Br)	Less than 1.0 mg/L	4110.B
		Sulphate (SO_4)	Less than 4.0 mg/L	4110.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	1.02 mg/L	3111.B
		Manganese (Mn)	Less than 0.05 mg/L	3110.B

3.11.15

Sig and Name of the Validator

Senior Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

*The results relate only to the items tested4

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জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service (INARS)
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No. : i) 811 of BCSIR Lab. Dhaka dt. 14/10/2015
: ii) D-811 of Analytical Service Cell, BCSIR. 13/10/2015
Lab ID : A-1175 to A-1182
Name and address of Customer : Md. Rakibul Haque
Director
Environment and Resource Analysis Center Ltd.
464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details : **Prayer for water and testing**, Date: 13 October, 2015
Type of sample* : Water
Quantity of sample :16 Litre/bottle (7 bottles)
Packing and marking : Plastic bottle
Date of receipt : 14/10/2015
Period of analysis : 14/10/2015 to 03/11/2015
Visual observation/Remarks : Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1175	Surface water (Sample-09)	Turbidity	88.5 NTU	Turbidimeter
		DO	5.12 mg/L	---
		BOD_5	2.04 mg/L	5210.B
		Temparature	24. 8^0C	---
A-1177	Surface water (Sample-10)	Turbidity	165 NTU	Turbidimeter
		DO	5.20 mg/L	---
		BOD_5	2.08 mg/L	5210.B
		Temparature	25. 3^0C	---
A-1179	Surface water (Sample-11)	Turbidity	90.1 NTU	Turbidimeter
		DO	5.29 mg/L	---
		BOD_5	2.09 mg/L	5210.B
		Temparature	25. 2^0C	---
A-1181	Surface water (Sample-12)	Turbidity	98.0 NTU	Turbidimeter
		DO	0.89 mg/L	---
		BOD_5	58.3 mg/L	5210.B
		Temparature	25. 2^0C	---

*The results relate only to the items tested

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741; Fax: 880-2-8613022;
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Institute of National Analytical Research and Service (INARS)

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-1176	Ground water (Sample-09)	Temparature	25. 2^{0}C	---
A-1178	Ground water (Sample-10)	Temparature	24. 8^{0}C	---
A-1180	Ground water (Sample-11)	Temparature	25. 1^{0}C	---
A-1182	Ground water (Sample-12)	Temparature	25. 1^{0}C	---

Ahedul
3·11·15

Sig. and Name of the Validator
Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

3/11/15

Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

3.11.15

Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741; Fax: 880-2-8613022;
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Plankton Test

Department of Zoology
University of Dhaka
Analysis of the Plankton samples

Sampling procedure : Unknown
No of Samples : 12
Sample received on : 18th October 2015
Sample analyzed by : 2nd November 2015
Locations : Routes between Dhaka and Chittagong
Client : ENRAC

Sample No	Sample ID	References	Results	Comments (if any)
1	Plankton-1	23°09.856 N 90°36.908 E Dated: 30.09.2015	Blue Green Algae- 18 Protozoan- 13 Rotifers- 10 Cladoceran- 1	
2	Plankton-2	23°32.934N, 90°34.660 E Dated: 01.10.2015	Blue Green Algae- 35 Protozoan- 6 Rotifers - 25	
3	Plankton-3	23°36.644 N 90°27.415 E Dated: 01.10.2015	Blue Green Algae- 40 Protozoan- 2 Rotifers- 30 Cladoceran- 3	
4	Plankton-4	23°44.653 N 90°43.408 E Dated: 02.10.2015	Blue Green Algae- 10 Green Algae- 19 Diatoms- 3 Protozoan- 10 Rotifers- 6	
5	Plankton-5	23°36.638 N 90°27.418 E Dated: 03.10.2015	Algae- 16 Diatom- 8 Desmids- 2 Protozoan- 4 Rotifers- 10	
6	Plankton-6	23°42.287' N 90°24.517' E Dated: 03.10.2015	Algae- 4 Diatoms- 1 Protozoan- 8 Rotifers- 11	
7	Plankton-7	22°21.711'N 91°.32.829' E Dated. 07.10.2015	Algae-3 Diatoms-3 Desmids-3 Protozoan-10 Rotifers- 7	

Niamul 2.11.2015

M. Niamul Naser PhD
Professor
Department of Zoology
University of Dhaka

Sample No	Sample ID	References	Results	Comments (if any)
8	Plankton-8	23°09.843 N 90°38.576 E Dated: 07.10.2015	Algae- 12 Diatoms- 6 Protozoan- 3 Rotifers- 2	
9	Plankton-9	22°41.653' N 90°31.176' E Dated: 10.10.2015	Algae- 16 Diatoms- 2 Protozoan- 2 Rotifers- 4	
10	Plankton-10	22°50.207 N 90°37.258 E Dated: 10.10.2015	Algae- 6 Diatoms- 5 Desmids- 2 Protozoan- 3 Rotifers- 3	
11	Plankton-11	22°42.979' N 90°40.665' E Dated: 11.10.2015	Algae-13 Diatoms-5 Protozoan - 3 Rotifers- 2	
12	Plankton-12	23°38.142' N 90°46.125' E Dated: 11.10.2015	Algae-5 Diatoms-5 Desmids-5 Rotifers- 9	

2.11-2015

M. Niamul Naser PhD
Professor
Department of Zoology
University of Dhaka

River Bed Sample Test

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No. : i) 781 of BCSIR Laboratories, Dhaka. Date: 04/10/2015
: ii) D-781 of Analytical Service cell, BCSIR, Date: 04/10/2015

Lab ID : SE- 368

Referred by : Md. Rakibul Haque, Director, Environment and Resource Analysis Center Ltd.(ENRAC), 464/C (Ground Floor), Khilgaon, Dhaka-1219.

Work Order details : Analysis of the supplied samples (as supplied).

Type of Sample : Soil Samples

Analytical Result :

Sl. No.	Parameters	Results				
		Sample -1	Sample - 2	Sample - 3	Sample - 4	Sample - 5
01	Salinity	0.021 %	0.012 %	0.060 %	0.013 %	0.014 %
02	Total Magnesium (Mg)	0.295 %	0.423 %	0.852 %	0.719 %	0.379 %
03	Total Calcium (Ca)	0.179 %	0.068 %	0.088 %	0.085 %	0.084 %
04	Total Sodium (Na)	0.010 %	0.012 %	0.028 %	0.022 %	0.018 %
05	Total Potassium (K)	0.099 %	0.204 %	0.612 %	0.599 %	0.414 %
06	Total Organic Carbon (TOC)	0.223 %	0.428 %	0.459 %	0.536 %	1.172 %
07	Total Phosphate (PO_4^{3-})	0.232 %	0.246 %	0.482 %	0.474 %	0.321 %
08	Total Nitrate (NO_3^-)	8.00 ppm	37.96 ppm	36.28 ppm	33.89 ppm	10.63 ppm
09	Total Arsenic (As)	0.34 ppm	0.31 ppm	1.32 ppm	0.70 ppm	1.65 ppm
10	Total Cadmium (Cd)	0.13 ppm	0.12 ppm	0.10 ppm	0.21 ppm	0.11 ppm
11	Total Mercury (Hg)	BDL	BDL	BDL	BDL	BDL
12	Total Lead (Pb)	0.12 ppm	4.56 ppm	10.25 ppm	8.14 ppm	8.36 ppm
13	Total Chromium (Cr)	11.38 ppm	24.87 ppm	45.02 ppm	39.35 ppm	32.90 ppm
14	Total Zinc (Zn)	12.16 ppm	34.95 ppm	85.68 ppm	72.27 ppm	64.05 ppm
15	Total Nickel (Ni)	56.19 ppm	56.84 ppm	79.66 ppm	51.86 ppm	33.83 ppm

BDL= Below Detection Limit (Detection Limit of Hg is 5.0 ppb)

Methodology / Instrument:

01 **As :** Atomic Absorption Spectrophotometer with HVG

02 **Na, K :** Flame Photometric method

03 **Hg :** Atomic Absorption Spectrophotometer with MVU

04 **TOC:** Walkley and Black oxidation method

05 **Nitrate :** Ion Chromatographic method

06 **Salinity:** Salinity measuring meter

07 **Phosphate :** Vanadomolybdophosphophoric Yellow color method

08 **Ca, Mg, Cd, Pb, Cr, Ni, Zn :** Flame Atomic Absorption Spectrophotometer

Special Notes:

1. The result reported here pertained to the sample received in the laboratory only.
2. The laboratory is not responsible for the data quality affected due to the above. The precision & accuracy are defined only for the laboratory process, not for the sampling, transporting & storage processes.
3. The result should not be reproduced wholly or in part and cannot be used as evidence in the court of law and should not be used in any advertising media without our special permission in writing.
4. Any complain about the test result will not be accepted after one month from the date of issuing of the said report.
5. This report is free from any legal litigation and BCSIR Laboratories, Dhaka is not liable for any legal implication relating the report.

Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
27.10.15	27.10.15	27.10.15	27.10.15
BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka BCSIR, Dhanmondi, Dhaka-1205	Akhtar Hamid Dewan Chief Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr. Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Phone: 88-02-8621741, Fax: 88-02-8613022 Email: bcsir@bangla.net

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No. : i) 779 of BCSIR Laboratories, Dhaka. Date: 04/10/2015
: ii) D-779 of Analytical Service cell, BCSIR, Date: 04/10/2015

Lab ID : SE- 369

Referred by : Md. Rakibul Haque, Director, Environment and Resource Analysis Center Ltd.(ENRAC), 464/C (Ground Floor), Khilgaon, Dhaka-1219.

Work Order details : Analysis of the supplied samples (as supplied).

Type of Sample : Soil Samples

Analytical Result :

Sl. No.	Parameters	Results Sample - 6
01	Salinity	0.051 %
02	Total Magnesium (Mg)	0.163 %
03	Total Calcium (Ca)	0.094 %
04	Total Sodium (Na)	0.011 %
05	Total Potassium (K)	0.093 %
06	Total Organic Carbon (TOC)	0.370 %
07	Total Phosphate (PO_4^{3-})	0.205 %
08	Total Nitrate (NO_3^-)	34.20 ppm
09	Total Arsenic (As)	0.38 ppm
10	Total Cadmium (Cd)	0.11 ppm
11	Total Mercury (Hg)	BDL
12	Total Lead (Pb)	14.63 ppm
13	Total Chromium (Cr)	10.56 ppm
14	Total Zinc (Zn)	39.84 ppm
15	Total Nickel (Ni)	82.26 ppm

BDL= Below Detection Limit (Detection Limit of Hg is 5.0 ppb)

Methodology / Instrument:

01 **As :** Atomic Absorption Spectrophotometer with HVG
02 **Na, K :** Flame Photometric method
03 **Hg :** Atomic Absorption Spectrophotometer with MVU
04 **TOC:** Walkley and Black oxidation method
05 **Nitrate :** Ion Chromatographic method
06 **Salinity:** Salinity measuring meter
07 **Phosphate :** Vanadomolybdophosphophoric Yellow color method
08 **Ca, Mg, Cd, Pb, Cr, Ni, Zn :** Flame Atomic Absorption Spectrophotometer

Special Notes:

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27.10.15 | 27.10.15 | 27.10.15 | 27.10.15

Signature of Scientist
BADHAN SAHA
Scientific Officer
Soil and Environment Section
Biological Research Division
BCSIR Laboratories, Dhaka
BCSIR, Dhanmondi, Dhaka-1205

Signature of Supervisor
Akhtar Hamid Dewan
Chief Scientific Officer
Soil and Environment Section
Biological Research Division
BCSIR Laboratories, Dhaka

Signature of Research Coordinator
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

Signature of Director
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Director
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Dr Qudrat-e-Khuda Road
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Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
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জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No.	: i) 795 of BCSIR Laboratories, Dhaka. Date: 08/10/2015
	: ii) D-795 of Analytical Service cell, BCSIR, Date: 08/10/2015
Lab ID	: SE- 370
Referred by	: Md. Rakibul Haque, Director, Environment and Resource Analysis Center Ltd.(ENRAC), 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details	: Analysis of the supplied samples (as supplied).
Type of Sample	: Soil Samples
Analytical Result	:

Sl. No.	Parameters	Results	
		Sample-7	Sample-8
01	Salinity	0.070 %	0.072 %
02	Total Organic Carbon (TOC)	0.222 %	0.377 %
03	Total Phosphate (PO_4^{3-})	0.307 %	0.076 %
04	Total Nitrate (NO_3^-)	8.87 ppm	6.85 ppm
05	Total Arsenic (As)	0.79 ppm	1.24 ppm
06	Total Cadmium (Cd)	0.24 ppm	0.17 ppm
07	Total Mercury (Hg)	BDL	BDL
08	Total Lead (Pb)	0.52 ppm	0.57 ppm
09	Total Chromium (Cr)	27.36 ppm	42.04 ppm
10	Total Zinc (Zn)	28.53 ppm	59.07 ppm
11	Total Nickel (Ni)	8.48 ppm	28.54 ppm

BDL= Below Detection Limit (Detection Limit of Hg is 5.0 ppb)

Methodology / Instrument:

- **01** **As :** Atomic Absorption Spectrophotometer with HVG
- **02** **Hg :** Atomic Absorption Spectrophotometer with MVU
- **03** **Phosphate :** Vanadomolybdophosphophoric Yellow color method
- **04** **Cd, Pb, Cr, Ni, Zn :** Flame Atomic Absorption Spectrophotometer
- **05** **Nitrate :** Ion Chromatographic method
- **06** **TOC:** Walkley and Black oxidation method
- **07** **Salinity:** Salinity measuring meter

Special Notes:

1. The result reported here pertained to the sample received in the laboratory only.
2. The laboratory is not responsible for the data quality affected due to the above. The precision & accuracy are defined only for the laboratory process, not for the sampling, transporting & storage processes.
3. The result should not be reproduced wholly or in part and cannot be used as evidence in the court of law and should not be used in any advertising media without our special permission in writing.
4. Any complain about the test result will not be accepted after one month from the date of issuing of the said report.
5. This report is free from any legal litigation and BCSIR Laboratories, Dhaka is not liable for any legal implication relating the report.

Saha 29.10.15	29.10.15	29.10.15	29.10.15
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka BCSIR, Dhanmondi, Dhaka-1205	Hamid Dewan Chief Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr. Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
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Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No. : i) 812 of BCSIR Laboratories, Dhaka. Date: 13/10/2015
: ii) D-812 of Analytical Service cell, BCSIR, Date: 13/10/2015

Lab ID : SE- 373

Referred by : Md. Rakibul Haque, Director, Environment and Resource Analysis Center Ltd.(ENRAC), 464/C (Ground Floor), Khilgaon, Dhaka-1219.

Work Order details : Analysis of the supplied samples (as supplied).

Type of Sample : Soil Samples

Analytical Result :

Sl. No.	Parameters	Results			
		Sample -9	Sample - 10	Sample - 11	Sample - 12
01	Salinity	0.010 %	0.020 %	0.011 %	0.021 %
02	Total Organic Carbon (TOC)	0.59 %	0.53 %	0.07 %	0.40%
03	Total Phosphate (PO_4^{3-})	0.051 %	0.015 %	0.035 %	0.026 %
04	Total Nitrate (NO_3^-)	6.14 ppm	4.30 ppm	1.44 ppm	4.72 ppm
05	Total Arsenic (As)	0.67 ppm	0.75 ppm	0.30 ppm	1.81 ppm
06	Total Cadmium (Cd)	0.18 ppm	0.14 ppm	0.11 ppm	0.10 ppm
07	Total Mercury (Hg)	BDL	BDL	BDL	BDL
08	Total Lead (Pb)	0.112 ppm	0.124 ppm	0.113 ppm	0.110 ppm
09	Total Chromium (Cr)	21.25 ppm	11.45 ppm	7.49 ppm	9.73 ppm
10	Total Zinc (Zn)	24.99 ppm	12.46 ppm	6.04 ppm	16.15 ppm
11	Total Nickel (Ni)	10.27 ppm	2.89 ppm	2.55 ppm	6.62 ppm

BDL= Below Detection Limit (Detection Limit: Hg = 5.0 ppb)

Methodology / Instrument:

01 **As :** Atomic Absorption Spectrophotometer with HVG
02 **Hg :** Atomic Absorption Spectrophotometer with MVU
03 **Phosphate :** Vanadomolybdophosphophoric Yellow color method
04 **Cd, Pb, Cr, Ni, Zn :** Flame Atomic Absorption Spectrophotometer
05 **TOC:** Walkley and Black oxidation method
06 **Salinity:** Salinity measuring meter
07 **Nitrate :** Ion Chromatographic method

Special Notes:

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2.11.15	02.11.15	02.11.15	2.11.15
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka. BCSIR, Dhanmondi, Dhaka-1205	Akhtar Hamid Dewan Chief Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service (INARS)
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No. : i) 794 of BCSIR Lab. Dhaka dt. 08/10/2015
ii) D-794 of Analytical Service Cell, BCSIR. 08/10/2015
Lab ID : A-1128 to A-1129
Name and address of Customer : Md. Rakibul Haque
Director
Environment and Resource Analysis Center Ltd.
464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details : **Prayer for water and testing**, Date: 13 October, 2015
Type of sample* : Water
Quantity of sample : 1 Kg/Pot (2 Plastic Pot)
Packing and marking : Plastic Pot
Date of receipt : 08/10/2015
Period of analysis : 08/10/2015 to 03/11/2015
Visual observation/Remarks : Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (mg/kg)	Test Method (APHA)
A-1128	SOIL Riverbed Sediment (Sample-07)	2,2',3,4,4',5,5' - HEPTACHLOROBI	6.4	GC
		2,2',3,4,4',5' - HEXACHLOROBIPHE	ND	GC
		2,2',4,4',5,5' - HEXACHLOROBIPHE	ND	GC
		2,2',5,5' - TETRACHLOROBIPHENLY	ND	GC
		2,4,4'- TETRACHLOROBIPHENLY	ND	GC
		2,6- DICHLOROBIPHENYL	ND	GC
A-1129	SOIL Riverbed Sediment (Sample-08)	2,2',3,4,4',5,5' - HEPTACHLOROBI	4.3	GC
		2,2',3,4,4',5' - HEXACHLOROBIPHE	ND	GC
		2,2',4,4',5,5' - HEXACHLOROBIPHE	ND	GC
		2,2',5,5' - TETRACHLOROBIPHENLY	ND	GC
		2,4,4'- TETRACHLOROBIPHENLY	ND	GC
		2,6- DICHLOROBIPHENYL	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

3·11·15 3/4/15 3·11·15

Sig. and Name of the Validator
Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr. Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 811 of BCSIR Lab. Dhaka dt. 14/10/2015 : ii) D-811 of Analytical Service Cell, BCSIR. 13/10/2015
Lab ID	: A-1183 to A-1186
Name and address of Customer	: Md. Rakibul Haque Director Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work order details	: **Prayer for water and testing**, Date: 13 October, 2015
Type of sample*	: Water
Quantity of sample	:1 Kg/Pot (4 Pots)
Packing and marking	: Plastic Pot
Date of receipt	: 14/10/2015
Period of analysis	: 14/10/2015 to 03/11/2015
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration (mg/kg)	Test Method (APHA)
A-1183	Riverbed Sediment/Soil (Sample-09)	2,2',3,4,4',5,5' - HEPTACHLOROBI	4.6	GC
		2,2',3,4,4',5' - HEXACHLOROBIPHE	ND	GC
		2,2',4,4',5,5' - HEXACHLOROBIPHE	ND	GC
		2,2',5,5' - TETRACHLOROBIPHENLY	ND	GC
		2,4,4'- TETRACHLOROBIPHENLY	ND	GC
		2,6- DICHLOROBIPHENYL	ND	GC
A-1184	Riverbed Sediment/Soil (Sample-10)	2,2',3,4,4',5,5' - HEPTACHLOROBI	4.7	GC
		2,2',3,4,4',5' - HEXACHLOROBIPHE	ND	GC
		2,2',4,4',5,5' - HEXACHLOROBIPHE	ND	GC
		2,2',5,5' - TETRACHLOROBIPHENLY	ND	GC
		2,4,4'- TETRACHLOROBIPHENLY	ND	GC
		2,6- DICHLOROBIPHENYL	ND	GC

*The results relate only to the items tested

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PABX: 8611057-61, 8625038-9, 8626034-5, 8626032, Ext. /325; E-mail: directordl@yahoo.com, bcsir@bangla.net

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration (mg/kg)	Test Method (APHA)
A-1185	Riverbed Sediment/Soil (Sample-11)	2,2',3,4,4',5,5' - HEPTACHLOROBI	4.4	GC
		2,2',3,4,4',5' - HEXACHLOROBIPHE	ND	GC
		2,2',4,4',5,5' - HEXACHLOROBIPHE	ND	GC
		2,2',5,5' - TETRACHLOROBIPHENLY	ND	GC
		2,4,4'- TETRACHLOROBIPHENLY	ND	GC
		2,6- DICHLOROBIPHENYL	ND	GC
A-1186	Riverbed Sediment/Soil (Sample-12)	2,2',3,4,4',5,5' - HEPTACHLOROBI	ND	GC
		2,2',3,4,4',5' - HEXACHLOROBIPHE	ND	GC
		2,2',4,4',5,5' - HEXACHLOROBIPHE	ND	GC
		2,2',5,5' - TETRACHLOROBIPHENLY	ND	GC
		2,4,4'- TETRACHLOROBIPHENLY	ND	GC
		2,6- DICHLOROBIPHENYL	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

Ahdul 3.11.15 — Sig. and Name of the Validator
Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

3/11/15 — Counter Signature (Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

3.11.15 — Counter Signature (Director)
Dr. Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr. Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested

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PABX: 8611057-61, 8625038-9, 8626034-5, 8626032, Ext. /325; E-mail: directordl@yahoo.com, bcsir@bangla.net

IWM SEDIMENT LABORATORY

Determination of Grain Size Distribution

Analysis Type : Andreasens Tube & Wet Sieving

River: Upper Meghna
Station: Ashugonj
Collection Date:
Collection Time:

Bottol No: 5
Sample Type : Bed Sample
Position (m) (Easting) : 90° 27.418'
Position (m) (Northing) : 23° 36.638'
X-Section:

Temperature In ºC. **Initial :** 30.0 **Final :** **Factor, F:** **0.01220**

Time	Time (T) (min)	Height (H) (Initial)	SQRT. (H/T)	Volume (ml)	Filter Paper Wt.(g)	Filter Paper & Sample Wt.(g)	Concentration (mg/l)	Dia [D} (mm) [F*SQRT(H/T)]	Finer (%)	Adjusted Finer (%)
8:20	0	102.0		100.0	0.0752	0.4355	3603.00		100.00	95.404
8:21	1	100.0	10.000	100.0	0.0758	0.3760	3002.00	0.122	83.32	79.490
8:23	3	98.0	5.715	100.0	0.0762	0.3714	2952.00	0.070	81.93	78.166
8:27	7	96.0	3.703	100.0	0.0757	0.3483	2726.00	0.045	75.66	72.182
8:35	15	94.0	2.503	100.0	0.0750	0.3264	2514.00	0.031	69.78	66.568
8:50	30	92.0	1.751	100.0	0.0757	0.2800	2043.00	0.021	56.70	54.097
9:20	60	90.0	1.225	100.0	0.0765	0.2245	1480.00	0.015	41.08	39.189
10:20	120	88.0	0.856	100.0	0.0767	0.1982	1215.00	0.010	33.72	32.172
12:20	240	86.0	0.599	100.0	0.0762	0.1742	980.00	0.007	27.20	25.949
16:20	480	84.0	0.418	100.0	0.0757	0.1448	691.00	0.005	19.18	18.297
8:20	1440	82.0	0.239	100.0	0.0760	0.1108	348.00	0.003	9.66	9.215

B.Coarser Part (>63μm)

Sample Weight before Sieving (g):	50.4749
Sample (>63μm) Weight after Sieving (g):	2.3701
Sample (< 63μm) Weight after Sieving (g):	48.1048

Sieve Size (mm)	Weight Retained (g)	Weight Retained (%)	Cumulative Retained (%)	Finer (%)
4.000	0.0000	0.0000	0.0000	100.0000
2.000	0.0000	0.0000	0.0000	100.0000
1.000	0.0000	0.0000	0.0000	100.0000
0.500	0.0748	0.1482	0.1482	99.8518
0.250	0.3372	0.6681	0.8162	99.1838
0.125	0.7256	1.4375	2.2538	97.7462
0.063	1.1823	2.3424	4.5961	95.4039
Pan	0.0502	0.0995	4.6956	95.3044

C. Summary of Results :

Grain Diameter (mm)	**4.000**	**2.000**	**1.000**	**0.500**	**0.250**	**0.125**	**0.063**	**0.045**
Percent Finer	100.00	100.00	100.00	99.85	99.18	97.75	95.40	72.18
Grain Diameter (mm)	**0.031**	**0.021**	**0.015**	**0.010**	**0.007**	**0.005**	**0.003**	
Percent Finer	66.57	54.10	39.19	32.17	25.95	18.30	9.21	

D10 (mm)	D16 (mm)	D35 (mm)	D50 (mm)	D65 (mm)	D84 (mm)	D90 (mm)	Geometric Standard Deviation
0.003	0.004	0.012	0.019	0.029	0.054	0.058	3.796

IWM SEDIMENT LABORATORY

Determination of Grain Size Distribution

Analysis Type : Andreasens Tube & Wet Sieving

River: Upper Meghna
Station: Araihazar
Collection Date:
Collection Time:

Bottol No: 4
Sample Type : Bed Sample
Position (m) (Easting) : 90° 43.408'
Position (m) (Northing) : 23° 44.653'
X-Section:

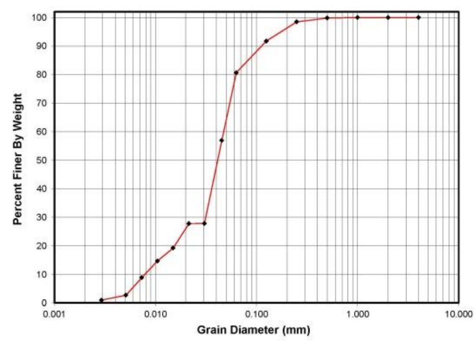
Temperature In °C. Initial : 30.0 Final : **Factor, F:** 0.01220

Time	Time (T) (min)	Height (H) (Initial)	SQRT. (H/T)	Volume (ml)	Filter Paper Wt.(g)	Filter Paper & Sample Wt.(g)	Concentration (mg/l)	Dia [D} (mm) [F*SQRT(H/T)]	Finer (%)	Adjusted Finer (%)
8:20	0	102.0		100.0	0.0760	0.3314	2554.00		100.00	80.650
8:21	1	100.0	10.000	100.0	0.0761	0.3133	2372.00	0.122	92.87	74.902
8:23	3	98.0	5.715	100.0	0.0754	0.2853	2099.00	0.070	82.18	66.282
8:27	7	96.0	3.703	100.0	0.0769	0.2570	1801.00	0.045	70.52	56.872
8:35	15	94.0	2.503	100.0	0.0769	0.1650	881.00	0.031	34.49	27.820
8:50	30	92.0	1.751	100.0	0.0770	0.1650	880.00	0.021	34.46	27.788
9:20	60	90.0	1.225	100.0	0.0759	0.1366	607.00	0.015	23.77	19.168
10:20	120	88.0	0.856	100.0	0.0752	0.1217	465.00	0.010	18.21	14.684
12:20	240	86.0	0.599	100.0	0.0752	0.1033	281.00	0.007	11.00	8.873
16:20	480	84.0	0.418	100.0	0.0758	0.0844	86.00	0.005	3.37	2.716
8:20	1440	82.0	0.239	100.0	0.0762	0.0792	30.00	0.003	1.17	0.947

B.Coarser Part (>63µm)

Sample Weight before Sieving (g):	50.4950
Sample (>63µm) Weight after Sieving (g):	9.8302
Sample (< 63µm) Weight after Sieving (g):	40.6648

Sieve Size (mm)	Weight Retained (g)	Weight Retained (%)	Cumulative Retained (%)	Finer (%)
4.000	0.0000	0.0000	0.0000	100.0000
2.000	0.0000	0.0000	0.0000	100.0000
1.000	0.0000	0.0000	0.0000	100.0000
0.500	0.0972	0.1925	0.1925	99.8075
0.250	0.6872	1.3609	1.5534	98.4466
0.125	3.4018	6.7369	8.2903	91.7097
0.063	5.5848	11.0601	19.3504	80.6496
Pan	0.0592	0.1172	19.4677	80.5323



C. Summary of Results :

Grain Diameter (mm)	4.000	2.000	1.000	0.500	0.250	0.125	0.063	0.045
Percent Finer	100.00	100.00	100.00	99.81	98.45	91.71	80.65	56.87
Grain Diameter (mm)	0.031	0.021	0.015	0.010	0.007	0.005	0.003	
Percent Finer	27.82	27.79	19.17	14.68	8.87	2.72	0.95	

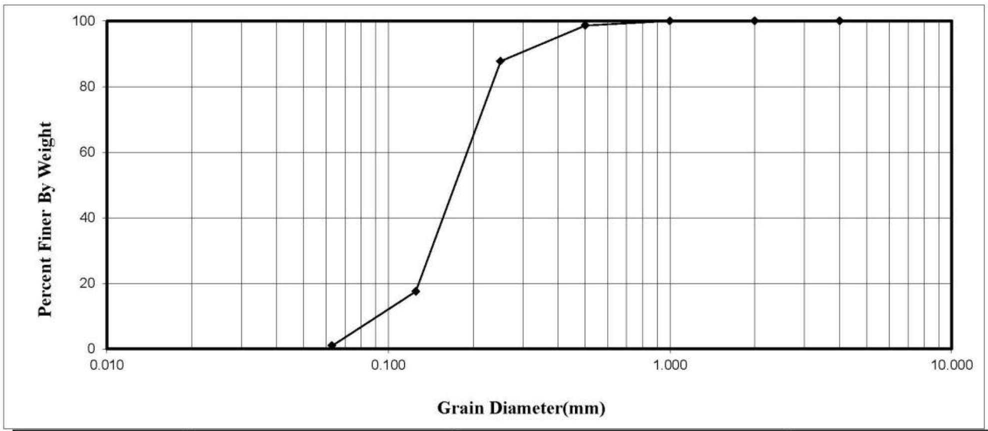
D10 (mm)	D16 (mm)	D35 (mm)	D50 (mm)	D65 (mm)	D84 (mm)	D90 (mm)	Geometric Standard Deviation
0.008	0.012	0.034	0.041	0.051	0.078	0.112	2.660

IWM SEDIMENT LABORATORY

Sieve Analysis of Bed Sample

Analysis Type:	Dry Sieving	**Sample Number:**	6
Station:	Sadarghat	**Position [Easting] (m) :**	90° 24.862'
River/Channel:	Buriganga	**Position [Northing] (m) :**	23° 41.124'
Collection Date:		**Sample Weight before Sieving (g):**	50.2472
Collection Time:		**Sample Weight after Sieving (g):**	50.1557
		Sample Loss after Sieving (g):	0.092
		Sand(%) [> 63 µm] :	99.06
		Silt & Clay(%) [< 63 µm] :	0.94

Sieve Size (mm)	Material Retained (g)	Material Retained (%)	Material Finer (%)
4.000	0.0000	0.000	100.000
2.000	0.0000	0.000	100.000
1.000	0.0000	0.000	100.000
0.500	0.6817	1.359	98.641
0.250	5.4826	10.931	87.710
0.125	35.2111	70.204	17.506
0.063	8.3108	16.570	0.936
Pan	0.4695	0.936	0.000



D10 (mm)	D16 (mm)	D35 (mm)	D50 (mm)
0.092	0.117	0.149	0.172

D65 (mm)	D84 (mm)	D90 (mm)	Geometric Standard Deviation
0.200	0.241	0.289	1.436

IWM SEDIMENT LABORATORY

Determination of Grain Size Distribution

Analysis Type : Andreasens Tube & Wet Sieving

River: Dhaleswari
Station: Narayangonj
Collection Date:
Collection Time:

Bottol No: 3
Sample Type : Bed Sample
Position (m) (Easting) : 90° 27.415'
Position (m) (Northing) : 23° 36.644'
X-Section:

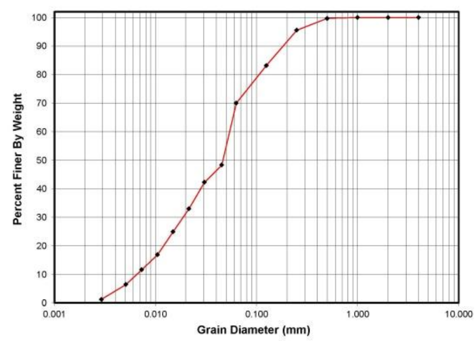
Temperature In °C. **Initial :** 30.0 **Final :** **Factor, F:** 0.01220

Time	Time (T) (min)	Height (H) (Initial)	SQRT. (H/T)	Volume (ml)	Filter Paper Wt.(g)	Filter Paper & Sample Wt.(g)	Concentration (mg/l)	Dia [D} (mm) [F*SQRT(H/T)]	Finer (%)	Adjusted Finer (%)
8:00	0	102.0		100.0	0.0755	0.3722	2967.00		100.00	70.003
8:01	1	100.0	10.000	100.0	0.0753	0.3428	2675.00	0.122	90.16	63.113
8:03	3	98.0	5.715	100.0	0.0752	0.3153	2401.00	0.070	80.92	56.649
8:07	7	96.0	3.703	100.0	0.0758	0.2804	2046.00	0.045	68.96	48.273
8:15	15	94.0	2.503	100.0	0.0754	0.2545	1791.00	0.031	60.36	42.256
8:30	30	92.0	1.751	100.0	0.0753	0.2148	1395.00	0.021	47.02	32.913
9:00	60	90.0	1.225	100.0	0.0757	0.1814	1057.00	0.015	35.63	24.939
10:00	120	88.0	0.856	100.0	0.0768	0.1483	715.00	0.010	24.10	16.870
12:00	240	86.0	0.599	100.0	0.0757	0.1248	491.00	0.007	16.55	11.585
16:00	480	84.0	0.418	100.0	0.0758	0.1030	272.00	0.005	9.17	6.417
8:00	1440	82.0	0.239	100.0	0.0760	0.0812	52.00	0.003	1.75	1.227

B.Coarser Part (>63μm)

Sample Weight before Sieving (g):	50.1607
Sample (>63μm) Weight after Sieving (g):	15.1470
Sample (< 63μm) Weight after Sieving (g):	35.0137

Sieve Size (mm)	Weight Retained (g)	Weight Retained (%)	Cumulative Retained (%)	Finer (%)
4.000	0.0000	0.0000	0.0000	100.0000
2.000	0.0000	0.0000	0.0000	100.0000
1.000	0.0000	0.0000	0.0000	100.0000
0.500	0.1733	0.3455	0.3455	99.6545
0.250	2.0942	4.1750	4.5205	95.4795
0.125	6.1856	12.3316	16.8520	83.1480
0.063	6.5938	13.1454	29.9974	70.0026
Pan	0.1001	0.1996	30.1969	69.8031



C. Summary of Results :

Grain Diameter (mm)	4.000	2.000	1.000	0.500	0.250	0.125	0.063	0.045
Percent Finer	100.00	100.00	100.00	99.65	95.48	83.15	70.00	48.27
Grain Diameter (mm)	0.031	0.021	0.015	0.010	0.007	0.005	0.003	
Percent Finer	42.26	32.91	24.94	16.87	11.58	6.42	1.23	

D10 (mm)	D16 (mm)	D35 (mm)	D50 (mm)	D65 (mm)	D84 (mm)	D90 (mm)	Geometric Standard Deviation
0.007	0.010	0.023	0.046	0.058	0.131	0.184	3.724

IWM SEDIMENT LABORATORY

Determination of Grain Size Distribution

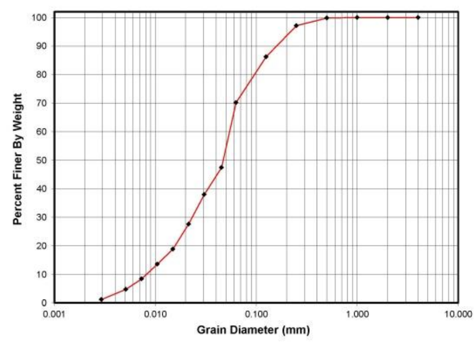
Analysis Type : Andreasens Tube & Wet Sieving

River: Upper Meghna
Station: Munshiganj
Collection Date:
Collection Time:

Bottol No: 2
Sample Type : Bed Sample
Position (m) (Easting) : 90° 34.660'
Position (m) (Northing) : 23° 32.974'
X-Section:

Temperature In °C. **Initial :** 30.0 **Final :** **Factor, F:** **0.01220**

Time	Time (T) (min)	Height (H) (Initial)	SQRT. (H/T)	Volume (ml)	Filter Paper Wt.(g)	Filter Paper & Sample Wt.(g)	Concentration (mg/l)	Dia [D} (mm) [F*SQRT(H/T)]	Finer (%)	Adjusted Finer (%)
8:00	0	102.0		100.0	0.0768	0.3207	2439.00		100.00	70.196
8:01	1	100.0	10.000	100.0	0.0760	0.2980	2220.00	0.122	91.02	63.893
8:03	3	98.0	5.715	100.0	0.0762	0.2860	2098.00	0.070	86.02	60.382
8:07	7	96.0	3.703	100.0	0.0753	0.2400	1647.00	0.045	67.53	47.402
8:15	15	94.0	2.503	100.0	0.0752	0.2070	1318.00	0.031	54.04	37.933
8:30	30	92.0	1.751	100.0	0.0754	0.1714	960.00	0.021	39.36	27.629
9:00	60	90.0	1.225	100.0	0.0766	0.1420	654.00	0.015	26.81	18.823
10:00	120	88.0	0.856	100.0	0.0764	0.1235	471.00	0.010	19.31	13.556
12:00	240	86.0	0.599	100.0	0.0755	0.1048	293.00	0.007	12.01	8.433
16:00	480	84.0	0.418	100.0	0.0753	0.0917	164.00	0.005	6.72	4.720
8:00	1440	82.0	0.239	100.0	0.0752	0.0792	40.00	0.003	1.64	1.151



B.Coarser Part (>63µm)

Sample Weight before Sieving (g):	50.2428
Sample (>63µm) Weight after Sieving (g):	15.0619
Sample (< 63µm) Weight after Sieving (g):	35.1809

Sieve Size (mm)	Weight Retained (g)	Weight Retained (%)	Cumulative Retained (%)	Finer (%)
4.000	0.0000	0.0000	0.0000	100.0000
2.000	0.0000	0.0000	0.0000	100.0000
1.000	0.0000	0.0000	0.0000	100.0000
0.500	0.1148	0.2285	0.2285	99.7715
0.250	1.3310	2.6491	2.8776	97.1224
0.125	5.4856	10.9182	13.7958	86.2042
0.063	8.0429	16.0081	29.8039	70.1961
Pan	0.0876	0.1744	29.9782	70.0218

C. Summary of Results :

Grain Diameter (mm)	**4.000**	**2.000**	**1.000**	**0.500**	**0.250**	**0.125**	**0.063**	**0.045**
Percent Finer	100.00	100.00	100.00	99.77	97.12	86.20	70.20	47.40
Grain Diameter (mm)	**0.031**	**0.021**	**0.015**	**0.010**	**0.007**	**0.005**	**0.003**	
Percent Finer	37.93	27.63	18.82	13.56	8.43	4.72	1.15	

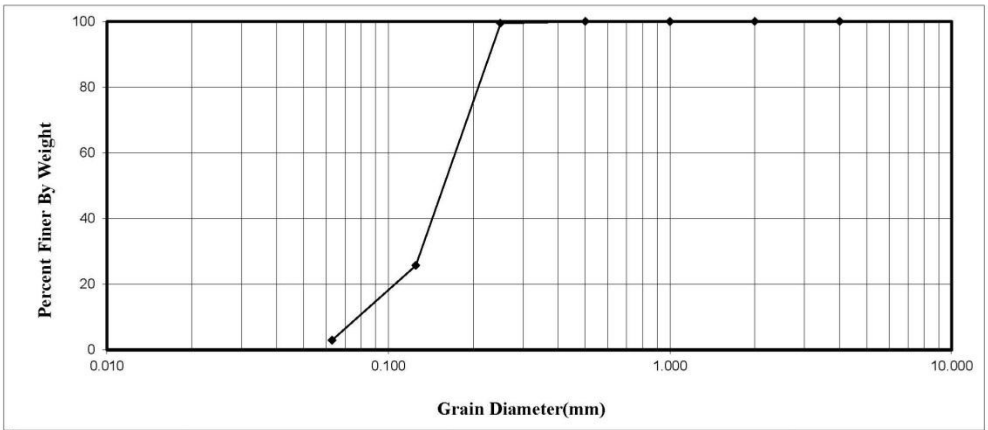
D10 (mm)	D16 (mm)	D35 (mm)	D50 (mm)	D65 (mm)	D84 (mm)	D90 (mm)	Geometric Standard Deviation
0.008	0.012	0.028	0.047	0.058	0.114	0.159	3.171

IWM SEDIMENT LABORATORY

Sieve Analysis of Bed Sample

Analysis Type:	Dry Sieving	**Sample Number:**	1
Station:	Chandpur	**Position [Easting] (m) :**	90° 36.908'
River/Channel:	Lower Meghna	**Position [Northing] (m) :**	23° 09.856'
Collection Date:		**Sample Weight before Sieving (g):**	50.1558
Collection Time:		**Sample Weight after Sieving (g):**	50.0892
		Sample Loss after Sieving (g):	0.067
		Sand(%) [> 63 µm] :	97.06
		Silt & Clay(%) [< 63 µm] :	2.94

Sieve Size (mm)	Material Retained (g)	Material Retained (%)	Material Finer (%)
4.000	0.0000	0.000	100.000
2.000	0.0000	0.000	100.000
1.000	0.0000	0.000	100.000
0.500	0.0000	0.000	100.000
0.250	0.2809	0.561	99.439
0.125	36.9597	73.788	25.651
0.063	11.3778	22.715	2.936
Pan	1.4708	2.936	0.000



D10 (mm)	D16 (mm)	D35 (mm)	D50 (mm)
0.078	0.093	0.136	0.157

D65 (mm)	D84 (mm)	D90 (mm)	Geometric Standard Deviation
0.181	0.216	0.229	1.532

Benthic Test

Department of Zoology
University of Dhaka
Analysis of Benthic Samples

Sampling procedure : Unknown
No of Samples : 24
Sample received on : 18th October 2015
Sample analysed on : 30th October 2015
Locations : Routes between Dhaka and Chittagong
Client : ENRAC

Sample No	Sample ID	References	Results	Comments (if any)
1	Ben-01-01	23°09.856N, 90°.36908 E Dt. 30.09.2015	Oligochaetes:3,Polychaetes:1	
2	Ben-01-02	23°09.858N , 90°36.908 E Dt. 30.09.2015	Oligochaetes:3	
3	Ben 02-01	23°32.934N, 90°34.660 E Dt. 01.10.2015	Polychaetes:17,Oligochaetes:2,Bivalves :15	
4	Ben-02-02	23°32.936 N. 90°34.662 E Dt. 01.10.2015	Polychaetes:8,Oligochaetes:5	
5	BEN 03-01	23°36.642 N, 90°27.413 E Dt. 01.10.2015	Oligochaetes: 3, Polychaetes:2 Bivalves:4	
6	Ben-03-02	23°36.644 N, 90°27.415E Dt. 01.10.2015	Boligochaete:1,Bivalve:1	
7	Ben 04-01	23°44.653 N, 90°43.408 E Dt. 02.10.2015	Oligichaetes:5,Polychaetes:2,Bavalves:2 , Gastropodes:20	
8	Ben-04-02	23°44.655 N, 90°24.862 E Dt. 02.10.2015	Aquatic insects:1,Gastropods:2	

1. 11. 2015

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ঢাকা বিশ্ববিদ্যালয়

Sample No	Sample ID	References	Results	Comments (if any)
9	Ben-05-01	23°36.638 N, 90°27.418 E Dt. 03.10.2015	Oligochaetes : 4,Aquatic insects:3, Bivalves:2	
10	Ben-05-02	23°36.639 N, 90°27.419 E Dt. 03.10.2015	Aquatic insects:5, Bivalves:2, Gastropods:5	
11	Ben-06-01	23°41.124 N, 90°24.852 E Dt. 03.10.2015	Oligochaetes:24	
12	Ben-06-02	23°41.125 N, 90°24.863 E Dt. 03.10.2015	Oligochates:12	
13	Ben-07-01	22°23.373 N, 91°32.717 E Dt. 06.10.2015	Oligochaetes:2	
14	Ben-07-02	22°23.372 N, 91°32.718 E Dt. 96.10.2015	Oligochates:2, Aquatic insects:1	
15	Ben-08-01	22°31.786 N, 91°.40.665 E Dt. 07.10.2015	Polychaetes:4, Oligochaetes:1	
16	Ben-08-02	22°31.370 N, 91°05.343 E Dt. 07.10.2015	Aquatic insects:1	
17	Ben-09-01	22°41.653 N, 90°27.415 E Dt. 10.10.2015	Oligochaetes: 1,Gastropods:1	
18	Ben-09-02	22°42.282 N, 90°31.152 E Dt. 10.10.2015	Oligochaetes:3,Polychates: 2,Bivalves:2	

1.11.2015

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ঢাকা বিশ্ববিদ্যালয়

Sample No	Sample ID	References	Results	Comments (if any)
19	Ben-10-01	22°50.207 N, 90°37.258 E Dt. 10.10.2015	Oligochaetes:2 , Aquatic insects:3	
20	Ben-10-02	22°50.207N, 90°37.285 E Dt. 10.10.2015	Oligochates:2,Polychates:2,Bivalves:10	
21	Ben-11-01	22°42.979 N, 90°40.665 E Dt. 11.10.2015	Polychaetes:5,Aquatic insects:2	
22	Ben-11-02	22°42.979 N, 90°40.665 E Dt. 11.10.2015	Polychaetes:9,Aquatic insects:1	
23	Ben-12-01	23°38.142 N, 90°46.125 E Dt. 11.10.2015	Oligochaetes:1	
24	Ben-12-02	22°37.886 N, 90°46.097E Dt. 11.10.2015	Aquatic insects:9	

1.11.2015

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ঢাকা বিশ্ববিদ্যালয়

Air and Noise Quality Test

ENRAC

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 02/10/2015, 12:19 PM
ANALYSIS DATE	: 18/10/2015
SAMPLING ID	: AAQ_01 (Ashuganj)
GPS COORDINATES	: 24º02.405′ N 90º59.696′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set on the Meghna river bank which was 380 and 280 meter south from the Bhairab road bridge and rail bridge respectively. • Construction of second Bhairab rail bridge was running and different type of water transports were plying through this river during sampling. However, Ashuganj fertilizer and power plant was located about 800 m down stream from the sampling location. • Vegetation was less and some aquatic fauna were found around the sampling site.	Carbon Monoxide (CO)	$\mu g/m^3$	72	1069	510.77	10000 (8 hour)
	Nitric Oxide (NO)	$\mu g/m^3$	0	49	22.61	100 (Annual)
	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	0	39	18.34	
	Sulphur Dioxide (SO_2)	$\mu g/m^3$	0	44	16.98	365 (24 hour)
	Ozone (O_3)	$\mu g/m^3$	0	36	11.37	157 (8 hour)
	Particulate Matter (PM_{10})	$\mu g/m^3$	26	169	89.21	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	2	95	41.41	65 (24 hour)
	Air Temperature	ºC	31	35	32.69	NSE**
	Relative Humidity	%	50	60	55.01	NSE**

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_01	12:19 PM (480)	dBA	41.2	56.7	49.86

GoB Noise Standard***	Zone	Day	Night
	Silent	50	40
	Residential	55	45
	Mixed	60	50
	Commercial	70	60
	Industrial	75	70

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997 **
NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Analysed and Prepared by

Shahid

Shahid Zaman

Approved by

Md. Rakibul Haque 15/10/2015

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ENRAC

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 03/10/2015, 11:05 AM
ANALYSIS DATE	: 18/10/2015
SAMPLING ID	: AAQ_02 (Sadarghat)
GPS COORDINATES	: 23°42.392′ N 90°24.474′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set at Sadarghat launch terminal area which was 2 m south from the river bank. • The terminal was very busy and crowded with passengers. Different type of water transports (such as launch, trawler, engine boat) were anchored along the sampling location. Country boats run by engine was prominent among them. • Vegetation was less and no wildlife except some birds were found around the sampling site.	Carbon Monoxide (CO)	μg/m^3	110	1877	1016.25	10000 (8 hour)
	Nitric Oxide (NO)	μg/m^3	0	80	31.84	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m^3	0	64	20.15	
	Sulphur Dioxide (SO_2)	μg/m^3	0	52	23.67	365 (24 hour)
	Ozone (O_3)	μg/m^3	0	37	15.89	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m^3	44	279	127.18	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m^3	5	139	54.33	65 (24 hour)
	Air Temperature	°C	28	35	30.83	NSE**
	Relative Humidity	%	38	70	57.82	NSE**

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_02	11:05 AM (480)	dBA	52.5	87.5	65.06
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997 **
NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Analysed and Prepared by

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Approved by

Md. Rakibul Haque 15/10/2015

ENRAC

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 10/10/2015, 08:06 AM
ANALYSIS DATE	: 18/10/2015
SAMPLING ID	: AAQ_03 (Barisal)
GPS COORDINATES	: 22°42.033′ N 90°31.460′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set on the Kalabhadurpur river bank which was about 700 m south from the Shreepur bazar and the location was prone to erosion. • Different type of water vessels were plying through the river channel. Country boats run by engine was dominant which were used for fishing. However, ferry, launch and trawler also observed during sampling. • Vegetation was high and different type of aquatic fauna were found around the sampling site.	Carbon Monoxide (CO)	μg/m^3	46	537	254.14	10000 (8 hour)
	Nitric Oxide (NO)	μg/m^3	0	44	12.51	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m^3	0	29	9.79	
	Sulphur Dioxide (SO_2)	μg/m^3	0	33	11.62	365 (24 hour)
	Ozone (O_3)	μg/m^3	0	25	8.44	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m^3	5	89	49.67	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m^3	0	34	21.84	65 (24 hour)
	Air Temperature	°C	25	28	26.71	NSE**
	Relative Humidity	%	59	71	62.56	NSE**

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_03	08:06 AM (480)	dBA	44.5	64.5	55.72
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997 **

NSE- No standards established yet

*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Analysed and Prepared by

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Shahid Zaman

Approved by

Md. Rakibul Haque 15/10/2015

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ENRAC

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 11/10/2015, 10:04 AM
ANALYSIS DATE	: 18/10/2015
SAMPLING ID	: AAQ_04 (Bhola)
GPS COORDINATES	: 22º42.978′ N 90º40.665′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set on the bank of Meghna river which was about 100 m east from the local bazar. • Due to fishing season, different type of water vessels were observed to ply along the sampling location. Country boats run by shallow engine were dominant among them. • Vegetation was high and some birds and aquatic fauna were found around the sampling site. • A boat ghat was located near the sampling location thus number of boats were found to cross the sampling point with heavy noise.	Carbon Monoxide (CO)	μg/m^3	67	641	319.08	10000 (8 hour)
	Nitric Oxide (NO)	μg/m^3	0	58	18.22	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m^3	0	32	15.51	
	Sulphur Dioxide (SO_2)	μg/m^3	0	47	15.18	365 (24 hour)
	Ozone (O_3)	μg/m^3	0	39	10.32	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m^3	7	118	83.11	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m^3	0	40	28.56	65 (24 hour)
	Air Temperature	ºC	27	29	27.70	NSE**
	Relative Humidity	%	66	75	69.91	NSE**

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_04	10:04 AM (480)	dBA	46.5	67.9	60.66
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997 **

NSE- No standards established yet

*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Analysed and Prepared by

Shahid

Shahid Zaman

Approved by

15/10/2015

Md. Rakibul Haque

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ENRAC

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 13/10/2015, 12:08 PM
ANALYSIS DATE	: 18/10/2015
SAMPLING ID	: AAQ_05 (Chandpur)
GPS COORDINATES	: 23°13.991′ N 90°38.896′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set at the launch terminal which was located on the Meghna river. • A boat ghat was located near the sampling location thus number of boats were found to cross the sampling point with heavy noise. • Various types of motor boats and launches were sailing in the river during sampling.	Carbon Monoxide (CO)	μg/m³	84	1061	802.77	10000 (8 hour)
	Nitric Oxide (NO)	μg/m³	0	55	27.76	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m³	0	41	19.32	
	Sulphur Dioxide (SO_2)	μg/m³	0	50	21.07	365 (24 hour)
	Ozone (O_3)	μg/m³	0	39	14.37	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m³	23	178	95.83	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m³	4	91	46.17	65 (24 hour)
	Air Temperature	°C	25	28	26.34	NSE**
	Relative Humidity	%	61	75	67.48	NSE**

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_05	12:08 PM (480)	dBA	50.2	79.3	63.52

GoB Noise Standard***	Zone	Day	Night
	Silent	50	40
	Residential	55	45
	Mixed	60	50
	Commercial	70	60
	Industrial	75	70

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NSE- No standards established yet

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Analysed and Prepared by

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ENRAC

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 14/10/2015, 08:49 AM
ANALYSIS DATE	: 18/10/2015
SAMPLING ID	: AAQ_06 (Munshiganj)
GPS COORDINATES	: 23°32.635′ N, 90°35.287′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set at the Gozaria bazar on the Meghna river bank.The launch terminal was located 100 m inside the river. • Various types of motor boats and launches were sailing in the river during sampling. • A boat ghat was located near the sampling location thus number of boats were found to cross the sampling point with heavy noise.	Carbon Monoxide (CO)	µg/m^3	65	788	421.25	10000 (8 hour)
	Nitric Oxide (NO)	µg/m^3	0	45	19.07	100 (Annual)
	Nitrogen Dioxide (NO_2)	µg/m^3	0	30	16.56	
	Sulphur Dioxide (SO_2)	µg/m^3	0	46	16.01	365 (24 hour)
	Ozone (O_3)	µg/m^3	0	26	12.61	157 (8 hour)
	Particulate Matter (PM_{10})	µg/m^3	14	137	87.22	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	µg/m^3	2	69	37.58	65 (24 hour)
	Air Temperature	°C	26	35	30.43	NSE**
	Relative Humidity	%	45	68	57.88	NSE**

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_06	08:49 AM (480)	dBA	46.8	70.2	53.52
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997 **

NSE- No standards established yet

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Dry Period

Water Quality Test

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
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ENVIRONMENTAL ENGINEERING LABORATORY

BRTC
Bureau of Research, Testing & Consultation

BRTC No. : **1100110104259 /15-16/CE; Dt: 31/1/2016** Ref. No. : Letter; Dt: 31/1/2016

Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -1 A (SW 1) Location : Haringhat, Chandpur

Date of Test : 31/1/2016 - 28/2/2016 Source : Surface water (Sampling Date- 29/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
1	pH	---	**8.47**	USEPA 150.1; SM 4500-H+ B	0
2	Electrical Conductivity (EC) at 25°	µS/cm	**264**	USEPA 120.1; SM 2510 B	0.1
3	Turbidity	NTU	**8.2**	USEPA 180.1 Rev 2; SM 2130 B	0.01
4	Dissolved Oxygen (DO)	mg/l	**3.18***	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
5	Total Dissolved Solids (TDS)	mg/l	**155**	USEPA 160.2; SM 2540 B - D	5
6	Total Suspended Solids (TSS)	mg/l	**26**	USEPA 160.2; SM 2540 B - D	5
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	**2**	USEPA 410.4; SM 5220 D	0.2
8	Biochemical oxygen Demand (BOD5)	mg/l	**<MDL**	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
9	Nitrate - Nitrogen (NO3 - N)	mg/l	**0.3**	USEPA 353.2; SM 4500-NO3-N-F	0.1
10	Sodium (Na)	mg/l	**25**	USEPA 200.9 ; SM 3111 B	0.01

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.
3. * As the supplied samples were collected couple of days before testing (as per letter), obtained dissolved oxygen (DO) concentration may not represent the actual DO concentration at the source.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned *by*:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed *by*:

2/3/16
Snigdha Afsana
Assisstant Professor, Dept. of Civil Engineering

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Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -1 A (SW 1) Location : Haringhat, Chandpur

Date of Test : 31/1/2016 - 28/2/2016 Source : Surface water (Sampling Date- 29/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
11	Potassium (K)	mg/l	**17.9**	USEPA 200.9 ; SM 3111 B	0.02
12	Cadmium (Cd)	mg/l	**26.85**	USEPA 213.2 ; SM 3113 B	0.001
13	Magnesium (Mg)	mg/l	**6.69**	USEPA 200.9 ; SM 3111 B	0.001
14	Total Organic Carbon (TOC)	mg/l	**3.56**	USEPA 415.3 ; SM 5310 D	---
15	Total Phosphorous (TP)	mg/l	**0.19**	USEPA 365.4; SM 4500 – P B & E	0.06
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	---	---	---	---	---
20	---	---	---	---	---

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Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -2 A (SW 2) Location : Gazaria, Chandpur

Date of Test : 31/1/2016 - 28/2/2016 Source : Surface water (Sampling Date- 27/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
1	pH	---	**7.31**	USEPA 150.1; SM 4500-H+ B	0
2	Electrical Conductivity (EC) at 25°	μS/cm	**278**	USEPA 120.1; SM 2510 B	0.1
3	Turbidity	NTU	**3.34**	USEPA 180.1 Rev 2; SM 2130 B	0.01
4	Dissolved Oxygen (DO)	mg/l	**0.83***	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
5	Total Dissolved Solids (TDS)	mg/l	**191**	USEPA 160.2; SM 2540 B - D	5
6	Total Suspended Solids (TSS)	mg/l	**35**	USEPA 160.2; SM 2540 B - D	5
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	**7**	USEPA 410.4; SM 5220 D	0.2
8	Biochemical oxygen Demand (BOD5)	mg/l	**1**	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
9	Nitrate - Nitrogen (NO3 - N)	mg/l	**2.2**	USEPA 353.2; SM 4500-NO3-N-F	0.1
10	Sodium (Na)	mg/l	**44.7**	USEPA 200.9 ; SM 3111 B	0.01

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Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -2 A (SW 2) Location : Gazaria, Chandpur

Date of Test : 31/1/2016 - 28/2/2016 Source : Surface water (Sampling Date- 27/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
11	Potassium (K)	mg/l	**5.8**	USEPA 200.9 ; SM 3111 B	0.02
12	Cadmium (Cd)	mg/l	**16.41**	USEPA 213.2 ; SM 3113 B	0.001
13	Magnesium (Mg)	mg/l	**5.73**	USEPA 200.9 ; SM 3111 B	0.001
14	Total Organic Carbon (TOC)	mg/l	**4.89**	USEPA 415.3 ; SM 5310 D	---
15	Total Phosphorous (TP)	mg/l	**0.69**	USEPA 365.4; SM 4500 – P B & E	0.06
16	---	---	**---**	---	---
17	---	---	**---**	---	---
18	---	---	**---**	---	---
19	---	---	**---**	---	---
20	---	---	**---**	---	---

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Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -3 A (SW 4) Location : Araihazar, Narayangonj

Date of Test : 31/1/2016 - 28/2/2016 Source : Surface water (Sampling Date- 27/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
11	Potassium (K)	mg/l	**22.8**	USEPA 200.9 ; SM 3111 B	0.02
12	Cadmium (Cd)	mg/l	**39.65**	USEPA 213.2 ; SM 3113 B	0.001
13	Magnesium (Mg)	mg/l	**8.86**	USEPA 200.9 ; SM 3111 B	0.001
14	Total Organic Carbon (TOC)	mg/l	**11.48**	USEPA 415.3 ; SM 5310 D	---
15	Total Phosphorous (TP)	mg/l	**3.84**	USEPA 365.4; SM 4500 – P B & E	0.06
16	---	---	---	---	---
17	---	---	---	---	---
18	---	---	---	---	---
19	---	---	---	---	---
20	---	---	---	---	---

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DEPARTMENT OF CIVIL ENGINEERING * BUET *

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Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)
Project : Navigational Improvement on Dhaka-Chittagong Waterways Project
Company Address : 464/C (Ground Floor), Khilgaon, Dhaka
Sample Id : Sample No. -3 A (SW 4) Location : Araihazar, Narayangonj
Date of Test : 31/1/2016 - 28/2/2016 Source : Surface water (Sampling Date- 27/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
1	pH	---	**7.77**	USEPA 150.1; SM 4500-H+ B	0
2	Electrical Conductivity (EC) at 25°	μS/cm	**786**	USEPA 120.1; SM 2510 B	0.1
3	Turbidity	NTU	**48.6**	USEPA 180.1 Rev 2; SM 2130 B	0.01
4	Dissolved Oxygen (DO)	mg/l	**1.02***	USEPA 360.3, 360.2; SM 4500- O B,G	0.1
5	Total Dissolved Solids (TDS)	mg/l	**492**	USEPA 160.2; SM 2540 B - D	5
6	Total Suspended Solids (TSS)	mg/l	**19**	USEPA 160.2; SM 2540 B - D	5
7	Chemical Oxygen Demand (COD) : Dichromate	mg/l	**21**	USEPA 410.4; SM 5220 D	0.2
8	Biochemical oxygen Demand (BOD5)	mg/l	**14.4**	USEPA 405.1; SM 5210 B; SM 5210 D	0.2
9	Nitrate - Nitrogen (NO3 - N)	mg/l	**1.3**	USEPA 353.2; SM 4500-NO3-N-F	0.1
10	Sodium (Na)	mg/l	**187.1**	USEPA 200.9 ; SM 3111 B	0.01

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Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)
Project : Navigational Improvement on Dhaka-Chittagong Waterways Project
Company Address : 464/C (Ground Floor), Khilgaon, Dhaka
Sample Id : Sample No. -4A (GW 1) Location : Haringhat, Chandpur
Date of Test : 31/1/2016 - 28/2/2016 Source : Ground water (Sampling Date- 29/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
1	pH	---	**7.9**	USEPA 150.1; SM 4500-H+ B	0
2	Electrical Conductivity (EC) at 25°	μS/cm	**411**	USEPA 120.1; SM 2510 B	0.1
3	Total Dissolved Solids (TDS)	mg/l	**284**	USEPA 160.2; SM 2540 B - D	5
4	Iron (Fe)	mg/l	**1.7**	USEPA 200.9 ; SM 3111 B	0.02
5	Manganese (Mn)	mg/l	**<MDL**	USEPA 200.9 ; SM 3111 B	0.08
6	Arsenic (As)	mg/l	**0.001**	USEPA 206.2; SM 3113 B	0.001
7	Sodium (Na)	mg/l	**48.7**	USEPA 200.9 ; SM 3111 B	0.01
8	Potassium (K)	mg/l	**8.2**	USEPA 200.9 ; SM 3111 B	0.02
9	Calcium (Ca)	mg/l	**18.78**	USEPA 215.2; SM 3113 B	0.02
10	Magnesium (Mg)	mg/l	**7.74**	USEPA 200.9 ; SM 3111 B	0.001

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DEPARTMENT OF CIVIL ENGINEERING * BUET *

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Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)
Project : Navigational Improvement on Dhaka-Chittagong Waterways Project
Company Address : 464/C (Ground Floor), Khilgaon, Dhaka
Sample Id : Sample No. -5A (GW 2) Location : Gazaria, Chandpur
Date of Test : 31/1/2016 - 28/2/2016 Source : Ground water (Sampling Date- 27/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
1	pH	---	**7.72**	USEPA 150.1; SM 4500-H+ B	0
2	Electrical Conductivity (EC) at 25°	μS/cm	**763**	USEPA 120.1; SM 2510 B	0.1
3	Total Dissolved Solids (TDS)	mg/l	**469**	USEPA 160.2; SM 2540 B - D	5
4	Iron (Fe)	mg/l	**0.9**	USEPA 200.9 ; SM 3111 B	0.02
5	Manganese (Mn)	mg/l	**<MDL**	USEPA 200.9 ; SM 3111 B	0.08
6	Arsenic (As)	mg/l	**0.001**	USEPA 206.2; SM 3113 B	0.001
7	Sodium (Na)	mg/l	**200**	USEPA 200.9 ; SM 3111 B	0.01
8	Potassium (K)	mg/l	**4.4**	USEPA 200.9 ; SM 3111 B	0.02
9	Calcium (Ca)	mg/l	**23.62**	USEPA 215.2; SM 3113 B	0.02
10	Magnesium (Mg)	mg/l	**10.68**	USEPA 200.9 ; SM 3111 B	0.001

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned *by*:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed *by*:

2/3/16
Snigdha Afsana
Assisstant Professor, Dept. of Civil Engineering

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
DEPARTMENT OF CIVIL ENGINEERING
Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/
ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

BRTC No. : **1100110104259 /15-16/CE; Dt: 31/1/2016** Ref. No. : Letter; Dt: 31/1/2016

Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -6A (GW 4) Location : Araihazar, Narayangonj

Date of Test : 31/1/2016 - 28/2/2016 Source : Ground water (Sampling Date- 27/01/2016)

TEST REPORT (CHEMICAL ANALYSIS OF WATER SAMPLE)

Sl. No.	Water Quality Parameters	Unit	Concentration Present	Method of analysis	Minimum Detection Limit (MDL)
1	pH	---	**7.54**	USEPA 150.1; SM 4500-H+ B	0
2	Electrical Conductivity (EC) at 25°	μS/cm	**712**	USEPA 120.1; SM 2510 B	0.1
3	Total Dissolved Solids (TDS)	mg/l	**430**	USEPA 160.2; SM 2540 B - D	5
4	Iron (Fe)	mg/l	**22**	USEPA 200.9 ; SM 3111 B	0.02
5	Manganese (Mn)	mg/l	**0.26**	USEPA 200.9 ; SM 3111 B	0.08
6	Arsenic (As)	mg/l	**0.006**	USEPA 206.2; SM 3113 B	0.001
7	Sodium (Na)	mg/l	**148.2**	USEPA 200.9 ; SM 3111 B	0.01
8	Potassium (K)	mg/l	**4.2**	USEPA 200.9 ; SM 3111 B	0.02
9	Calcium (Ca)	mg/l	**52.78**	USEPA 215.2; SM 3113 B	0.02
10	Magnesium (Mg)	mg/l	**23.01**	USEPA 200.9 ; SM 3111 B	0.001

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Countersigned *by*:

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed *by*:

2/3/16

Snigdha Afsana
Assisstant Professor, Dept. of Civil Engineering

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No. : i) 71 of BCSIR Laboratories, Dhaka. Date: 02/02/2016
: ii) D-71 of Analytical Service cell, BCSIR, Date: 01/02/2016
Lab ID : SE- 404
Referred by : Bashir Ahmed, Environment Specialist, Environment and Resource Analysis Center Ltd., 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details : Testing of riverbed sediment, surface water (SW), ground water (GW) and soil (as supplied).

Analytical Result :

Sl. No.	Parameters	Results					
		SW 5	GW 5	RB 5	Soil 1	Soil 2	Soil 3
01	pH	7.541	6.763	----	6.177	6.127	6.187
02	EC	129.1 μS/cm	462.1 μS/cm	----	441 μS/cm	350 μS/cm	1877 μS/cm
03	TDS	64.5 mg/L	231.1 mg/L	----	----	----	----
04	Turbidity	6.97 NTU	----	----	----	----	----
05	DO	7.74 mg/L	----	----	----	----	----
06	BOD_5	3.2 mg/L	----	----	----	----	----
07	Salinity	----	----	0.06 %	----	----	----
08	TSS	117 mg/L	----	----	----	----	----
09	Magnesium (Mg)	6.854 ppm	26.714 ppm	----	0.206 %	0.016 %	0.369 %
10	Potassium (K)	2.14 ppm	4.01 ppm	----	0.123 %	0.113 %	0.287 %
11	Calcium (Ca)	13.896 ppm	42.960 ppm	----	0.145 %	0.234 %	0.539 %
12	Sodium (Na)	8.21 ppm	1.19 ppm	----	0.045 %	0.046 %	0.072 %
13	Iron (Fe)	----	1.75 ppm	----	----	----	----
14	Manganese (Mn)	----	5.67 ppm	----	----	----	----
15	Arsenic (As)	----	0.011 ppm	0.051 ppm	----	----	----
16	TOC	0.0011 %	----	0.666 %	0.248 %	0.074 %	1.518 %
17	Total Phosphate	3.435 ppm	----	0.217 %	0.134 %	0.069 %	0.460 %
18	Total Nitrate	0.714 ppm	----	6.675 ppm	10.108 ppm	3.750 ppm	98.796 ppm
19	Cadmium (Cd)	----	----	0.140 ppm	----	----	----
20	Lead (Pb)	----	----	10.525 ppm	----	----	----
21	Chromium (Cr)	----	----	23.797 ppm	----	----	----
22	Zinc (Zn)	----	----	51.658 ppm	----	----	----
23	Nickel (Ni)	----	----	35.261 ppm	----	----	----
24	Mercury (Hg)	----	----	BDL*	----	----	----

***BDL** = Below Detection Limit (Detection Limits: Hg = 1.0 ppb)

Methodology / Instrument: 1. pH: pH meter, **2.** EC: EC meter, **3.** Salinity: Salinity Meter, **4.** Nitrate: Ion Chromatographic Method, **5.** Phosphate: Vanadomolybdophosphophoric Yellow color method, **6.** TDS: TDS meter, **7.** DO: DO meter, **8.** Turbidity: Turbidity meter, **9.** TSS: Gravimetric method **10.** Mg, Ca, Cd, Pb, Cr, Zn & Ni: Flame Atomic Absorption Spectrophotometric method, **11.** As: Atomic Absorption Spectrophotometer with Hydride Vapour Generator unit, **12.** Hg: Atomic Absorption Spectrophotometer with Mercury Vaporizer unit, **13.** BOD_5: BOD Tracking System. **14.** TOC: Walkley and Black oxidation method

Special Notes: (1) The result reported here pertained to the sample received in the laboratory only. The laboratory is not responsible for the data quality affected due to the above. The precision & accuracy are defined only for the laboratory process, not for the sampling, transporting & storage processes. **(2)** The result should not be reproduced wholly or in part and cannot be used as evidence in the court of law and should not be used in any advertising media without our special permission in writing. **(3)** Any complain about the test result will not be accepted after one month from the date of issuing of the said report. **(4)** This report is free from any legal litigation and BCSIR Laboratories, Dhaka is not liable for any legal implication relating the report.

Afroza 29.02.2016	29/2/16	29.2	29.2.16
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
Afroza Parvin Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr. Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr. Qudrat-e-Khuda Road Dhaka-1205

Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Phone: 88-02-8621741, Fax: 88-02-8613022 Email: bcsir@bangla.net

জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service

BCSIR LABORATORIES, DHAKA

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Forwarding of Analysis Report

Ref No: i) 136 of BCSIR Lab. Dhaka dt. 15/02/2016
ii) D-136 of Analytical Service Cell, BCSIR. 14/02/2016

Attachment: Please find the Analysis Report as an attachment (page-1 of 1).

06-03-2016

Sig, and Name of the Validator

Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

6/3/16

Counter Signature
(Research Coordinator)

Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

6.3.16

Counter Signature
(Director)

Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

Certificate No: T-1676

Institute of National Analytical Research and Service (INARS)

ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস

BCSIR LABORATORIES, DHAKA

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 136 of BCSIR Lab. Dhaka dt. 15/02/2016 : ii) D-136 of Analytical Service Cell, BCSIR. 14/02/2016
Lab ID	: A-124 to A-127
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Surface water, Ground water and Riverbed sediment and Soil)** Date: 14/02/2016
Type of sample*	: Water
Quantity of sample	: 1 Litre/bottle (7 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 15/02/2016
Period of analysis	: 15/02/2016 to 06/03/2016
Visual observation/Remarks	: Yellowish, Blackish & Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-124	Surface water (Sample ID # SW 3)	pH at 25.1^{0}C	6.95	4500-H^+.B
		EC	560 μS/cm	2510.B
		TSS	18.4 mg/L	2540.D
		TDS	300 mg/L	2540.C
		Mg	11.7 mg/L	3111.B
		K	6.89 mg/L	3500-K B
		Ca	35.5 mg/L	3111.B
		Na	30.0 mg/L	3500-Na B
		TOC	3.17 mg/L	5310.B
		Total PO_4	2.38 mg/L	4500-P C
		Total NO_3	Less than 3 mg/L	4110.B
A-125	Surface water (Sample ID # SW 6)	pH at 24.8^{0}C	7.02	4500-H^+.B
		EC	1073 μS/cm	2510.B
		TSS	33.6 mg/L	2540.D
		TDS	537 mg/L	2540.C

*The results relate only to the items tested.

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Certificate No: T-1676

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-125	Surface water (Sample ID # SW 6)	Mg	15.2 mg/L	3111.B
		K	10.9 mg/L	3500-K B
		Ca	50.6 mg/L	3111.B
		Na	107 mg/L	3500-Na B
		TOC	10.8 mg/L	5310.B
		Total PO_4	7.24 mg/L	4500-P C
		Total NO_3	Less than 3 mg/L	4110.B
A-126	Ground water (Sample ID # SW 3)	pH at 25.1^0C	6.90	4500-H^+.B
		EC	861 µS/cm	2510.B
		TDS	540 mg/L	2540.C
		Mg	23.2 mg/L	3111.B
		K	5.48 mg/L	3500-K B
		Ca	123 mg/L	3111.B
		Na	11.4 mg/L	3500-Na B
		As	Less than 0.005 mg/L	3114.C
		Fe	1.57 mg/L	3111.B
		Mn	2.58 mg/L	3110.B
A-127	Ground water (Sample ID # SW 6)	pH at 24.7^0C	6.85	4500-H^+.B
		EC	986 µS/cm	2510.B
		TDS	562 mg/L	2540.C
		Mg	31.3 mg/L	3111.B
		K	4.04 mg/L	3500-K B
		Ca	94.3 mg/L	3111.B
		Na	31.4 mg/L	3500-Na B
		As	Less than 0.005 mg/L	3114.C
		Fe	0.36 mg/L	3111.B
		Mn	0.38 mg/L	3110.B

06-03-2016

Sig and Name of the Validator

Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

*The results relate only to the items tested.

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Form No. QSF-22 Revision No. 07 Revision Date: 22 July, 2014

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Institute of National Analytical Research and Service (INARS)
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 136 of BCSIR Lab. Dhaka dt. 15/02/2016
	: ii) D-136 of Analytical Service Cell, BCSIR. 14/02/2016
Lab ID	: A-124 to A-127
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Surface water, Ground water and Riverbed sediment and Soil)** Date: 14/02/2016
Type of sample*	: Water
Quantity of sample	: 1 Litre/bottle (7 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 15/02/2016
Period of analysis	: 15/02/2016 to 06/03/2016
Visual observation/Remarks	: Yellowish, Blackish & Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-124	Surface water (Sample ID # SW 3)	Turbidity	22.5 NTU	Turbidimeter
		DO	4.00 mg/L	---
		BOD_5	2.24 mg/L	5210.B
A-125	Surface water (Sample ID # SW 6)	Turbidity	14.2 NTU	Turbidimeter
		DO	2.40 mg/L	---
		BOD_5	15.7 mg/L	5210.B

06-03-2016

Sig, and Name of the Validator

Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

6/3/16

Counter Signature
(Research Coordinator)

Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

6.3.16

Counter Signature
(Director)

Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested.

Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741; Fax: 880-2-8613022;
PABX: 8611057-61, 8625038-9, 8626034-5, 8626032, Ext. /325; E-mail: directordl@yahoo.com, bcsir@bangla.net

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Institute of National Analytical Research and Service

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Forwarding of Analysis Report

Ref No: i) 153 of BCSIR Lab. Dhaka dt. 22/02/2016

ii) D-153 of Analytical Service Cell, BCSIR. 18/02/2016

Attachment: Please find the Analysis Report as an attachment (page-1 of 1).

06-03-2016	6/3/16	6.3.16
Sig, and Name of the Validator	Counter Signature (Research Coordinator)	Counter Signature (Director)
Md. Aminul Ahsan Principal Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	

Form No. QSF-22 | Revision No. 08 | Revision Date: 24 June, 2016
ISO/IEC 17025:2005 Certified
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Certificate No: T-1676

Institute of National Analytical Research and Service (INARS)
ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস
BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No. : i) 153 of BCSIR Lab. Dhaka dt. 22/02/2016
: ii) D-153 of Analytical Service Cell, BCSIR. 18/02/2016
Lab ID : A-137 to A-140
Name and address of Customer : Bashir Ahmed
Environment Specialist
Environment and Resource Analysis Center Ltd.
464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details : **Application for testing of materials (Surface water, Ground water),** Date: 16/02/2016
Type of sample* : Water
Quantity of sample : 1 Litre/bottle (8 bottles)
Packing and marking : Plastic bottle
Date of receipt : 15/02/2016
Period of analysis : 15/02/2016 to 06/03/2016
Visual observation/Remarks : Colourless & Redish

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-137	Surface water (Sample ID # SW 7)	pH at 25.1^{0}C	7.65	4500-H^+.B
		EC	22450 µS/cm	2510.B
		TSS	40.2 mg/L	2540.D
		TDS	14738 mg/L	2540.C
		Mg	468 mg/L	3111.B
		K	49.2 mg/L	3500-K B
		Ca	279 mg/L	3111.B
		Na	1071 mg/L	3500-Na B
		TOC	3.09 mg/L	5310.B
		Total PO_4	1.50 mg/L	4500-P C
		Total NO_3	Less than 3 mg/L	4110.B
A-138	Surface water (Sample ID # SW 8)	pH at 25.2^{0}C	7.80	4500-H^+.B
		EC	13975 µS/cm	2510.B
		TSS	356 mg/L	2540.D
		TDS	6583 mg/L	2540.C

*The results relate only to the items tested.

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BCSIR LABORATORIES, DHAKA

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-138	Surface water (Sample ID # SW 8)	Mg	244 mg/L	3111.B
		K	47.2 mg/L	3500-K B
		Ca	162 mg/L	3111.B
		Na	893 mg/L	3500-Na B
		TOC	1.92 mg/L	5310.B
		Total PO_4	6.44 mg/L	4500-P C
		Total NO_3	Less than 3 mg/L	4110.B
A-139	Ground water (Sample ID # SW 7)	pH at 24.8^{0}C	7.66	4500-H^+.B
		EC	29900 µS/cm	2510.B
		TDS	17380 mg/L	2540.C
		Mg	558 mg/L	3111.B
		K	61.4 mg/L	3500-K B
		Ca	320 mg/L	3111.B
		Na	1357 mg/L	3500-Na B
		As	Less than 0.005 mg/L	3114.C
		Fe	19.3 mg/L	3111.B
		Mn	0.41 mg/L	3110.B
A-140	Ground water (Sample ID # SW 8)	pH at 24.7^{0}C	7.88	4500-H^+.B
		EC	5950 µS/cm	2510.B
		TDS	2905 mg/L	2540.C
		Mg	136 mg/L	3111.B
		K	21.3 mg/L	3500-K B
		Ca	172 mg/L	3111.B
		Na	500 mg/L	3500-Na B
		As	0.029 mg/L	3114.C
		Fe	2.43 mg/L	3111.B
		Mn	2.04 mg/L	3110.B

06-03-2016

Sig and Name of the Validator

Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

*The results relate only to the items tested.

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741, 9664959, Fax: 880-2-8613022, PABX: 8611057-61, 8625038-9, 8626034-5, 8626032, Ext/325; E-mail: directordl@yahoo.com, bcsir@bangla.net

জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service (INARS)
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 153 of BCSIR Lab. Dhaka dt. 22/02/2016
	: ii) D-153 of Analytical Service Cell, BCSIR. 18/02/2016
Lab ID	: A-137 to A-140
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Surface water, Ground water),** Date: 16/02/2016
Type of sample*	: Water
Quantity of sample	: 1 Litre/bottle (8 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 15/02/2016
Period of analysis	: 15/02/2016 to 01/03/2016
Visual observation/Remarks	: Colourless & Redish

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-137	Surface water (Sample ID # SW 7)	Turbidity	47.8 NTU	Turbidimeter
		DO	0.55 mg/L	---
		BOD_5	67.3 mg/L	5210.B
A-138	Surface water (Sample ID # SW 8)	Turbidity	9.06 NTU	Turbidimeter
		DO	4.05 mg/L	---
		BOD_5	2.12 mg/L	5210.B

06-03-2016 6/3/16 6.3.16

Sig, and Name of the Validator
Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested.

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জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service

BCSIR LABORATORIES, DHAKA

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Forwarding of Analysis Report

Ref No: i) 106 of BCSIR Lab. Dhaka dt. 10/02/2016

ii) D-106 of Analytical Service Cell, BCSIR. 09/02/2016

Attachment: Please find the Analysis Report as an attachment (page-1 of 4).

28-02-2016	for. 29/2/16	28.2.16
Sig, and Name of the Validator	Counter Signature (Research Coordinator)	Counter Signature (Director)
Md. Aminul Ahsan Principal Scientific Officer Institute of National Analytical Research & Service (INARS) BCSIR Laboratories, Dhaka	Badhan Saha Scientific Officer Analytical Service Cell BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

Certificate No: T-1676

Institute of National Analytical Research and Service (INARS)
ইনস্টিটিউট অব ন্যাশনাল এনালাইটিক্যাল রিসার্চ এন্ড সার্ভিস
BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 106 of BCSIR Lab. Dhaka dt. 10/02/2016 : ii) D-106 of Analytical Service Cell, BCSIR. 09/02/2016
Lab ID	: A-101 to A-108
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Surface water, Ground water and Riverbed sediment,** Date: 09/02/2016
Type of sample*	: Water
Quantity of sample	:1 Litre/bottle (16 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 11/02/2016
Period of analysis	: 11/02/2016 to 28/02/2016
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-101	Surface water (Sample ID # SW 9)	pH at 24.8^{0}C	7.10	4500-H$^+$.B
		EC	271 μS/cm	2510.B
		TSS	89.4 mg/L	2540.D
		TDS	159 mg/L	2540.C
		Magnesium (Mg)	11.3 mg/L	3111.B
		Potassium (K)`	2.76 mg/L	3500-K B
		Calcium (Ca)	40.2 mg/L	3111.B
		Sodium (Na)	7.98 mg/L	3500-Na B
		TOC	7.29 mg/L	5310.B
		Total Nitrate	Less than 3.0 mg/L	4110.B
A-102	Surface water (Sample ID # SW 10)	pH at 24.8^{0}C	7.29	4500-H$^+$.B
		EC	245 μS/cm	2510.B
		TSS	33.8 mg/L	2540.D
		TDS	136 mg/L	2540.C

*The results relate only to the items tested

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Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-102	Surface water (Sample ID # SW 10)	Magnesium (Mg)	7.30 mg/L	3111.B
		Potassium (K)`	2.81 mg/L	3500-K B
		Calcium (Ca)	26.2 mg/L	3111.B
		Sodium (Na)	7.46 mg/L	3500-Na B
		TOC	8.04 mg/L	5310.B
		Total Nitrate	Less than 3.0 mg/L	4110.B
A-103	Surface water (Sample ID # SW 11)	pH at 24.7^{0}C	7.42	4500-H$^+$.B
		EC	607 μS/cm	2510.B
		TSS	36.0 mg/L	2540.D
		TDS	375 mg/L	2540.C
		Magnesium (Mg)	13.8 mg/L	3111.B
		Potassium (K)`	4.38 mg/L	3500-K B
		Calcium (Ca)	20.3 mg/L	3111.B
		Sodium (Na)	86.7 mg/L	3500-Na B
		TOC	Less than 0.5 mg/L	5310.B
		Total Nitrate	Less than 3.0 mg/L	4110.B
A-104	Surface water (Sample ID # SW 12)	pH at 25.2^{0}C	7.45	4500-H$^+$.B
		EC	275 μS/cm	2510.B
		TSS	141 mg/L	2540.D
		TDS	147 mg/L	2540.C
		Magnesium (Mg)	9.88 mg/L	3111.B
		Potassium (K)`	3.67 mg/L	3500-K B
		Calcium (Ca)	29.5 mg/L	3111.B
		Sodium (Na)	10.8 mg/L	3500-Na B
		TOC	6.34 mg/L	5310.B
		Total Nitrate	Less than 3.0 mg/L	4110.B

*The results relate only to the items tested

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BCSIR LABORATORIES, DHAKA
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-105	Ground water (Sample ID # GW 9)	pH at 25.2^{0}C	7.08	4500-H$^+$.B
		EC	11700 µS/cm	2510.B
		TDS	5747 mg/L	2540.C
		Magnesium (Mg)	308 mg/L	3111.B
		Potassium (K)`	19.1 mg/L	3500-K B
		Calcium (Ca)	534 mg/L	3111.B
		Sodium (Na)	1145 mg/L	3500-Na B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	2.89 mg/L	3111.B
		Manganese (Mn)	0.32 mg/L	3110.B
A-106	Ground water (Sample ID # GW 10)	pH at 24.7^{0}C	7.85	4500-H$^+$.B
		EC	931 µS/cm	2510.B
		TDS	520 mg/L	2540.C
		Magnesium (Mg)	2.05 mg/L	3111.B
		Potassium (K)`	2.67 mg/L	3500-K B
		Calcium (Ca)	116 mg/L	3111.B
		Sodium (Na)	186 mg/L	3500-Na B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	Less than 0.2 mg/L	3111.B
		Manganese (Mn)	Less than 0.05 mg/L	3110.B
A-107	Ground water (Sample ID # GW 11)	pH at 24.8^{0}C	7.58	4500-H$^+$.B
		EC	240 µS/cm	2510.B
		TDS	142 mg/L	2540.C
		Magnesium (Mg)	7.50 mg/L	3111.B
		Potassium (K)`	4.38 mg/L	3500-K B
		Calcium (Ca)	27.5 mg/L	3111.B
		Sodium (Na)	99.8 mg/L	3500-Na B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	1.04 mg/L	3111.B
		Manganese (Mn)	Less than 0.05 mg/L	3110.B

*The results relate only to the items tested

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-108	Ground water (Sample ID # GW 12)	pH at 25.2^{0}C	7.20	4500-H^+.B
		EC	742 μS/cm	2510.B
		TDS	444 mg/L	2540.C
		Magnesium (Mg)	26.2 mg/L	3111.B
		Potassium (K)`	4.19 mg/L	3500-K B
		Calcium (Ca)	44.8 mg/L	3111.B
		Sodium (Na)	63.8 mg/L	3500-Na B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Iron (Fe)	2.20 mg/L	3111.B
		Manganese (Mn)	0.06 mg/L	3110.B

NB: The results of PO4, PCB & POP will be sent soon.

28-02-2016

Sig and Name of the Validator
Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR Laboratories, Dhaka

*The results relate only to the items tested

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জীবনের জন্য বিজ্ঞান

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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 106 of BCSIR Lab. Dhaka dt. 10/02/2016 : ii) D-106 of Analytical Service Cell, BCSIR. 09/02/2016
Lab ID	: A-101 to A-108
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Surface water, Ground water and Riverbed sediment,** Date: 09/02/2016
Type of sample*	: Water
Quantity of sample	:1 Litre/bottle (16 bottles)
Packing and marking	: Plastic bottle
Date of receipt	: 11/02/2016
Period of analysis	: 11/02/2016 to 28/02/2016
Visual observation/Remarks	: Colourless

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-101	Surface water (Sample ID # SW 9)	Turbidity	36.9 NTU	Turbidimeter
		DO	4.58 mg/L	---
		BOD_5	15.3 mg/L	5210.B
A-102	Surface water (Sample ID # SW 10)	Turbidity	19.8 NTU	Turbidimeter
		DO	5.33 mg/L	---
		BOD_5	2.83 mg/L	5210.B
A-103	Surface water (Sample ID # SW 11)	Turbidity	8.22 NTU	Turbidimeter
		DO	2.00 mg/L	---
		BOD_5	18.9 mg/L	5210.B

*The results relate only to the items tested.

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741; Fax: 880-2-8613022;
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জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service (INARS)
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বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration	Test Method (APHA)
A-104	Surface water (Sample ID # SW 12)	Turbidity	12.5 NTU	Turbidimeter
		DO	5.50 mg/L	---
		BOD_5	2.87 mg/L	5210.B

NB: The results of PO4, PCB & POP will be sent soon.

28-02-2016
Sig, and Name of the Validator
Md. Aminul Ahsan
Principal Scientific Officer
Institute of National Analytica
Research & Service (INARS)
BCSIR Laboratories, Dhaka

29/2/16
Counter Signature
(Research Coordinator)
Badhan Saha
Scientific Officer
Analytical Service Cell
BCSIR, Dhaka

28.2.16
Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested.

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ENRAC REF: IWM/NIP/02.07

ONSITE TEMPERATURE (°C) DATA OF SURFACE WATER AND GROUNDWATER

COMPANY NAME : Institute of Water Modelling (IWM)
PROJECT NAME : Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF. : N/A
CLIENT ADDRESS : House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh

Onsite Temperature Data (SW 1-6 & GW 1-6)

Sample ID	Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Sample-6
Location	Harinagha, Chandpur	Gozaria	Boktabali	Araihazar	Bhairab	Sadarghat, Dhaka
Unit	°C	°C	°C	°C	°C	°C
Surface Water	23	25	22.5	23	24.5	22
Ground Water	27	26.2	27	25.5	26	29

Onsite Temperature Data (SW 7-12 & GW 7-12)

Sample ID	Sample-7	Sample-8	Sample-9	Sample-10	Sample-11	Sample-12
Location	Chukkhalighat, Sandwip	Chairman Ghat	Sripurdwip, Barisal	Mehndiganj, Kaliganj	Ilisha Ghat, Bhola	Vabanipur Launchghat
Unit	°C	°C	°C	°C	°C	°C
Surface Water	24.5	23	22.5	22.5	23	21.5
Ground Water	28	26.3	29	25.5	30	26

Prepared and Checked By:

Saiful 03.07.2016
Md. Saiful Islam
Environmental Specialist

Environment and Resource Analysis Center Ltd. ENRAC

Plankton Test

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http://www.univdhaka.edu

প্রাণিবিদ্যা বিভাগ
ঢাকা বিশ্ববিদ্যালয়
ঢাকা-১০০০, বাংলাদেশ
পিএবিএক্স ঃ ৮৮০-২-৯৬৬১৯০০, এক্স ঃ ৭৫৮০, ৭৫৮১
ফ্যাক্স ঃ ৮৮০-২-৯৬৬৭২২২ (উপাচার্যের অফিস)

নং জ/.....................................

তারিখ...

Plankton Analysis Report

Date Received: 4-12 February 2016

Sample location: Different rivers

Project Name : NIP-ESCT

ID: Plan3, 6,7,9,11, 12

Method used: S-R cell counting under high resolution microscope (1ox X 10x)

Results: Pls See the Attached sheets

Report delivery date: 24 February 2016

24/02/2016
Dr. Pronob Kumar Mozumder

24.2.16
DR. MD ABDUR ROB MOLLAH
Professor
Department of Zoology
University of Dhaka
Dhaka, Bangladesh

Project Name: Navigational Improvement on Dhaka Chittagong Waterway (NIP_ESCT)

Group Name	Species Name	Sample ID and location name											
		Plan - 1	Plan - 2	Plan - 3	Plan - 4	Plan - 5	Plan - 6	Plan - 7	Plan - 8	Plan - 9	Plan - 10	Plan - 11	Plan - 12
		Haringhat, Chandpur	Gazaria, Munshiganj	Boktobali ferryghat, NG	Araihazar, Narayanganj	Bhoirab, Ashuganj	Sadarghat	Vasanchar, Chukkhalighat	Chairman ghat, Noakhali	Beduria launch ghat	Hizla	Ilisha char	Daulatkhan launch ghat
Protozoa	*Arcella* sp.							5.6	8.4	4.2			
	Centropyxis sp.				1.35								
	Difflugia sp.	1.4		1	1.35	21.6	0.7	12.6	40.6	5.6	3.5	14	17.5
	Paramecium sp.						0.7						
	Phacus sp.			1			2.1						
Rotifera	*Anuraeopsis sp.*		5.6	1		2.7							
	Asplanchna sp.	1.4			1.35	8.1					10.5	3.5	14
	Brachionus angularis									4.2		3.5	
	Brachionus calyciflorus		7							1.4	3.5	3.5	
	Brachionus forficula							1.4					
	Brachionus urceolaris						0.7						3.5
	Brachionus sp.	1.4			2.7								
	Filinia longiseta		1.4										
	Filinia sp.				1.35								
	Hexarthra sp.					1.35							
	Horaella sp.					2.7					3.5		
	Keratella cochlearis	28	18.2	1	13.5	12.2				11.2	52.5	108.5	84
	Notholca sp.	1.4											
	Keratella sp.		5.6	2		4.05				12.6	70	101.5	105
	Keratella tropica	21	1.4		5.4	13.5		2.8		8.4	42	42	91
	Lecane sp.			1									3.5
	Lepadella sp.											3.5	

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Dhaka, Bangladesh

DEPARTMENT OF ZOOLOGY
UNIVERSITY OF DHAKA
BANGLADESH

Group Name	Species Name	Sample ID and location name											
		Plan - 1	Plan - 2	Plan - 3	Plan - 4	Plan - 5	Plan - 6	Plan - 7	Plan - 8	Plan - 9	Plan - 10	Plan - 11	Plan - 12
		Haringhat, Chandpur	Gazaria, Munshiganj	Boktobali ferryghat, NG	Araihazar, Narayanganj	Bhoirab, Ashuganj	Sadarghat	Vasanchar, Chukkhalighat	Chairman ghat, Noakhali	Beduria launch ghat	Hizla	Ilisha char	Daulatkhan launch ghat
	Monostyla sp.		1.4	3									
	Polyarthra sp.	1.4											10.5
	Polyarthra vulgaris												
	Testudinella sp.				4.05								
	Pompholyx sp.			40							3.5		
	Trichocerca similis	2.8	2.8							1.4	10.5	7	3.5
	Unidentified			5	1.35		2.1			1.4	3.5	7	
Nauplii	Nauplius	2.8	12.6	2	9.45	23		25.2	9.8	8.4	14	24.5	24.5
	Metanauplius	1.4						5.6	1.4			3.5	3.5
Copepoda	*Diaptomus sp.*							23.8					
	Cyclops sp.	1.4			2.7								
	Cyclops nanus		2.8										
	Mesocyclops sp.								1.4				
Cladocera	*Bosmina sp.*	2.8				5.4			1.4		7	10.5	17.5
	Diaphanosoma sp.			2									
Ostracoda	*Herpetocypris* sp.											10.5	
Algae	*Agmenellum sp.*					6.75							
	Amphipora sp.							5.6	182				
	Bacillaria sp.								1.4				
	Ceratium sp.					5.4		26.6	7	2.8	3.5		
	Centritractus sp.								2.8				

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Professor
Department of Zoology
University of Dhaka
Dhaka, Bangladesh

Group Name	Species Name	Sample ID and location name											
		Plan - 1	Plan - 2	Plan - 3	Plan - 4	Plan - 5	Plan - 6	Plan - 7	Plan - 8	Plan - 9	Plan - 10	Plan - 11	Plan - 12
		Haringhat, Chandpur	Gazaria, Munshiganj	Boktobali ferryghat, NG	Araihazar, Narayanganj	Bhoirab, Ashuganj	Sadarghat	Vasanchar, Chukkhalighat	Chairman ghat, Noakhali	Beduria launch ghat	Hizla	Ilisha char	Daulatkhan launch ghat
	Chlorosarcina minor	2.8		1	2.7	40.5				11.2	10.5	35	28
	Closteriopsiis longissima	1.4											
	Golenkinia sp.									22.4	143.5	31.5	21
	Hormidium sp.	67.2	47.6	30	75.6	83.7				35	126	73.5	112
	Mastogloria sp.								1.4				
	Navicula sp.										3.5		
	Pediastrum biradiatum	22.4	14	3	4.05	8.1	4.2	1.4		32.2	59.5	77	63
	Schizogonium sp.				1.35								
	Rhopalodia sp.			1									3.5
	Staurastrum sp.										21	14	
	Golenkinia sp.	30.8											
	Gyrosigma sp.							5.6	16.8				
	Volvox sp.		2.8			4.05			12.6				3.5
	Unidentified	2.8	9.8					4.2					24.5
TOTAL (Plankton/L)		**197**	**133**	**96**	**128.3**	**243**	**10.5**	**120.4**	**287**	**162.4**	**591.5**	**574**	**633.5**

DEPARTMENT OF ZOOLOGY
BANGLADESH
UNIVERSITY OF DHAKA

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University of Dhaka
Dhaka, Bangladesh

River Bed Sample and Soil Sample Test Results (12 Regular Locations and 1 Dredging Location for River Bed Sample, 5 Potential On Land Disposal Site for Soil Sample)

Soil Sampling at the potential on land dredged material disposal locations (Locations and Laboratory Test ID):

ID	Location	River Name	Coordinate
1	Char Sonarampur, Bhairab bazar, Ashuganj	Upper Meghna	24° 02´ 52.09´´N 91° 00´ 23.62´´E
2	Char Chartola, Bhairab bazar, Ashuganj	Upper Meghna	24° 02´ 13.55´´N 90° 59´ 45.02´´E
3	Boro Char, Munshiganj	Upper Meghna	23° 21´ 18.09´´N 90° 35´ 3.65´´E
4	Selimabad, Bancharampur, Brahmanbaria	Branch of Upper Meghna	23° 45' 19.41"N 90° 48' 9.45"E
5	Opposite Bank of krishnanagar, Homna, Comilla	Branch of Upper Meghna	23° 43' 12.54" N 90° 46' 48.70"E

River Bed Sampling at one of the probable dredging locations in Branch of Upper Meghna River (Location and Laboratory Test ID):

ID	Location	River Name	Coordinate
A-285	Homna, Comilla	Branch of Upper Meghna	23° 43´ 12.54´´N 90° 46´ 48.70´´E

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
DEPARTMENT OF CIVIL ENGINEERING
Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/
ENVIRONMENTAL ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

BRTC No. : **110104259 /15-16/CE; Dt: 31/1/2016** Ref. No. : Letter; Dt: 31/1/2016

Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -7 (RBM1) Source : Riverbed Sediment (Sampling Date- 29/01/2016)

Date of Test : 31/1/2016 - 28/2/2016 Location : Haringhat, Chandpur

TEST REPORT (TOTAL EXTRACTION OF SOIL SAMPLES : TOTAL EXTRACTION DONE BY AQUA-REGIA)

Sl. No.	Parameter	Unit	Concentration Present	EU Directive 86/278/EEC for Land Application	Method of analysis	Minimum Detection Limit (MDL)
1	Arsenic (As)	mg/kg	**15.04**	---	USEPA 206.2; SM 3113 B	---
2	Lead (Pb)	mg/kg	**16**	1200	USEPA 200.9 Rev 2.2; SM 3111 B	---
3	Cadmium (Cd)	mg/kg	**0**	40	USEPA 213.2 ; SM 3113 B	---
4	Chromium (Cr)	mg/kg	**18.9**	---	USEPA 200.9 Rev 2.2; SM 3111 B	---
5	Nickel (Ni)	mg/kg	**21**	400	USEPA 200.9 ; SM 3111 B	---
6	Zinc (Zn)	mg/kg	**59.2**	4000	USEPA 200.9 ; SM 3111 B	---
7	Mercury (Hg)	mg/kg	**0.041**	25	USEPA 245.1 Rev. 3.0; SM 3112 B	---
8	---	---	**---**	---	---	---
9	---	---	**---**	---	---	---
10	---	---	**---**	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Note : Above is a partial analysis performed at our laboratory as per client's request. It should be noted that in order to certify a SOIL sample according to EU Directive 86/278/EEC a number of additional tests have to be performed

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by :

2/3/16
Snigdha Afsana
Assisstant Professor, Dept. of Civil Engineering

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DEPARTMENT OF CIVIL ENGINEERING
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BRTC Bureau of Research, Testing & Consultation

BRTC No. : **110104259 /15-16/CE; Dt: 31/1/2016** Ref. No. : Letter; Dt: 31/1/2016

Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -8 (RBM2) Source : Riverbed Sediment (Sampling Date- 27/01/2016)

Date of Test : 31/1/2016 - 28/2/2016 Location : Gazaria, Chandpur

TEST REPORT (TOTAL EXTRACTION OF SOIL SAMPLES : TOTAL EXTRACTION DONE BY AQUA-REGIA)

Sl. No.	Parameter	Unit	Concentration Present	EU Directive 86/278/EEC for Land Application	Method of analysis	Minimum Detection Limit (MDL)
1	Arsenic (As)	mg/kg	**1.34**	---	USEPA 206.2; SM 3113 B	---
2	Lead (Pb)	mg/kg	**12.6**	1200	USEPA 200.9 Rev 2.2; SM 3111 B	---
3	Cadmium (Cd)	mg/kg	**0**	40	USEPA 213.2 ; SM 3113 B	---
4	Chromium (Cr)	mg/kg	**17.5**	---	USEPA 200.9 Rev 2.2; SM 3111 B	---
5	Nickel (Ni)	mg/kg	**21.1**	400	USEPA 200.9 ; SM 3111 B	---
6	Zinc (Zn)	mg/kg	**62.4**	4000	USEPA 200.9 ; SM 3111 B	---
7	Mercury (Hg)	mg/kg	**0.041**	25	USEPA 245.1 Rev. 3.0; SM 3112 B	---
8	---	---	---	---	---	---
9	---	---	---	---	---	---
10	---	---	---	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Note : Above is a partial analysis performed at our laboratory as per client's request. It should be noted that in order to certify a SOIL sample according to EU Directive 86/278/EEC a number of additional tests have to be performed

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by :

2/3/16
Snigdha Afsana
Assisstant Professor, Dept. of Civil Engineering

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BRTC No. : **110104259 /15-16/CE; Dt: 31/1/2016** Ref. No. : Letter; Dt: 31/1/2016

Sent by : Environment and Resource Analysis Center Ltd. (ENRAC)

Project : Navigational Improvement on Dhaka-Chittagong Waterways Project

Company Address : 464/C (Ground Floor), Khilgaon, Dhaka

Sample Id : Sample No. -9 (RBM4) Source : Riverbed Sediment (Sampling Date- 27/01/2016)

Date of Test : 31/1/2016 - 28/2/2016 Location : Araihazar, Narayangonj

TEST REPORT (TOTAL EXTRACTION OF SOIL SAMPLES : TOTAL EXTRACTION DONE BY AQUA-REGIA)

Sl. No.	Parameter	Unit	Concentration Present	EU Directive 86/278/EEC for Land Application	Method of analysis	Minimum Detection Limit (MDL)
1	Arsenic (As)	mg/kg	**9.7**	---	USEPA 206.2; SM 3113 B	---
2	Lead (Pb)	mg/kg	**23.1**	1200	USEPA 200.9 Rev 2.2; SM 3111 B	---
3	Cadmium (Cd)	mg/kg	**0**	40	USEPA 213.2 ; SM 3113 B	---
4	Chromium (Cr)	mg/kg	**20.2**	---	USEPA 200.9 Rev 2.2; SM 3111 B	---
5	Nickel (Ni)	mg/kg	**21.3**	400	USEPA 200.9 ; SM 3111 B	---
6	Zinc (Zn)	mg/kg	**112.8**	4000	USEPA 200.9 ; SM 3111 B	---
7	Mercury (Hg)	mg/kg	**0.055**	25	USEPA 245.1 Rev. 3.0; SM 3112 B	---
8	---	---	**---**	---	---	---
9	---	---	**---**	---	---	---
10	---	---	**---**	---	---	---

Comments : 1. Sample was supplied by CLIENT
2. Sample was received in unsealed condition.

Note : Above is a partial analysis performed at our laboratory as per client's request. It should be noted that in order to certify a SOIL sample according to EU Directive 86/278/EEC a number of additional tests have to be performed

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/pack

Countersigned by :

Dr. Abu Siddique
Professor, Dept. of Civil Engg.

DEPARTMENT OF CIVIL ENGINEERING * BUET *

Test Performed by :

2/3/16

Snigdha Afsana
Assisstant Professor, Dept. of Civil Engineering

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No.	: i) 63 of BCSIR Laboratories, Dhaka. Date: 01/02/2016
	: ii) D-63 of Analytical Service cell, BCSIR, Date: 31/01/2016
Lab ID	: SE- 403
Referred by	: Bashir Ahmed, Environment Specialist, Environment and Resource Analysis Center Ltd., 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details	: Analysis of the supplied samples (as supplied).
Type of Sample	: Riverbed Sediment (as mentioned)
Date of Receipt	: 01/02/2016
Analytical Result	:

Sl. No.	Parameters	Results		
		Sample: RB - 1	Sample: RB - 2	Sample: RB - 4
01	Total Organic Carbon (TOC)	0.32 %	0.67 %	0.17 %
02	Total Phosphate	0.188 %	0.245 %	0.104 %
03	Nitrate	5.67 ppm	2.23 ppm	102.46 ppm

Methodology / Instrument:

1. **Total Organic Carbon:** Walkley and Black oxidation method
2. **Phosphate :** Vanadomolybdophosphophoric Yellow color method
3. **Nitrate:** Ion Chromatographic method

Special Notes:

1. The result reported here pertained to the sample received in the laboratory only.
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3. The result should not be reproduced wholly or in part and cannot be used as evidence in the court of law and should not be used in any advertising media without our special permission in writing.
4. Any complain about the test result will not be accepted after one month from the date of issuing of the said report.
5. This report is free from any legal litigation and BCSIR Laboratories, Dhaka is not liable for any legal implication relating the report.

22.2.2016	22.2.16	22.2.16	22.2.16
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
Dr. Md. Kamal Hossain Senior Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka Dhaka-1205, Bangladesh	Akhtar Hamid Dewan Chief Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road, Dhaka-1205

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No. : i) 135 of BCSIR Laboratories, Dhaka. Date: 15/02/2016
: ii) D-135 of Analytical Service cell, BCSIR, Date: 14/02/2016
Lab ID : SE- 411
Referred by : Bashir Ahmed, Environment Specialist, Environment and Resource Analysis Center Ltd., 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details : Testing of riverbed sediment (RB) and soil sample (as supplied).
Date of receipt : 15/02/2016.

Analytical Result :

Sl. No.	Parameters	Results			
		RB 3	RB 6	Soil 4	Soil 5
01	pH	----	----	5.276	7.459
02	EC	----	----	735 μS/cm	444 μS/cm
03	Salinity	0.04 %	0.06 %	----	----
04	Magnesium (Mg)	----	----	0.110 %	0.111 %
05	Calcium (Mg)	----	----	0.024 %	0.033 %
06	Sodium (Na)	----	----	0.017 %	0.015 %
07	Potassium (K)	----	----	0.150 %	0.215 %
08	TOC	0.45 %	0.32 %	1.13 %	1.27 %
09	Total Phosphate	0.220 %	0.248 %	0.218 %	0.278 %
10	Total Nitrate	0.71 ppm	0.61 ppm	0.76 ppm	95.48 ppm
11	Arsenic (As)	2.352 ppm	4.227 ppm	----	----
12	Cadmium (Cd)	BDL	BDL	----	----
13	Mercury (Hg)	0.005 ppm	0.020 ppm	----	----
14	Lead (Pb)	6.70 ppm	204.63 ppm	----	----
15	Chromium (Cr)	27.73 ppm	66.01 ppm	----	----
16	Zinc (Zn)	46.13 ppm	251.22 ppm	----	----
17	Nickel (Ni)	32.969 ppm	18.015 ppm	----	----

BDL = Below Detection Limit (Detection Limits: Cd = 0.03 ppm)

Methodology / Instrument:

1. pH: pH meter, **2.** EC: EC meter, **3.** Salinity: Salinity Meter, **4.** Mg, Ca, Cd, Pb, Cr, Zn & Ni: Flame Atomic Absorption Spectrophotometric method, **5.** Na & K: Flame photometric method, **6.** TOC: Walkley & Black oxidation method, **7.** Phosphate: Vanadomolybdophosphophoric Yellow color method, **8.** Nitrate: Ion Chromatographic Method, **9.** As: Atomic Absorption Spectrophotometer with Hydride Vapour Generator unit, **10.** Hg: Atomic Absorption Spectrophotometer with Mercury Vaporizer unit.

Special Notes:

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2.3.16	02.3.16	3.3.16	3.3.16
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka BCSIR, Dhanmondi, Dhaka-1205	Akhtar Hamid Dewan Chief Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Phone: 88-02-8621741, Fax: 88-02-8613022 Email: bcsir@bangla.net

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No.	: i) 71 of BCSIR Laboratories, Dhaka. Date: 02/02/2016
	: ii) D-71 of Analytical Service cell, BCSIR, Date: 01/02/2016
Lab ID	: SE- 404
Referred by	: Bashir Ahmed, Environment Specialist, Environment and Resource Analysis Center Ltd., 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details	: Testing of riverbed sediment, surface water (SW), ground water (GW) and soil (as supplied).

Analytical Result :

Sl. No.	Parameters	Results					
		SW 5	GW 5	RB 5	Soil 1	Soil 2	Soil 3
01	pH	7.541	6.763	----	6.177	6.127	6.187
02	EC	129.1 μS/cm	462.1 μS/cm	----	441 μS/cm	350 μS/cm	1877 μS/cm
03	TDS	64.5 mg/L	231.1 mg/L	----	----	----	----
04	Turbidity	6.97 NTU	----	----	----	----	----
05	DO	7.74 mg/L	----	----	----	----	----
06	BOD_5	3.2 mg/L	----	----	----	----	----
07	Salinity	----	----	0.06 %	----	----	----
08	TSS	117 mg/L	----	----	----	----	----
09	Magnesium (Mg)	6.854 ppm	26.714 ppm	----	0.206 %	0.016 %	0.369 %
10	Potassium (K)	2.14 ppm	4.01 ppm	----	0.123 %	0.113 %	0.287 %
11	Calcium (Ca)	13.896 ppm	42.960 ppm	----	0.145 %	0.234 %	0.539 %
12	Sodium (Na)	8.21 ppm	1.19 ppm	----	0.045 %	0.046 %	0.072 %
13	Iron (Fe)	----	1.75 ppm	----	----	----	----
14	Manganese (Mn)	----	5.67 ppm	----	----	----	----
15	Arsenic (As)	----	0.011 ppm	0.051 ppm	----	----	----
16	TOC	0.0011 %	----	0.666 %	0.248 %	0.074 %	1.518 %
17	Total Phosphate	3.435 ppm	----	0.217 %	0.134 %	0.069 %	0.460 %
18	Total Nitrate	0.714 ppm	----	6.675 ppm	10.108 ppm	3.750 ppm	98.796 ppm
19	Cadmium (Cd)	----	----	0.140 ppm	----	----	----
20	Lead (Pb)	----	----	10.525 ppm	----	----	----
21	Chromium (Cr)	----	----	23.797 ppm	----	----	----
22	Zinc (Zn)	----	----	51.658 ppm	----	----	----
23	Nickel (Ni)	----	----	35.261 ppm	----	----	----
24	Mercury (Hg)	----	----	BDL*	----	----	----

***BDL** = Below Detection Limit (Detection Limits: Hg = 1.0 ppb)

Methodology / Instrument: 1. pH: pH meter, **2.** EC: EC meter, **3.** Salinity: Salinity Meter, **4.** Nitrate: Ion Chromatographic Method, **5.** Phosphate: Vanadomolybdophosphophoric Yellow color method, **6.** TDS: TDS meter, **7.** DO: DO meter, **8.** Turbidity: Turbidity meter, **9.** TSS: Gravimetric method **10.** Mg, Ca, Cd, Pb, Cr, Zn & Ni: Flame Atomic Absorption Spectrophotometric method, **11.** As: Atomic Absorption Spectrophotometer with Hydride Vapour Generator unit, **12.** Hg: Atomic Absorption Spectrophotometer with Mercury Vaporizer unit, **13.** BOD_5: BOD Tracking System. **14.** TOC: Walkley and Black oxidation method

Special Notes: (1) The result reported here pertained to the sample received in the laboratory only. The laboratory is not responsible for the data quality affected due to the above. The precision & accuracy are defined only for the laboratory process, not for the sampling, transporting & storage processes. **(2)** The result should not be reproduced wholly or in part and cannot be used as evidence in the court of law and should not be used in any advertising media without our special permission in writing. **(3)** Any complain about the test result will not be accepted after one month from the date of issuing of the said report. **(4)** This report is free from any legal litigation and BCSIR Laboratories, Dhaka is not liable for any legal implication relating the report.

Afroza 29.02.2016	29/2/16	29.2	29.2.16
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
Afroza Parvin Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka-1205	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr. Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr. Qudrat-e-Khuda Road Dhaka-1205

জীবনের জন্য বিজ্ঞান

বিসিএসআইআর গবেষণাগার, ঢাকা
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No.	: i) 108 of BCSIR Laboratories, Dhaka. Date: 10/02/2016
	: ii) D-108 of Analytical Service cell, BCSIR, Date: 09/02/2016
Lab ID	: SE- 408
Referred by	: Bashir Ahmed, Environment Specialist, Environment and Resource Analysis Center Ltd., 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details	: Testing of riverbed sediment (as supplied).
Date of receipt	: 10/02/2016.
Analytical Result	:

Sl. No.	Parameters	Results	
		Riverbed Sediment RB 7	**Riverbed Sediment RB 8**
01	Salinity	0.88 %	0.59 %
02	TOC	0.44 %	0.38 %
03	Total Phosphate	0.0152 %	0.0154 %
04	Total Nitrate	1.280 ppm	0.524 ppm
05	Arsenic (As)	4.324 ppm	4.967 ppm
06	Cadmium (Cd)	0.035 ppm	0.054 ppm
07	Mercury (Hg)	7.26 ppb	3.17 ppb
08	Lead (Pb)	13.404 ppm	11.353 ppm
09	Chromium (Cr)	31.727 ppm	34.512 ppm
10	Zinc (Zn)	51.176 ppm	57.331 ppm
11	Nickel (Ni)	40.918 ppm	45.682 ppm

BDL = Below Detection Limit (Detection Limits: Hg = 1.0 ppb)

Methodology / Instrument:

1. Salinity: Salinity Meter,
2. TOC: Walkley & Black oxidation method
3. Phosphate: Vanadomolybdophosphophoric Yellow color method
4. Nitrate: Ion Chromatographic Method
5. As: Atomic Absorption Spectrophotometer with Hydride Vapour Generator unit
6. Cd, Pb, Cr, Zn & Ni: Flame Atomic Absorption Spectrophotometric method,
7. Hg: Atomic Absorption Spectrophotometer with Mercury Vaporizer unit

Special Notes:

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Afroza 29.02.2016	Badha 29/2/16	29.2.16	29.2.16
Signature of Scientist	Signature of Supervisor	Signature of Research Coordinator	Signature of Director
Afroza Parvin Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka	BADHAN SAHA Scientific Officer Soil and Environment Section Biological Research Division BCSIR Laboratories, Dhaka BCSIR, Dhanmondi, Dhaka-1205	Monzur Morshed Ahmed Research Co-ordinator BCSIR, Dhaka	Dr Husna Parvin Nur Director BCSIR Laboratories, Dhaka Dr Qudrat-e-Khuda Road Dhaka-1205

জীবনের জন্য বিজ্ঞান

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Bangladesh Council of Scientific and Industrial Research (BCSIR)

Analytical Report

Ref No.	: i) 107 of BCSIR Laboratories, Dhaka. Date: 10/02/2016 : ii) D-107 of Analytical Service cell, BCSIR, Date: 09/02/2016
Lab ID	: SE- 409
Referred by	: Bashir Ahmed, Environment Specialist, Environment and Resource Analysis Center Ltd., 464/C (Ground Floor), Khilgaon, Dhaka-1219.
Work Order details	: Testing of riverbed sediment (as supplied).
Date of receipt	: 10/02/2016.
Analytical Result	:

Sl. No.	Parameters	Results			
		RB 9	**RB 10**	**RB 11**	**RB 12**
01	Salinity	0.02 %	0.021 %	0.019 %	0.040 %
02	TOC	0.22 %	0.45 %	0.26 %	0.64 %
03	Total Phosphate	0.160 %	0.148 %	0.176 %	0.127 %
04	Total Nitrate	0.113 ppm	0.106 ppm	0.117 ppm	0.103 ppm
05	Arsenic (As)	2.395 ppm	4.326 ppm	2.871 ppm	5.134 ppm
06	Cadmium (Cd)	BDL	BDL	BDL	BDL
07	Mercury (Hg)	BDL	BDL	BDL	BDL
08	Lead (Pb)	4.264 ppm	11.487 ppm	5.922 ppm	15.080 ppm
09	Chromium (Cr)	26.647 ppm	32.126 ppm	21.470 ppm	33.483 ppm
10	Zinc (Zn)	30.443 ppm	54.468 ppm	35.306 ppm	59.746 ppm
11	Nickel (Ni)	20.711 ppm	42.851 ppm	21.405 ppm	35.318 ppm

BDL = Below Detection Limit (Detection Limits: Hg = 1.0 ppb and Cd = 0.03 ppm)

Methodology / Instrument:

1. Salinity: Salinity Meter,
2. TOC: Walkley & Black oxidation method
3. Phosphate: Vanadomolybdophosphophoric Yellow color method
4. Nitrate: Ion Chromatographic Method
5. As: Atomic Absorption Spectrophotometer with Hydride Vapour Generator unit
6. Cd, Pb, Cr, Zn & Ni: Flame Atomic Absorption Spectrophotometric method,
7. Hg: Atomic Absorption Spectrophotometer with Mercury Vaporizer unit

Special Notes:

1. The result reported here pertained to the sample received in the laboratory only.
2. The laboratory is not responsible for the data quality affected due to the above. The precision & accuracy are defined only for the laboratory process, not for the sampling, transporting & storage processes.
3. The result should not be reproduced wholly or in part and cannot be used as evidence in the court of law and should not be used in any advertising media without our special permission in writing.
4. Any complain about the test result will not be accepted after one month from the date of issuing of the said report.
5. This report is free from any legal litigation and BCSIR Laboratories, Dhaka is not liable for any legal implication relating the report.

Afroza 29.02.2016 — Signature of Scientist
Afroza Parvin
Scientific Officer
Soil and Environment Section
Biological Research Division
BCSIR Laboratories, Dhaka

29/2/16 — Signature of Supervisor
BADHAN SAHA
Scientific Officer
Soil and Environment Section
Biological Research Division
BCSIR Laboratories, Dhaka

29.2.16 — Signature of Research Coordinator
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

29.2.16 — Signature of Director
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Phone: 88-02-8621741, Fax: 88-02-8613022 Email: bcsir@bangla.net

Form No. QSF-22 | Revision No. 07 | Revision Date: 22 July, 2014

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Institute of National Analytical Research and Service (INARS)

BCSIR LABORATORIES, DHAKA

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No. : i) 316 of BCSIR Lab. Dhaka dt. 05/04/2016
: ii) D-316 of Analytical Service Cell, BCSIR. 04/04/2016

Lab ID : A-285

Name and address of Customer : Zahirul Haque Khan
Director and Principal Specialist
Coast, Port and Estuary Management Division
INSTITUTE OF WATER MODELLING
House # 496, Road # 32, New DOSH, Mohakhali, Dhaka-1206.

Work order details : **Request for Soil Testing,** Memo No. 42.07.014.03.05.1512. 2016/419, Date: 27 March, 2016

Type of sample* : Soil
Quantity of sample : 6 kg
Packing and marking : Polyethylene pack
Date of receipt : 06/04/2016
Period of analysis : 06/04/2016 to 05/05 /2016
Visual observation/Remarks : Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)
A-285	Soil	Salinity	Less than 0.1 mg/kg
		Mg	3013 mg/kg
		Ca	3764 mg/kg
		Na	376 mg/kg
		K	1525 mg/kg
		Total PO_4	2660 mg/kg
		Total NO_3	Less than 3.0 mg/kg
		As	3.81 mg/kg
		Cd	Less than 0.02 mg/kg
		Hg	0.40 mg/kg
		Pb	4.76 mg/kg
		Cr	13.0 mg/kg
		Zn	28.6 mg/kg
		Nickel	13.6 mg/kg

The Result of TOC will be send latter.

05.05.16

Sig, and Name of the Validator
উর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
এনালাইটিক্যাল রিসার্চ ডিভিশন
বিসিএসআইআর গবেষণাগার, ঢাকা

5/5/16

Counter Signature
(Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested.

Dr, Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741; Fax: 880-2-8613022;
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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 64 of BCSIR Lab. Dhaka dt. 01/02/2016 : ii) D-64 of Analytical Service Cell, BCSIR. 31/01/2016
Lab ID	: A-58 to A-60
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Riverbed Sediment, Date**: 31/01/2016
Type of sample*	: Riverbed sediment
Quantity of sample	: 1 kg (3 Plastic pots)
Packing and marking	: Plastic pot
Date of receipt	: 02/02/2016
Period of analysis	: 02/02/2016 to 03/03/2016
Visual observation/Remarks	: Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-58	Riverbed sediment, RBM-01, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	ND	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4′-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4′-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4′-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC

*The results relate only to the items tested.

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Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-58	Riverbed sediment, RBM-01, (PCB)	2,2',3,4,4',5,5' -Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC
A-59	Riverbed sediment, RBM-02, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	0.50	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC
A-59	Riverbed sediment, RBM-02, (PCB)	2,2',3,4,4',5,5' -Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC

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Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-60	Riverbed sediment, RBM-04, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	12.0	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC
A-60	Riverbed sediment, RBM-04, (PCB)	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

3/3/16 2.3.16 3.3.16

Sig, and Name of the Validator
Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

Counter Signature (Research Coordinator)
Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

Counter Signature (Director)
Dr Husna Parvin Nur
Director
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Dr Qudrat-e-Khuda Road
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*The results relate only to the items tested.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 134 of BCSIR Lab. Dhaka dt. 15/02/2016 : ii) D-134 of Analytical Service Cell, BCSIR. 14/02/2016
Lab ID	: A-122 to A-123
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Riverbed Sediment,** Date: 14/02/2016
Type of sample*	: Riverbed sediment
Quantity of sample	: 1 kg (2 Plastic pots)
Packing and marking	: Plastic pot
Date of receipt	: 15/02/2016
Period of analysis	: 15/02/2016 to 03/03/2016
Visual observation/Remarks	: Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-122	Riverbed sediment, RBM-03, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	1.0	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4′-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4′-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4′-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC

Abdul

*The results relate only to the items tested.

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Form No. QSF-22 | Revision No. 07 | Revision Date: 22 July, 2014

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-122	Riverbed sediment, RBM-03, (PCB)	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC
A-123	Riverbed sediment, RBM-06, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	ND	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC
A-123	Riverbed sediment, RBM-06, (PCB)	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	53.0	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	6.5	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

3/3/16 | 3.3.16 |
---|---|---
Sig, and Name of the Validator | Counter Signature (Research Coordinator) | Counter Signature (Director)
Md. Ahedul Akbor, Senior Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR Laboratories, Dhaka | Monzur Morshed Ahmed, Research Co-ordinator, BCSIR, Dhaka | Dr Husna Parvin Nur, Director, BCSIR Laboratories, Dhaka, Dr. Qudrat-e-Khuda Road, Dhaka-1205

*The results relate only to the items tested.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No. : i) 72 of BCSIR Lab. Dhaka dt. 02/02/2016
: ii) D-72 of Analytical Service Cell, BCSIR. 01/02/2016
Lab ID : A-66
Name and address of Customer : Bashir Ahmed
Environment Specialist
Environment and Resource Analysis Center Ltd.
464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details : **Application for testing of materials (Riverbed Sediment,** Date: 01/02/2016
Type of sample* : Riverbed sediment
Quantity of sample : 1 kg (1 Plastic pot)
Packing and marking : Plastic pot
Date of receipt : 02/02/2016
Period of analysis : 02/02/2016 to 03/03/2016
Visual observation/Remarks : Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-66	Riverbed sediment, RBM-05, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	14.0	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC

*The results relate only to the items tested.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration (µg/kg)	Test Method (APHA)
A-66	Riverbed sediment, RBM-05, (PCB)	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

3/3/16

Sig, and Name of the Validator

Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

3.3.16

Counter Signature
(Research Coordinator)

Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

3.3.16

Counter Signature
(Director)

Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
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Form No. QSF-22 Revision No. 07 Revision Date: 22 July, 2014

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 96 of BCSIR Lab. Dhaka dt. 08/02/2016 : ii) D-96 of Analytical Service Cell, BCSIR. 09/02/2016
Lab ID	: A-85 to A-86
Name and address of Customer	: Bashir Ahmed Environment Specialist Environment and Resource Analysis Center Ltd. 464/C (Ground Floor), Khilgaon, Dhaka-1219, Bangladesh.
Work order details	: **Application for testing of materials (Riverbed Sediment,** Date: 07/02/2016
Type of sample*	: Riverbed sediment
Quantity of sample	: 1 kg (2 Plastic pots)
Packing and marking	: Plastic pot
Date of receipt	: 09/02/2016
Period of analysis	: 09/02/2016 to 03/03/2016
Visual observation/Remarks	: Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-85	Riverbed sediment, RBM-07, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	0.70	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC

*The results relate only to the items tested.

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-85	Riverbed sediment, RBM-07, (PCB)	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC
A-86	Riverbed sediment, RBM-08, (organochlorine pesticide)	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	2.0	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC
A-86	Riverbed sediment, RBM-08, (PCB)	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

3/3/16 ... 3.3.16

Sig. and Name of the Validator
Md. Ahedul Akbor
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR Laboratories, Dhaka

Counter Signature
(Research Coordinator)
Page 2 of 2

Counter Signature
(Director)
Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested.

Dr Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Tel.: 88-02-8621741; Fax: 880-2-8613022; PABX: 8611057-61, 8625038-9, 8626034-5, 8626032, Ext. /325; E-mail: directordl@yahoo.com, bcsir@bangla.net

জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service (INARS)

BCSIR LABORATORIES, DHAKA

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

ANALYSIS REPORT

Ref. No.	: i) 316 of BCSIR Lab. Dhaka dt. 05/04/2016
	: ii) D-316 of Analytical Service Cell, BCSIR. 04/04/2016
Lab ID	: A-285
Name and address of Customer	: Zahirul Haque Khan Director and Principal Specialist Coast, Port and Estuary Management Division **INSTITUTE OF WATER MODELLING** House # 496, Road # 32, New DOSH, Mohakhali, Dhaka-1206.
Work order details	: **Request for Soil Testing,** Memo No. 42.07.014.03.05.151[illegible]. 2016/419, Date: 27 March, 2016
Type of sample*	: Soil
Quantity of sample	: 6 kg
Packing and marking	: Polyethylene pack
Date of receipt	: 06/04/2016
Period of analysis	: 06/04/2016 to 05/05/2016
Visual observation/Remarks	: Grey

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-285	Soil	α-BHC	ND	GC
		γ-BHC	ND	GC
		β-BHC	ND	GC
		Heptachlor	ND	GC
		delta-BHC	ND	GC
		Aldrin	ND	GC
		Heptachlor Epoxide (Isome B)	ND	GC
		γ-Chlordane	ND	GC
		α- Chlordane	ND	GC
		Endosulfan I	ND	GC
		4,4´-DDE	ND	GC
		Dieldrin	ND	GC
		Endrin	ND	GC
		4,4´-DDD	ND	GC
		Endosulfan II	ND	GC
		4,4´-DDT	ND	GC
		Endrin aldehyde	ND	GC
		Endosulfan sulphate	ND	GC
		Methoxychlor	ND	GC
		Endrin ketone	ND	GC

*The results relate only to the items tested.

8-8

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জীবনের জন্য বিজ্ঞান

Institute of National Analytical Research and Service (INARS)
BCSIR LABORATORIES, DHAKA
বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Concentration (μg/kg)	Test Method (APHA)
A-285	Soil	2,2',3,4,4',5,5' - Hexachlorobiphenyl	ND	GC
		2,2',3,4,4',5' – Hexachlorobiphenyl	ND	GC
		2,2',4,4',5,5' – Hexachlorobiphenyl	ND	GC
		2,2',5,5' – Tetrachlorobiphenyl	ND	GC
		2,4,4'- Tetrachlorobiphenyl	ND	GC
		2,6- Dichlorobiphenyl	ND	GC

GC=Gas Chromatorgaphy, ND=Not detectable

05.05.16

Sig, and Name of the Validator

শামীম আহমেদ
ঊর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা
এনালাইটিক্যাল রিসার্চ ডিভিশন
বিসিএসআইআর গবেষণাগার, ঢাকা

5/5/16

Counter Signature
(Research Coordinator)

Monzur Morshed Ahmed
Research Co-ordinator
BCSIR, Dhaka

5.5.16

Counter Signature
(Director)

Dr Husna Parvin Nur
Director
BCSIR Laboratories, Dhaka
Dr Qudrat-e-Khuda Road
Dhaka-1205

*The results relate only to the items tested.

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Benthic Test

Navigation Project

Department of Zoology, University of Dhaka
Analysis of Benthos samples

Sampling procedure: Unknown;
No of samples: 4 (Four)
Sample received on: 2nd **January 2016**
Sample analysed : **7th February 2016**

Sample No	Sample ID	References	Results	Comments (if any)
01	BEN-1	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Location:** Harinaghat, Chandpur **Sampling Date:** 29.01.16 **Sampling Time:** 04.00 PM Company: ENRAC	Polychaetes- 23 Chironomid larvae- 2	Samples with plant part and Mud mixed
02	BEN-2	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Location:** Gazaria , Munshiganj **Sampling Date:** 27.01.16 **Sampling Time:** 12.25 PM Company: ENRAC	Bivalve, Mollusca- 1 Gastropods, Mollusca (3 sps)- 16 Arachnids, Arthropds- 2	Sample with mud, sand and plants parts
03	BEN-4	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Location:** Araihazar ,Narayanganj **Sampling Date:** 27.01.16 **Sampling Time:** 4:50PM Company: ENRAC	Naididae worm, Annelid-1 Bivalve Mollusca- 1 Gastropoda, Mollusca- 6 Mollusca broken parts- 3	Sample with mud, sand and plants parts
04	BEN-5	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Location:** Bhoirab ,Ashuganj **Sampling Date:** 31.01.16 **Sampling Time:** 3:00PM Company: ENRAC	Polychaetes-11 Bivalve Mollusca- 29 Gastropod, Mollusca- 52 Water bug, Insecta- 2	Sample with mud and plants parts

ANALYSED BY:
Niamul 7.2.2016
M NIAMUL NASER PHD

M. Niamul Naser PhD
Professor
Department of Zoology
University of Dhaka

Department of Zoology, University of Dhaka
Analysis of Benthos samples

Sampling procedure: Unknown;
No of samples: 8 (Eight)
Sample received on: 15th January 2016
Sample analysed : 24^{th} February 2016

Sample No	Sample ID	References	Results	Comments (if any)
01	BEN-3	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 12.2.2016 **Sampling Time:** 3.30 pm Company: ENRAC	Oligochaetes- 35 Gastropods- 14 Bivlave parts- 6	Samples with sand
02	BEN-6	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 12.02.2016 **Sampling Time:** 11.10 am Company: ENRAC	Oligochaetes- 2 Gastropods- 2 Bivalve parts- 11	Sample with sand
03	BEN-7	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 04.02.2016 **Sampling Time:** 12.15 pm Company: ENRAC	Oligochaete- 1	Sample with plants parts
04	BEN-8	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 03.02.2016 **Sampling Time:** 4:00pm Company: ENRAC	No benthic animals	Sample plants parts

ANALYSED BY:

24.2.2016

M NIAMUL NASER PHD

Sample No	Sample ID	References	Results	Comments (if any)
05	BEN-9	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 6.2.2016 **Sampling Time:** 11.45 am Company: ENRAC	Polychaetes- 1 Gastropods- 2 Molluscan body part- 3	Samples with plant parts
06	BEN-10	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 06.02.2016 **Sampling Time:** 2.40 pm Company: ENRAC	Molluscan body parts-1	Sample with sand and plant parts
07	BEN-11	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 07.02.2016 **Sampling Time:** 10.00 am Company: ENRAC	Oligochaete- 1 Molluscan body part- 1 Shrimp- 2	Sample with sands
08	BEN-12	**Project Name:** Navigational Improvement on Dhaka Chittagong Waterway **Sampling Date:** 07.02.2016 **Sampling Time:** 1.50 pm Company: ENRAC	Mollusca body parts-1	Sample plants parts and sands

ANALYSED BY:

Niam 24.2.2016

M NIAMUL NASER PHD

Air & Noise Quality Test

ENRAC

ENRAC REF: IWM/ NIP/02.01

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 31/01/2016, 09:30 AM
ANALYSIS DATE	: 22/02/2016
SAMPLING ID	: AAQ_01D (Ashuganj)
GPS COORDINATES	: 24°02.405′ N 90°59.696′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set on the Meghna river bank which was 380 and 280 meter south from the Bhairab road bridge and rail bridge respectively. • Construction of second Bhairab rail bridge and a silo for rice storage were ongoing. • Different type of water vessels were plying through the river during sampling. However, Ashuganj fertilizer and power plant was located about 800 m down stream from the samling location. • Vegetation was less and some aquatic fauna were found around the sampling site.	Carbon Monoxide (CO)	$\mu g/m^3$	81	1293	859.17	10000 (8 hour)
	Nitric Oxide (NO)	$\mu g/m^3$	0	75	37.90	100 (Annual)
	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	0	44	26.14	
	Sulphur Dioxide (SO_2)	$\mu g/m^3$	0	63	32.08	365 (24 hour)
	Ozone (O_3)	$\mu g/m^3$	0	41	18.53	157 (8 hour)
	Particulate Matter (PM_{10})	$\mu g/m^3$	52	266	131.55	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	18	143	56.73	65 (24 hour)
	Air Temperature	°C	21	24	23.24	NSE**
	Relative Humidity	%	68	85	76.00	NSE**

Prepared and Checked By:

Saiful 28.02.16

Md. Saiful Islam

Environmental Scientist

Environment and Resource Analysis Center Ltd. ENRAC

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Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_01D	09:30 AM (480)	dBA	45.1	68.1	53.25
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997
** NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Prepared and Checked By:

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Md. Saiful Islam 28.02.16

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ENRAC

ENRAC REF: IWM/ NIP/02.02

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 12/02/2016, 09:17 AM
ANALYSIS DATE	: 22/02/2016
SAMPLING ID	: AAQ_02D (Sadarghat)
GPS COORDINATES	: 23⁰42.392′ N 90⁰24.474′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set at Sadarghat launch terminal area which was 2 m south from the river bank. • The terminal was very busy and crowded with passengers. Different type of water transports (such as launch, trawler, engine boat) were anchored along the sampling location. Country boats was prominent among them. • Vegetation was less and no wildlife except some birds were found around the sampling site. • Dust from demolition waste near the monitoring station observed.	Carbon Monoxide (CO)	$\mu g/m^3$	119	2130	1543.50	10000 (8 hour)
	Nitric Oxide (NO)	$\mu g/m^3$	0	92	56.53	100 (Annual)
	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	0	66	27.16	
	Sulphur Dioxide (SO_2)	$\mu g/m^3$	0	89	42.88	365 (24 hour)
	Ozone (O_3)	$\mu g/m^3$	0	53	20.07	157 (8 hour)
	Particulate Matter (PM_{10})	$\mu g/m^3$	58	269	144.76	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	21	156	61.84	65 (24 hour)
	Air Temperature	°C	21	29	26.04	NSE**
	Relative Humidity	%	55	94	72.46	NSE**

Prepared and Checked By:

Saiful 28.02.16

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ENRAC

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_02D	09:17 AM (480)	dBA	53.1	75.9	62.55
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997
** NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Prepared and Checked By:

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Md. Saiful Islam 28.02.16
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ENRAC

ENRAC REF: IWM/ NIP/02.03

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 06/02/2016, 08:49 AM
ANALYSIS DATE	: 22/02/2016
SAMPLING ID	: AAQ_03D (Barisal)
GPS COORDINATES	: 22°42.033′ N 90°31.460′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set on the Kalabhadurpur river bank which was about 700 m south from the Shreepur bazar and the location was prone to erosion. • Different type of water vessels were plying through the river chennel. Country boats run by engine was dominant which were used for fishing. However, ferry, launch and trawler also observed during sampling. • Vegetation was high and different type of aquatic fauna were found around the sampling site.	Carbon Monoxide (CO)	$\mu g/m^3$	51	946	376.72	10000 (8 hour)
	Nitric Oxide (NO)	$\mu g/m^3$	0	56	29.98	100 (Annual)
	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	0	35	12.90	
	Sulphur Dioxide (SO_2)	$\mu g/m^3$	0	52	26.09	365 (24 hour)
	Ozone (O_3)	$\mu g/m^3$	0	30	10.57	157 (8 hour)
	Particulate Matter (PM_{10})	$\mu g/m^3$	18	164	91.51	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	5	77	30.24	65 (24 hour)
	Air Temperature	°C	19	24	22.47	NSE**
	Relative Humidity	%	45	72	55.51	NSE**

Prepared and Checked By:

Saiful 28.02.16

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ENRAC

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_03D	08:49 AM (480)	dBA	44.1	69.8	56.42
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997
** NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

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ENRAC

ENRAC REF: IWM/ NIP/02.04

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 07/02/2016, 8:35 AM
ANALYSIS DATE	: 22/02/2016
SAMPLING ID	: AAQ_04D (Bhola)
GPS COORDINATES	: 22°42.978′ N 90°40.665′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set on the bank of Meghna river which was about 100 m east from the local bazar. • Different type of water vessels were observed to ply along the sampling location. Country boats run by shallow engine were dominant among them. • Vegetation was high and some birds and aquatic fauna were found around the sampling site. • A boat ghat was located near the sampling location thus number of boats were found to cross the sampling point with heavy noise.	Carbon Monoxide (CO)	μg/m^3	73	992	568.12	10000 (8 hour)
	Nitric Oxide (NO)	μg/m^3	0	79	40.30	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m^3	0	36	22.71	
	Sulphur Dioxide (SO_2)	μg/m^3	0	58	31.46	365 (24 hour)
	Ozone (O_3)	μg/m^3	0	42	15.77	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m^3	33	198	103.85	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m^3	7	86	36.96	65 (24 hour)
	Air Temperature	°C	19	26	22.88	NSE**
	Relative Humidity	%	46	79	61.18	NSE**

Prepared and Checked By:

Saiful 28.02.16
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Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_04D	08:35 AM (480)	dBA	43.1	70.1	53.69
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997
** NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Prepared and Checked By:

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Md. Saiful Islam 28.02.16

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ENRAC

ENRAC REF: IWM/ NIP/02.05

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 29/01/2016, 11:39 AM
ANALYSIS DATE	: 22/02/2016
SAMPLING ID	: AAQ_05D (Chandpur)
GPS COORDINATES	: 23^{0}13.991′ N 90^{0}38.896′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set at the launch terminal which was located on the Meghna river. • A boat ghat was located near the sampling location thus number of boats were found to cross the sampling point with heavy noise. • Various types of motor boats and launches were sailing in the river during sampling.	Carbon Monoxide (CO)	μg/m^3	79	1505	937.42	10000 (8 hour)
	Nitric Oxide (NO)	μg/m^3	0	84	50.47	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m^3	0	46	28.64	
	Sulphur Dioxide (SO_2)	μg/m^3	0	72	39.33	365 (24 hour)
	Ozone (O_3)	μg/m^3	0	51	21.11	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m^3	45	217	139.75	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m^3	16	128	58.27	65 (24 hour)
	Air Temperature	°C	21	23	22.21	NSE**
	Relative Humidity	%	62	87	74.71	NSE**

Prepared and Checked By:

Saiful 28.02.16

Md. Saiful Islam

Environmental Scientist

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ENRAC

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_05D	11:39 AM (480)	dBA	49.2	84.7	68.5
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997
** NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

Prepared and Checked By:

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ENRAC

ENRAC REF: IWM/ NIP/02.06

AMBIENT AIR QUALITY AND NOISE LEVEL MEASUREMENT REPORT

COMPANY NAME	: Institute of Water Modelling (IWM)
PROJECT NAME	: Dhaka- Chittagong Inland Water Transport Corridor Project
CLIENT REF.	: N/A
CLIENT ADDRESS	: House No.496, Road No. 32, New DOHS, Mohakhali, Dhaka- 1206, Bangladesh
SAMPLE COUNT	: 480 (8 hour)
SAMPLING DATE	: 30/01/2016, 09:40 AM
ANALYSIS DATE	: 22/02/2016
SAMPLING ID	: AAQ_06D (Munshiganj)
GPS COORDINATES	: 23^{0}32.635′ N, 90^{0}35.287′ E

Ambient Air Quality (AAQ) Test Results

Sampling Site Description	Description of Parameters	Unit	Concentration of Ambient Air Quality Parameters			GoB Air Quality Standards*
			Minimum	Maximum	Average	
• The EPAS was set at the Gozaria bazar on the Meghna river bank.The launch terminal was located 100 m inside the river. • Various types of motor boats and launches were sailing in the river during sampling. • A boat ghat was located near the sampling location thus number of boats were found to cross the sampling point with heavy noise.	Carbon Monoxide (CO)	μg/m^3	69	1255	755.98	10000 (8 hour)
	Nitric Oxide (NO)	μg/m^3	0	67	40.01	100 (Annual)
	Nitrogen Dioxide (NO_2)	μg/m^3	0	33	21.97	
	Sulphur Dioxide (SO_2)	μg/m^3	0	60	31.45	365 (24 hour)
	Ozone (O_3)	μg/m^3	0	38	17.54	157 (8 hour)
	Particulate Matter (PM_{10})	μg/m^3	48	236	126.58	150 (24 hour)
	Particulate Matter ($PM_{2.5}$)	μg/m^3	15	121	49.14	65 (24 hour)
	Air Temperature	°C	18	26	22.63	NSE**
	Relative Humidity	%	52	80	66.06	NSE**

Prepared and Checked By:

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ENRAC

Noise Measurement (NM) Results

Sampling ID	Time (No of Measurement)	Unit	Noise Measurement Data		
			Minimum	Maximum	L_{eq}
NM_06D	09:40 AM (480)	dBA	47.6	78.5	60.91
GoB Noise Standard***	Zone	Day		Night	
	Silent	50		40	
	Residential	55		45	
	Mixed	60		50	
	Commercial	70		60	
	Industrial	75		70	

* The amended Schedule-2, 2005, of (Air Quality Standard) Environmental Conservation Rules, 1997
** NSE- No standards established yet
*** The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, 1997

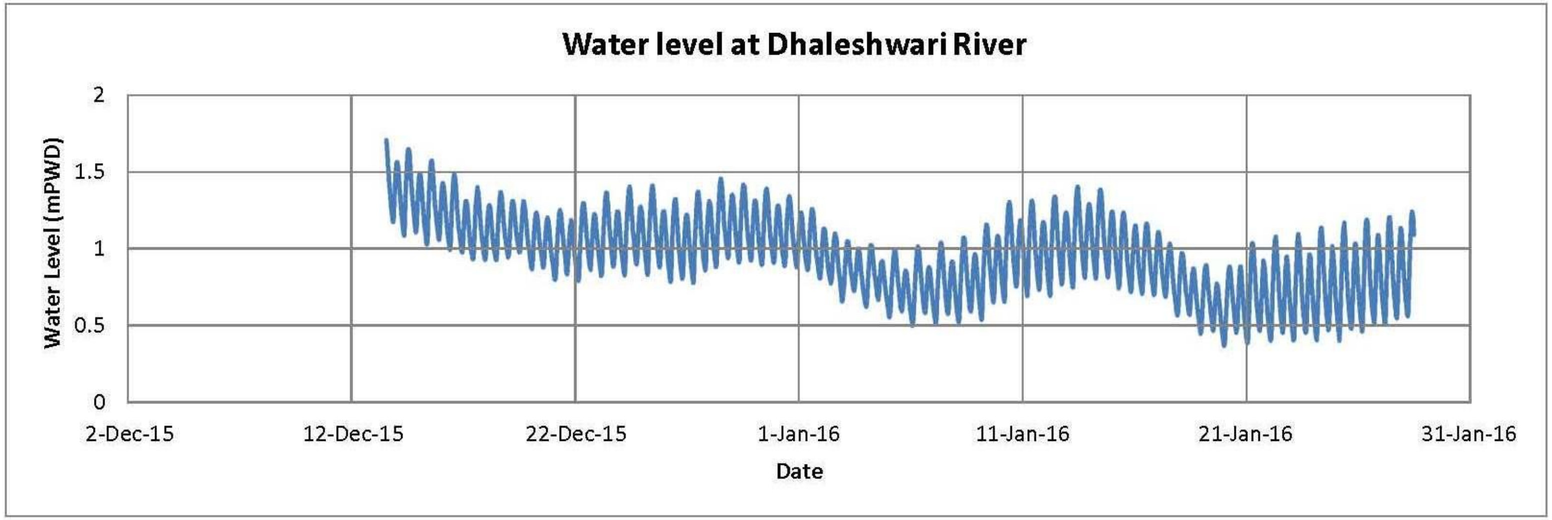
Prepared and Checked By:

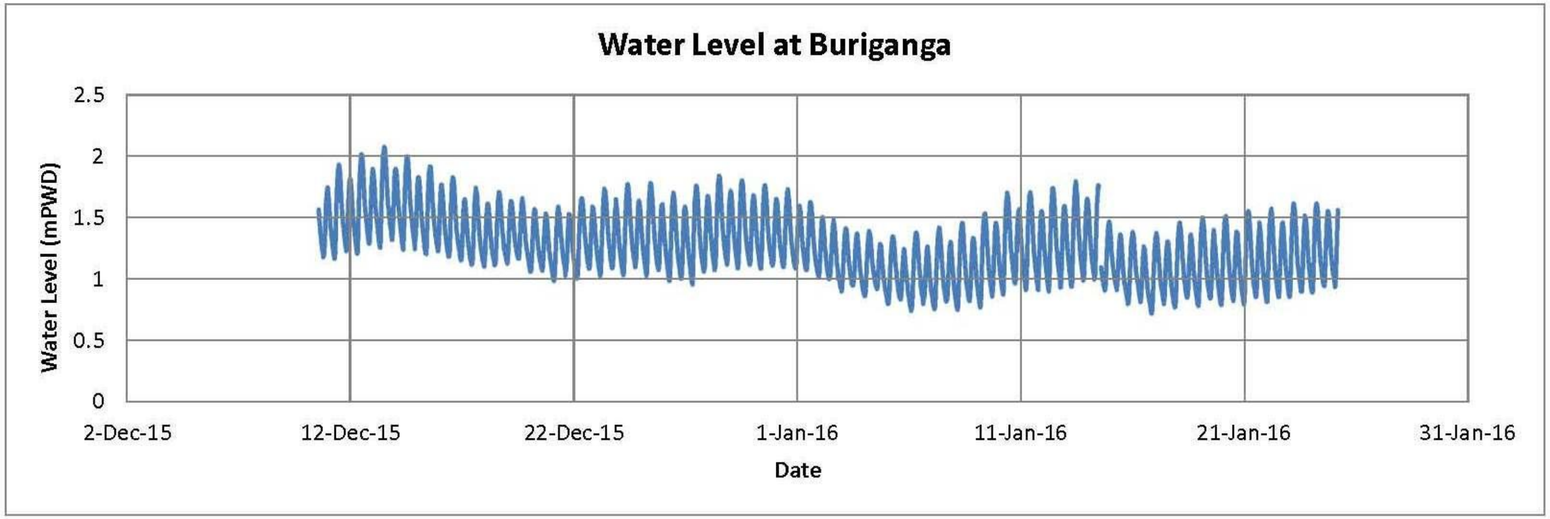
Saiful 28.02.16
Md. Saiful Islam
Environmental Scientist

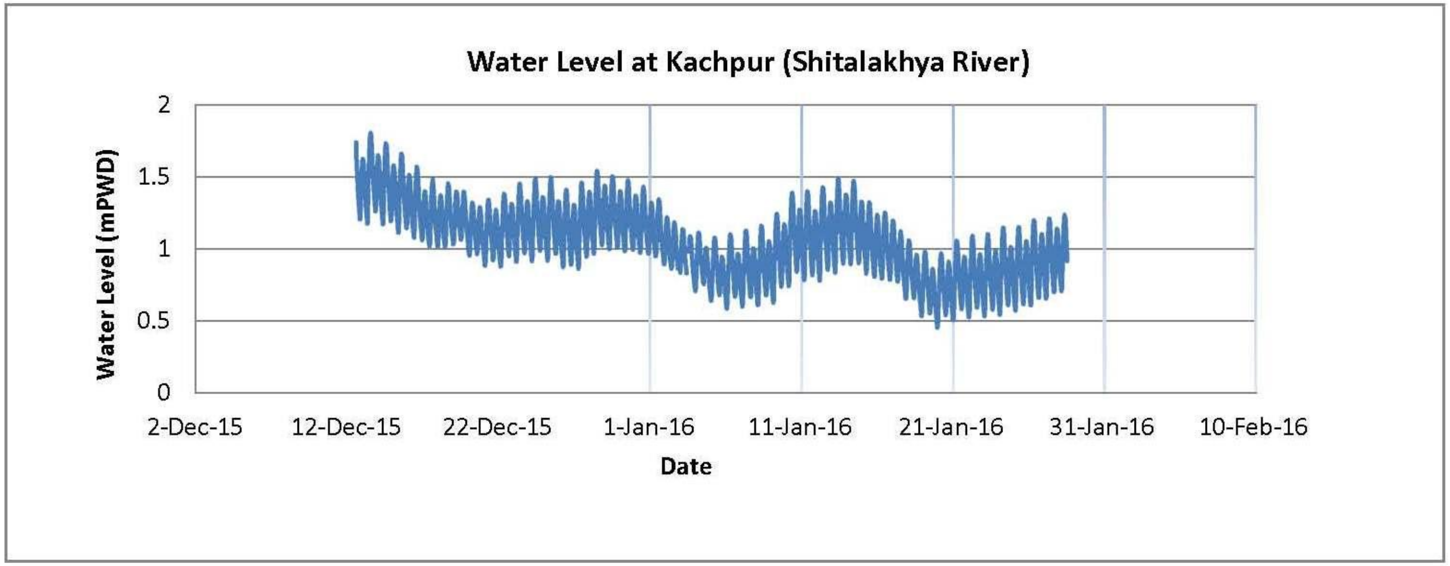
Environment and Resource Analysis Center Ltd. ENRAC * Environment and Resource Analysis Center Ltd.

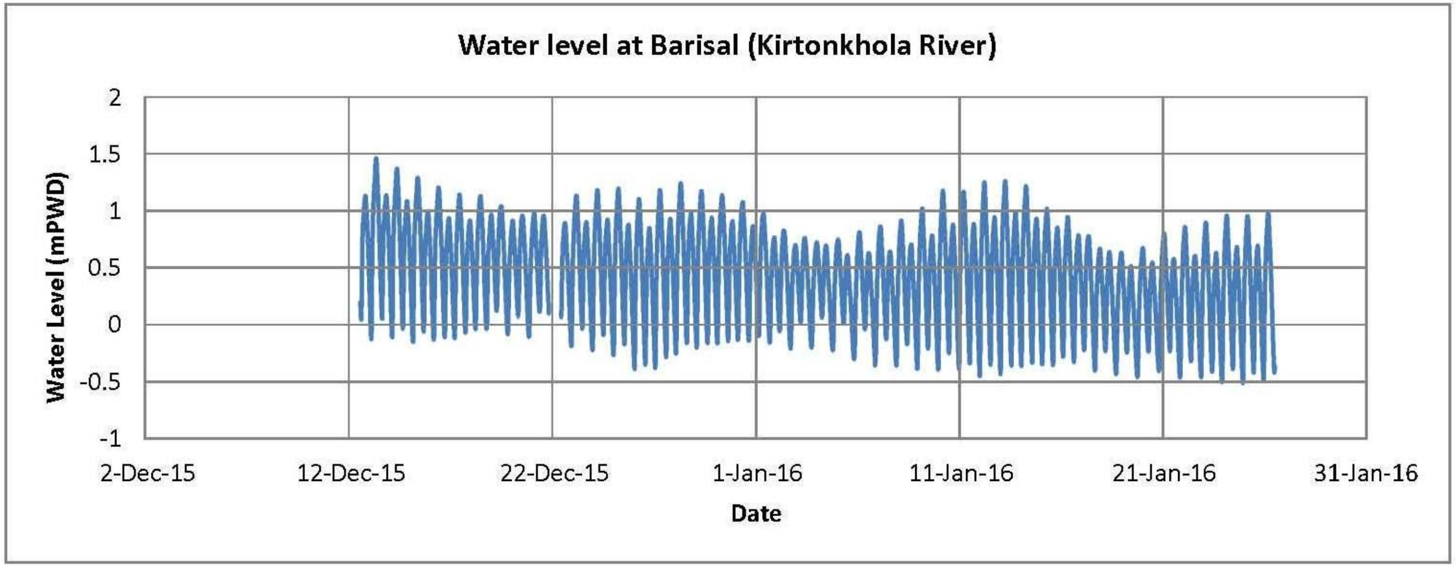
Annex D: Survey Data

Water Level Data





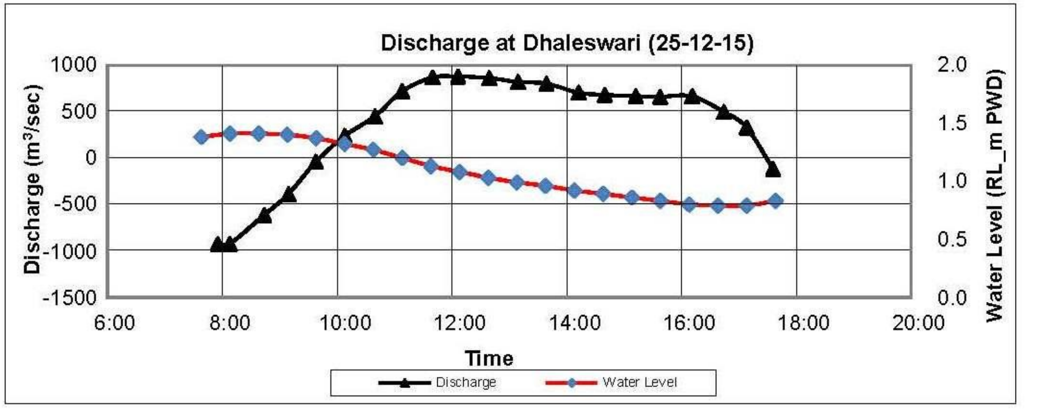

Water Level at Kachpur (Shitalakhya River)
2
1.5
1
0.5
0
Water Level (mPWD)
2-Dec-15
12-Dec-15
22-Dec-15
1-Jan-16
11-Jan-16
21-Jan-16
31-Jan-16
10-Feb-16
Date

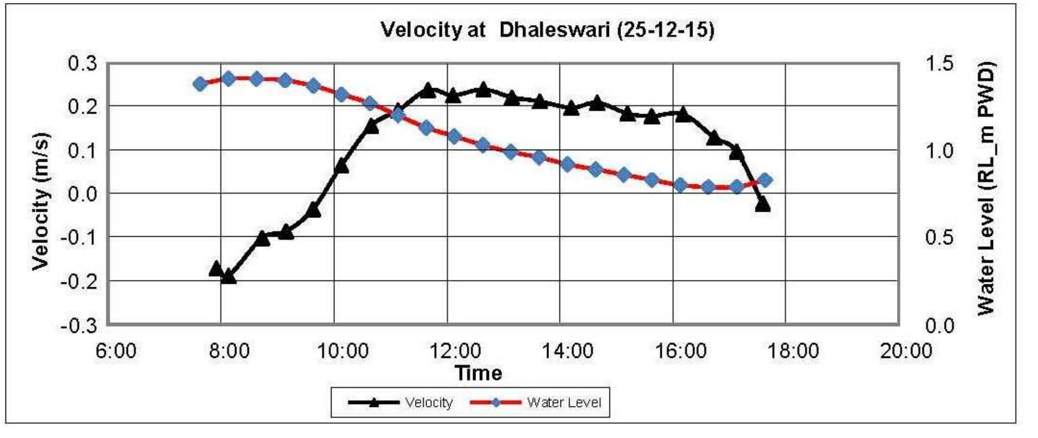

Water level at Barisal (Kirtonkhola River)
2
1.5
1
0.5
0
-0.5
-1
Water Level (mPWD)
2-Dec-15
12-Dec-15
22-Dec-15
1-Jan-16
11-Jan-16
21-Jan-16
31-Jan-16
Date

Discharge Measurement

River: Dhaleswari
Station:Dikri Char
Discharge observation at Dhaleswari River
Position 242121 2611597
Date: 25/12/2015 Tide:Spring

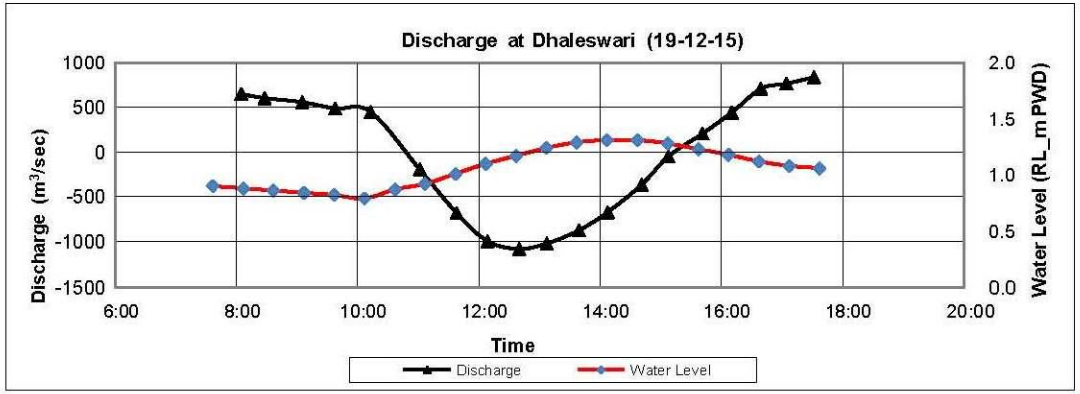
Time	Total Q	Velocity	Flow Dir.	WL
	m³/s	m/s	Degree	RL-mPWD
7:47:19	-924.98	-0.17	315.32	1.38
7:59:53	-921.54	-0.187	301.01	1.41
8:35:41	-611.008	-0.1	313.23	1.41
9:01:11	-385.137	-0.085	294.96	1.40
9:29:43	-38.822	-0.034	235.74	1.37
9:59:52	239.827	0.066	106.24	1.32
10:31:35	453.126	0.157	121.29	1.27
11:00:11	723.394	0.192	123.26	1.20
11:31:46	870.705	0.239	140.73	1.13
11:58:23	881.823	0.227	125.48	1.08
12:30:56	864.244	0.24	133.84	1.03
13:01:06	822.169	0.222	122.2	0.99
13:30:42	805.214	0.213	128.87	0.96
14:04:14	706.85	0.198	125.39	0.92
14:31:43	683.441	0.21	129.85	0.89
15:04:04	669.163	0.185	120.15	0.86
15:29:37	663.373	0.179	127.42	0.83
16:03:07	667.331	0.183	138.18	0.80
16:36:15	499.011	0.13	130.88	0.79
17:00:05	332.695	0.098	127.81	0.79
17:27:43	-114.728	-0.021	319.28	0.83

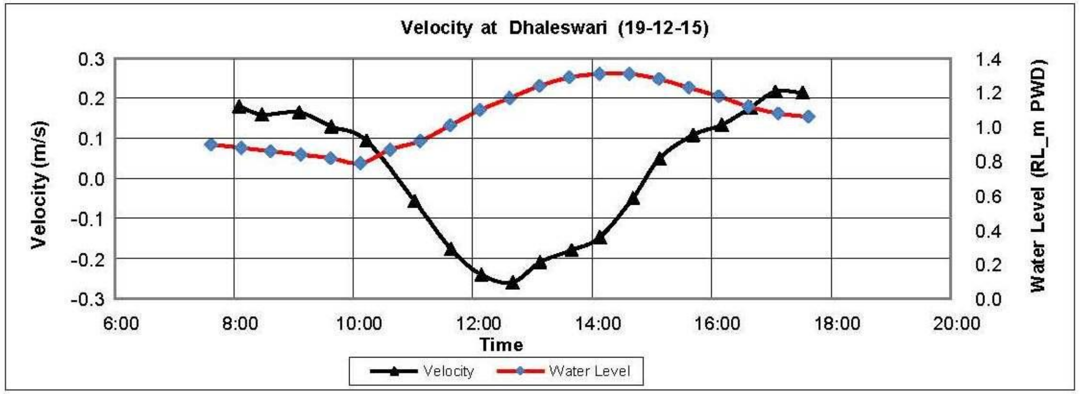




River:Dhaleswari
Station:Dikri Char
Discharge observation at Dhaleswari River
Position 242125 2611634
Date:19/12/2015 Tide:Neap

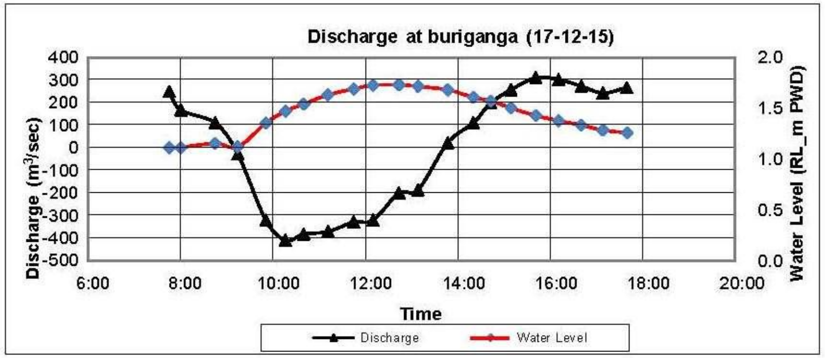
Time	Total Q	Velocity	Flow Dir.	WL
	m^3/s	m/s	Degree	RL_mPWD
7:58:06	654.17	0.181	131.3	0.88
8:21:06	609.436	0.161	134.24	0.86
8:58:23	564.031	0.166	134.74	0.84
9:30:45	494.098	0.131	118.83	0.82
10:06:01	455.705	0.096	124.81	0.79
10:54:38	-187.318	-0.055	304.85	0.92
11:31:07	-673.315	-0.174	317.65	1.01
12:01:41	-987.57	-0.238	299.23	1.10
12:32:54	-1074.08	-0.257	317.81	1.17
13:00:29	-1012.16	-0.192	315.59	1.24
13:32:11	-865.973	-0.152	307.8	1.29
14:00:30	-662.977	-0.145	308.35	1.31
14:33:59	-357.398	-0.047	342.24	1.31
15:00:32	-41.06	-0.051	72.51	1.28
15:34:22	214.398	0.11	113.23	1.23
16:03:07	448.187	0.135	131.11	1.18
16:32:03	714.744	0.178	116.86	1.12
16:57:10	769.787	0.218	132.27	1.08
17:24:20	842.549	0.215	123.75	1.06

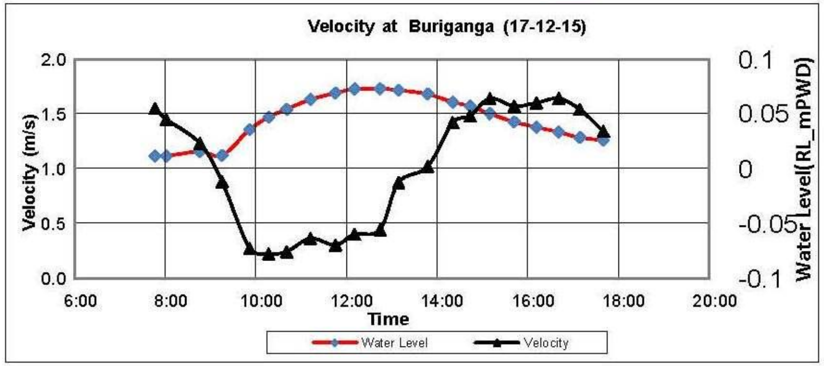




River:Buriganga
Station: Mill Barak
Discharge observation at Buriganga River
Position 236888 2622766
Date:17/12/2015 Tide:Spring

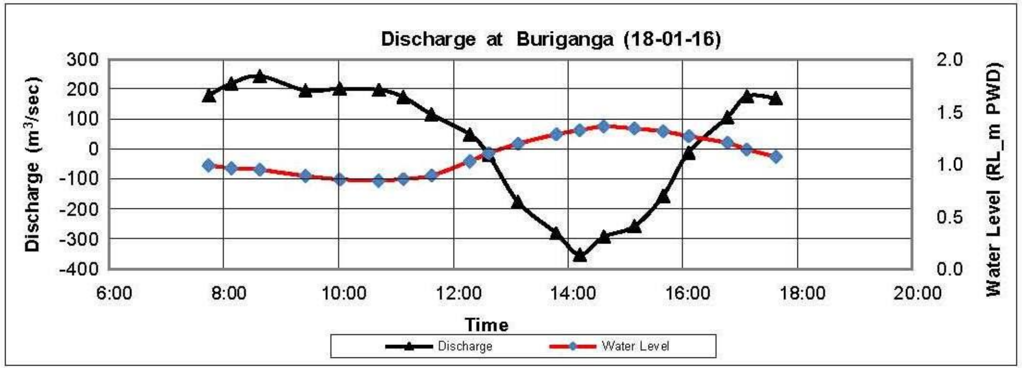
Time	Total Q	Velocity	Flow Dir.	Water Level
	m^3/s	m/s	Degree	RL_mPWD
7:37:30	249.888	0.055	157.93	1.115
7:52:27	167.881	0.045	142.51	1.115
8:37:15	110.229	0.023	139.23	1.156
9:06:29	-26.5	-0.012	344.88	1.121
9:42:55	-319.651	-0.073	315.81	1.356
10:08:14	-407.904	-0.078	322.16	1.471
10:32:04	-380.8	-0.076	322.95	1.542
11:03:37	-369.061	-0.064	313.86	1.633
11:36:49	-327.206	-0.07	324.94	1.691
12:01:55	-319.075	-0.06	311.58	1.728
12:35:38	-198.638	-0.056	327.13	1.732
13:00:23	-184.683	-0.0128	332.74	1.716
13:38:58	23.64	0.002	231.24	1.682
14:11:56	110.138	0.042	125.64	1.608
14:34:48	198.605	0.048	128.51	1.572
15:01:05	257.385	0.064	136.41	1.503
15:33:16	311.007	0.057	144.68	1.428
16:02:50	302.394	0.06	134.05	1.379
16:32:18	272.968	0.064	136.87	1.334
17:00:18	242.822	0.054	140.21	1.285
17:31:32	267.221	0.034	149.69	1.26

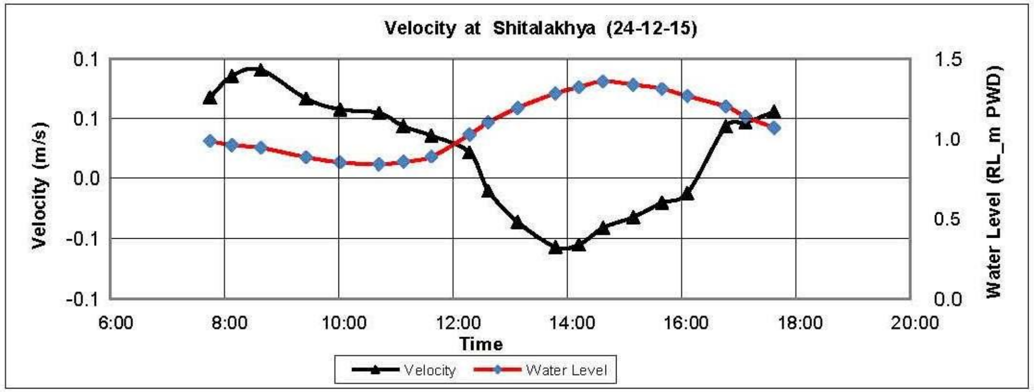




River:Buriganga
Station:Mill Barak
Discharge observation at Buriganga River
Position 236888 2622766
Date:18/01/2016 Tide:Neap

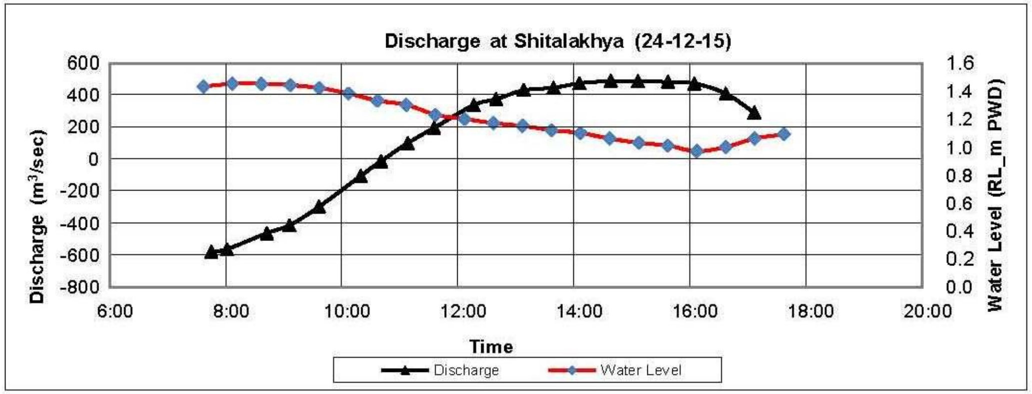
Time	Total Q	Velocity	Flow Dir.	WL
	m³/s	m/s	Degree	RL_mPWD
7:37:40	179.958	0.068	154.45	0.989
8:00:58	218.745	0.086	137.31	0.961
8:31:02	243.732	0.091	155.7	0.946
9:18:39	195.633	0.067	156.73	0.887
9:54:24	201.596	0.058	197.84	0.854
10:35:22	197.532	0.055	151.57	0.842
11:00:53	173.838	0.044	171.67	0.858
11:30:21	115.939	0.036	127.22	0.890
12:10:25	48.836	0.022	40.12	1.028
12:30:15	-19.505	-0.01	273.53	1.105
13:00:54	-175.826	-0.036	305.86	1.195
13:40:53	-280.359	-0.057	323.54	1.286
14:05:28	-352.321	-0.055	330.66	1.324
14:30:45	-292.534	-0.041	299.11	1.361
15:02:37	-257.102	-0.032	297.32	1.340
15:32:36	-155.78	-0.02	283.23	1.314
15:59:14	-11.252	-0.012	86.38	1.269
16:39:44	106.179	0.044	155.47	1.203
17:00:18	176.451	0.047	129.5	1.141
17:30:21	170.662	0.056	144.27	1.070

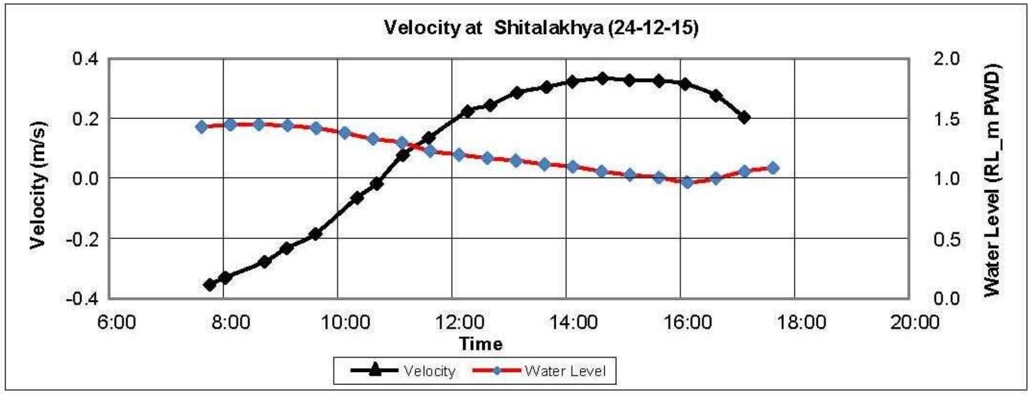




River: Shitalakhya
Station: kachpur
Discharge observation at Shitalakhya River
Position 246230 2624575
Date: 24/12/2015 Tide:Spring

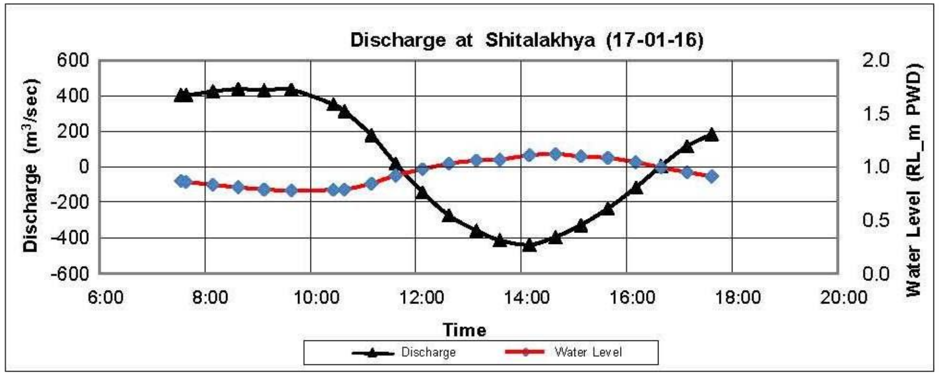
Time	Total Q	Velocity	Flow Dir.	Water Level
	m^3/s	m/s	Degree	RL_mPWD
7:38:05	-575.466	-0.352	312.94	1.43
7:54:29	-559.641	-0.328	311.99	1.45
8:35:53	-459.362	-0.275	317.35	1.45
8:58:59	-410.777	-0.23	315.79	1.44
9:29:22	-295.413	-0.182	311.29	1.42
10:12:50	-101.013	-0.063	310.14	1.38
10:33:40	-10.298	-0.015	178.76	1.33
11:01:07	101.663	0.08	133.24	1.30
11:28:21	197.24	0.137	136.11	1.23
12:09:23	339.395	0.225	135.36	1.20
12:32:44	377.607	0.246	136.4	1.17
13:01:12	432.744	0.287	134.3	1.15
13:32:03	448.595	0.306	134.1	1.12
13:58:57	476.055	0.324	133.57	1.10
14:31:09	490.176	0.335	135.19	1.06
14:59:22	489.194	0.329	134.22	1.03
15:30:21	484.733	0.327	134.35	1.01
15:57:42	475.261	0.316	132.9	0.97
16:30:09	411.637	0.278	134.76	1.00
16:59:36	292.738	0.206	131.63	1.06

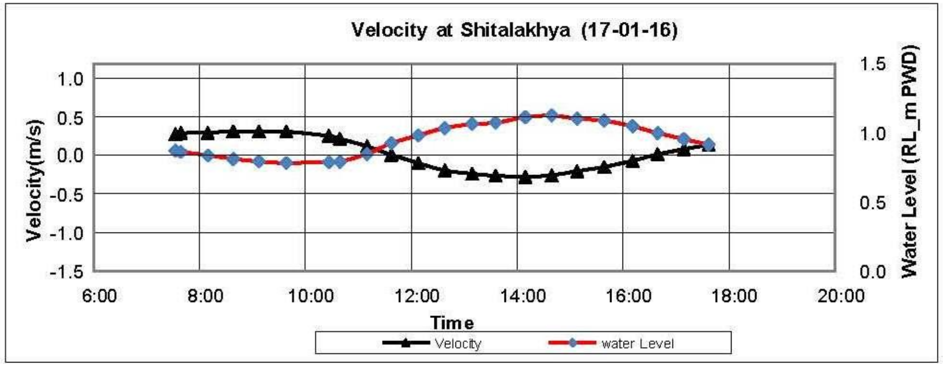




River:Shitalakhya
Station: kachpur
Discharge observation at Shitalakhya River
Position 246230 2624575
Date:17/01/2016 Tide:Neap

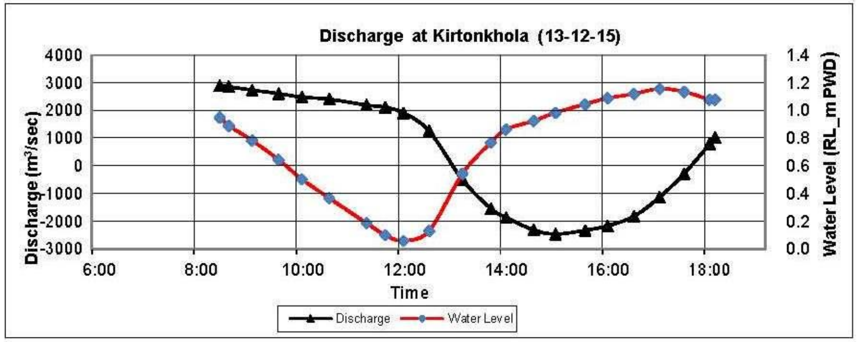
Time	Total Q	Velocity	Flow Dir.	WL
	m^3/s	m/s	Degree	RL_mPWD
7:24:54	407.054	0.283	132.75	0.87
7:31:07	405.46	0.294	134.2	0.86
8:01:39	425.983	0.301	130.04	0.84
8:30:24	440.095	0.318	132.45	0.81
8:59:44	432.513	0.318	129.65	0.79
9:30:32	436.231	0.315	132.8	0.78
10:18:37	353.713	0.259	131.8	0.788
10:31:19	315.001	0.221	132.26	0.79
11:01:56	180.332	0.124	132.21	0.847
11:29:33	19.288	0.014	110.51	0.923
12:00:10	-141.613	-0.095	314.38	0.981
12:30:08	-271.586	-0.191	313.37	1.034
13:01:11	-356.82	-0.234	313.77	1.063
13:27:44	-410.93	-0.258	313.39	1.072
14:01:23	-437.379	-0.273	316.45	1.112
14:31:12	-393.104	-0.253	314.94	1.124
15:00:07	-326.026	-0.2	317.22	1.102
15:30:44	-233.435	-0.145	313.04	1.087
16:02:46	-114.462	-0.065	315.13	1.047
16:31:11	5.729	0.019	155.69	0.998
17:00:42	116.765	0.085	138.93	0.954
17:28:53	184.867	0.142	131.35	0.914

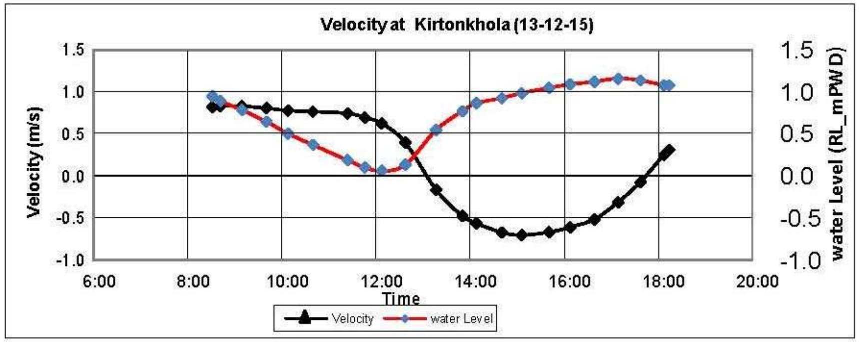




River: Kirtonkhola
Station: Rupatali
Discharge observation at Kirtonkhola River
Position 228466 2509397
Date: 13/12/2015 Tide:Spring

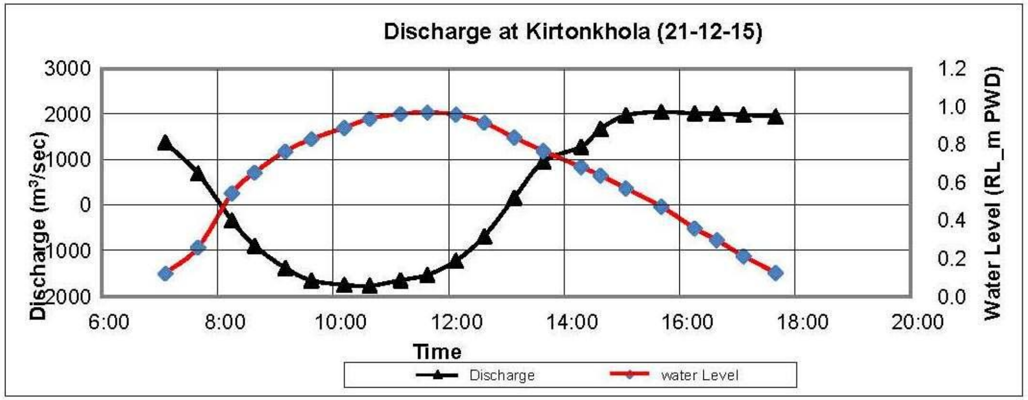
Time	Total Q	Velocity	Flow Dir.	Water Level
	m³/s	m/s	Degree	RL_mPWD
8:23:36	2891.66	0.818	221.01	0.9500
8:34:04	2862.902	0.83	220.44	0.8900
9:01:43	2740.487	0.828	222.46	0.7836
9:32:55	2614.19	0.804	221.63	0.6446
10:00:21	2483.923	0.777	221.08	0.5046
10:32:16	2412.675	0.764	222.68	0.3686
11:16:23	2198.161	0.743	222.13	0.1880
11:38:14	2121.771	0.694	220.56	0.1006
11:59:44	1910.744	0.624	222.84	0.0606
12:29:55	1262.988	0.396	223.53	0.1316
13:09:16	-502.105	-0.166	34.91	0.5446
13:42:36	-1537.017	-0.476	41.35	0.7686
14:00:27	-1859.191	-0.565	40.82	0.8636
14:32:58	-2310.294	-0.673	39.19	0.9246
14:58:29	-2457.681	-0.706	38.34	0.9836
15:33:20	-2323.406	-0.671	40.51	1.0456
15:59:57	-2158.705	-0.612	38.45	1.0886
16:30:52	-1811.851	-0.519	41.01	1.1196
17:01:05	-1124.316	-0.316	41.38	1.1566
17:29:47	-275.642	-0.074	46.25	1.1346
17:59:38	786.834	0.251	222.38	1.0786
18:06:15	1041.976	0.308	218.36	1.0784

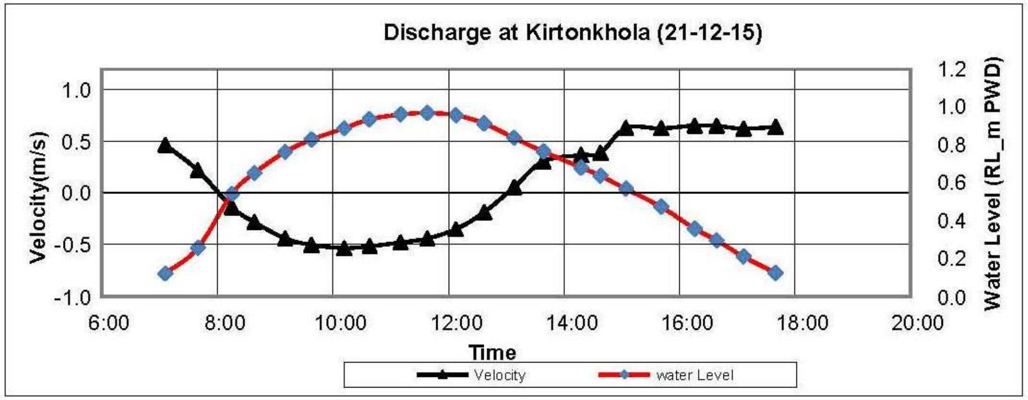




River: Kirtonkhola
Station: Rupatali
Discharge observation at Kirtonkhola River
Position: 228616 2509287
Date: 21/12/2015 Tide:Neap

Time	Total Q	Velocity	Flow Dir.	WL
	m^3/s	m/s	Degree	RL_mPWD
6:58:10	1390.857	0.473	223.08	0.123
7:32:00	707.778	0.224	227.45	0.259
8:07:21	-326.367	-0.131	44.37	0.545
8:30:45	-876.744	-0.278	41.7	0.654
9:02:35	-1368.19	-0.434	45.18	0.766
9:29:50	-1642.45	-0.498	44.44	0.831
10:03:55	-1738.47	-0.529	45.89	0.891
10:30:21	-1761.05	-0.511	42.88	0.939
11:02:24	-1636.03	-0.475	44.71	0.964
11:30:10	-1521.71	-0.436	43.43	0.972
11:59:54	-1210.2	-0.345	44.69	0.960
12:29:17	-671.476	-0.182	45.32	0.917
13:00:31	177.292	0.064	216.36	0.840
13:30:42	971.919	0.312	228.67	0.769
14:10:02	1298.847	0.373	226.84	0.684
14:30:02	1685.824	0.393	226.84	0.640
14:56:30	1989.636	0.634	225.43	0.571
15:33:08	2061.467	0.632	224	0.476
16:07:56	2032.883	0.659	225.22	0.361
16:30:44	2026.043	0.655	224.65	0.299
16:58:37	1998.46	0.63	224.03	0.214
17:32:02	1961.999	0.645	224.42	0.127





Annex E: Biodiversity Management Plan

INTRODUCTION:

Biodiversity has a very close relationship between ecosystem services and livelihoods when allocating land and natural resources. Healthy ecosystems ensure human well-being by providing food, materials (e.g. wood, crops, fibre, fruits and vegetables) and clean water, and also by breaking down waste materials. In addition, many plants and other organisms are useful in medical research or contain substances used as medicines. Minimising environmental harm is therefore a fundamental requirement for the sustainable operation of all developmental activities. Altering river beds through dredging and management of the dredged materials in an area rich in biodiversity and harbouring critically endangered species require preparation and implementation of biodiversity management plan (BMP). It is important to manage biodiversity as part of responsible and proactive risk management which in the past has mostly been ignored and/or not given due priority. Managing biodiversity can also result in cost savings, because nature can typically provide services more economically and efficiently than man-made infrastructure (for example discharging and treating water in a wetland instead of a treatment plant).

There are potential new revenue streams as well, where biodiversity on a site might be valued by people enough for them to pay to visit or enjoy it, for example, river cruising, bird-watching, or swimming and fishing in a wetland. It is imperative to demonstrate responsible business behaviour for any institution, project, or business by minimising their ecological footprint and ensuring the welfare of the communities and environments in their areas of operation. Projects implementing BMPs are more likely to avoid operational risks and gain public and consumer support. Large-scale projects and industries both depend and impact upon biodiversity and ecosystem services. Extracting has a direct negative impact, (although this can be minimised), while rehabilitation, if done appropriately, can have a neutral or positive impact on biodiversity. The local situation is important to understand when considering this impact – for example when operating within protected or ecologically sensitive areas. Projects also depend on biodiversity in a more indirect way, particularly through the provision of ecosystem services. For example, the availability of water, biomass fuel, water filtration services by wetlands, as well as trees and plant species for rehabilitation. The project thus require a management plan for impact assessment and implementing mitigation measures for the biological diversity in general and specifically the key ecosystems and threatened species. The BMP is the result from the biodiversity baseline survey and socio-economic situation analysis of the project area and would address, guide, monitor and minimize the impacts of the project activities. The guidelines would give the contractors (outsourced to a national NGO specialized in wildlife research, monitoring and management) instructions to implement and carry out activities to monitor the key species, ecosystems and document changes in a systematic manner including seasonal variations. This documentation and dissemination of information would allow the project management to act in a rational way without causing any colossal harm to the biodiversity or ecosystem.

Rather innovative ideas and activities are suggested to enhance the biodiversity, restore the habitats and benefit from the ecological services.

PROJECT DESCRIPTION:

The development objective of the project is to increase the capacity, reliability and safety of inland water transport along the Dhaka-Chittagong corridor. The project activities are intended to ensure more private sector involvement in inland water transport (IWT) sector and increased number of country boats and vessels as inland transport. The proposed activities might result in significant environmental impacts, if the investment activities are not properly planned, designed, executed, and maintained. Further to that, the project will provide an opportunity to improve the institutional capacity for environmental management, social management, and safety in overall IWT sector.

This project comprises four distinct physical components. They are i) Dhaka-Munshiganj-Gazaria-Chandpur-Chittagong River route, ii) Three associated river routes: Munshiganj-Demra-Ghorashal River route, Munshiganj-Ashuganj River route, and connecting routes (emerged from Dhaka-Chittagong route) approaching to Barisal, iii) Three ferry crossing routes (Chandpur-Shariatpur, Lakhmipur-Bhola and Beduaria-Laharhat), and iv) Six vessel shelters on the threat of cyclones and nor'westers at proposed locations along the routes. As physical interventions, capital and maintenance dredging at selected locations for the said river routes for the earlier three components have been planned, and construction of vessel shelters for the last one. A comprehensive ESIA has been carried out on each of the components. The purposes of the ESIA study are to foresee the probable impacts, their assessments, prepare environmental management plan (EMP), social management plan (SMP), and thus provide inputs into planning, design and implementing physical interventions. The project area habours globally and nationally significant biodiversity (species and habitats) and the study indicated that the project activities may have some impacts on the biodiversity rich habitats. Hence this Biodiversity Management Plan is prepared and will assist not only in mitigating the probable impacts but also contribute in protecting and conserving the species and their habitats. For further details of the project please refer to the main ESIA document.

OBJECTIVE OF THE BIODIVERSITY MANAGEMENT PLAN (BMP):

The objective of this BMP is to provide the key issues, explaining the connection between operations and healthy ecosystems, outlining some management approaches so that companies, contractors can progressively implement BMPs into site-level management through the development and implementation of an appropriately focused management plan. The BMP addresses the objective of the need for biodiversity conservation and encourages the measurement and monitoring of clearly stated biodiversity targets to minimise impacts and, where possible, to enhance biodiversity. BMP would act as an important tool to guide the project operation towards environmental friendly interventions for sustainable progress in river route transportation.

A BMP is a practical site-specific document developed and used by the site management team to maintain or improve biodiversity values during the operational and post-closure phases, and to determine risks and opportunities before extraction begins.

The development of BMP focused on identifying, evaluating, conserving (and if possible enhancing) the relevant aspects of biodiversity, and should serve to:

• Avoid or mitigate biodiversity loss, with the objective of maintaining the diversity of species, habitats and ecosystems and the integrity of ecological functions

• Contribute towards the remediation of significant global, regional and local biodiversity losses caused by expanding human economic activities

• Realise the business opportunities that arise from biodiversity management

• Respect the mitigation hierarchy

• Address any biodiversity risks identified through an environmental and social impact assessment (ESIA), and

• Respond to regulatory requirements that are relevant to BMPs like invasive species, protected species, protected habitats, nature conservation, and treatment of wildlife, waste management, pollution prevention and water management.

• Respond to M &E results for correcting the course of action at all levels of operation

LEGAL FRAMEWORK:

Government of Bangladesh formulated several national strategies and promulgated laws for the protection of environment, nature, biodiversity and wildlife conservation guided by green policies for ultimate sustainable development in almost all sectors.

The following documents have been prepared and referred to for biodiversity conservation in Bangladesh (Table 1). In addition, Bangladesh is a signatory to several multinational environmental agreements (MEA) for the protection and conservation of biodiversity. Details of these are provided in the main ESIA report.

Table. 1. List of the various national documents related to biodiversity conservation and MEAs signed by Bangladesh. Details are provided in the ESIA main report.

1.	National Biodiversity Strategy & Action Plan (NBSAP) 2007
2.	5th National Report for CBD 2016

3.	Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009
4.	Environmental Conservation Act (ECA), 1995 and Amendments (2010)
5.	Bangladesh Wildlife (Conservation & Security) Act, 2012
6.	The Forest Act 1927 (amended 2000)
7.	Protection and Conservation of Fish Act, 1950 (Amended 1963, 1970, 1982, 1995, 2000) & Protection and Conservation of Fish Rules, 1985 (Amended 1987)
8.	The Embankment and Drainage Act, 1952
9.	Open Place, Park & Wetland Conservation Act, 2000 (amended 2002)
10.	Dredging and Dredged Material Management Guidelines, 2013
11.	International Plant Protection Convention (IPPC) 1951
12.	Plant Protection Agreement for the South East Asia and Pacific Region 1956
13.	Convention on Biological Diversity (CBD) 1992
14.	UN Framework Convention on Climate Change (UNFCCC) 1992
15.	Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) 1973
16.	Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) (1971)
17.	Convention for the Prevention of Marine Pollution from Land-Based Sources 1974 (amended 1986)
18.	Convention on the Conservation of Migratory Species of Wild Animals (CMS) 1979
19.	Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA Marine Turtle MoU) 2004 (under CMS)

KEY BIODIVERSITY FEATURES (ONLY SUMMARY HERE, DETAILS IN ESIA)

Within a relatively small geographic boundary, Bangladesh hosts a diverse array of ecosystems. Being a low-lying deltaic country and dependent on the monsoon rain, seasonal variation in water availability is the major factor, which generates different ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems.

The ecosystems of Bangladesh could be categorized into two major groups, i.e. (i) terrestrial, and (ii) aquatic. The land-based terrestrial ecosystems include forest and hill ecosystems, agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category. Each of the ecosystems has many sub-units with distinct characteristics as well. Bangladesh is classified into twenty five bio-ecological zones (Fig. 1) some of which are constituted of one or more than one type of ecosystems. The Project Influence Area (PIA) consists of categories 4b, 4c, 4e, 8b, 8d, 11, and 12 of the bio-ecological zones and described in the ESIA report.

Each of the bio-ecological categories contains a unique set of characteristics based on which the species composition varies. Some of the categories share the same species whereby the species have to adapt themselves to that particular niche.

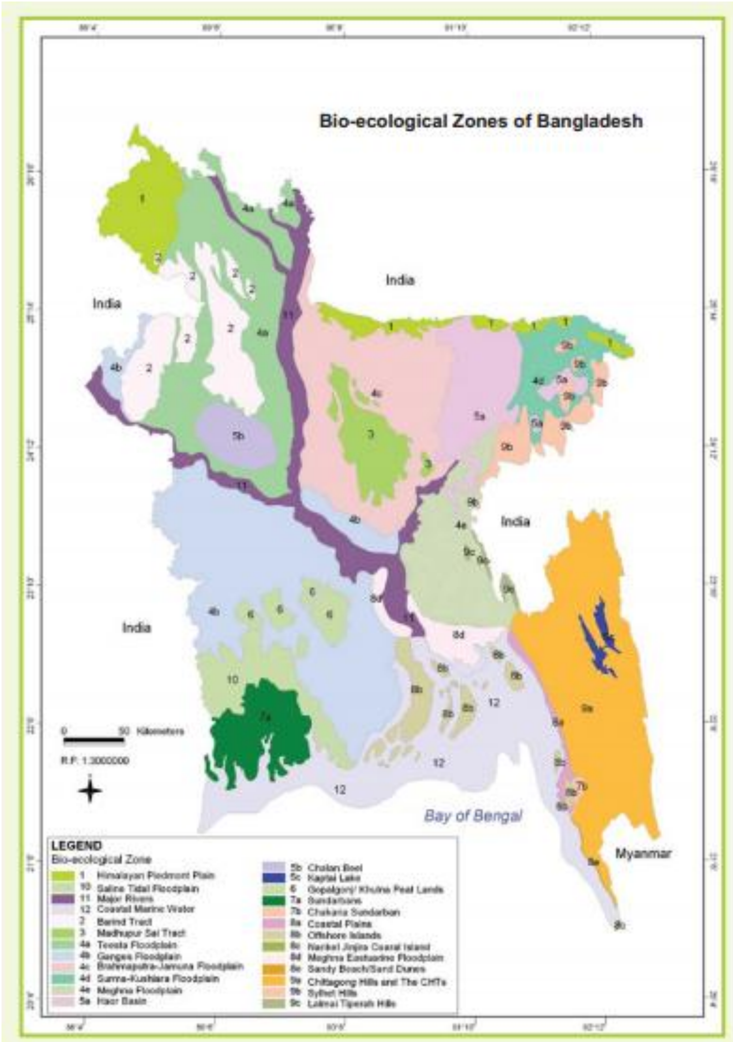


Fig. 1. Bio-ecological zones of Bangladesh (Source: IUCN 2002)

All wildlife species including butterflies are protected under the Bangladesh Wildlife (Conservation & Security) Act 2012. The Protection and Conservation of Fish (Amendment) Act, 1995 mentions about the prohibition of killing fishes in destructive ways (like poisoning, polluting fish habitat, etc.), prohibition of catching, carrying or selling of fries, fingerlings and brood of rui (*Labeo ruhita*), kalbaus (*L. calbasu*) and gonia (*L. gonius*), catla (*Catla catla*), mrigel (*Cirrhinus mrigala*), hilsa jatka (*Tenualosa ilisha*) <23 cm during November to May; pangas (*Pangasius pangasius*) <23 cm during Nov-April; and shilong (*Silonia silondia*); shol (*Channa striata*); and Ayre (*Mystus aur*) <30cm during Feb-Jun; and prohibition of catching fries, fingerlings and post larvae throughout the year in the coastal region.

About 267 species of freshwater fish inhabit the water bodies of Bangladesh (Rahman 2005, Mustafa 2013) of which about 200 species are small indigenous species (SIS). According to the IUCN Bangladesh (2000) fifty four (54) species (=20%) are endangered. The IUCN Redlist is currently being updated and the numbers and categories of fish and other fauna and flora species may change. The IUCN Global Species Programme working with the IUCN Species Survival Commission (SSC) assesses the conservation status of species, subspecies, varieties, and even selected sub-populations on a global scale, in order to highlight taxa threatened with extinction. The IUCN Red List of Threatened Species™ provides taxonomic, conservation status and distribution information on plants, fungi and animals that have been globally evaluated using the IUCN Red List Categories and Criteria (IUCN 2014).

Meghna River is one of the major rivers in Bangladesh, especially famous for its great estuary that discharges the flows of the Ganges-Padma, the Brahmaputra-Jamuna and the Meghna itself. The Meghna has two distinct parts (Fig. 2). The Upper Meghna from Kuliarchar to Shatnal is a comparatively small river. The Lower Meghna below Shatnal is one of the largest rivers in the world because of its wide estuary mouth. The Lower Meghna is at times treated as a separate river.

The Upper Meghna Flood Plain is a dominant freshwater environment inhabited by freshwater plant and animal species. The floodplain comprises a nutrient rich freshwater ecosystem supporting high fish production, and many aquatic species some of which are now endangered. Native waterfowl and migratory birds, freshwater turtles and other reptiles and amphibians depended on this system, and the area was rich in biodiversity. The construction of embankments along some sections of the Upper Meghna, effluents from the industries entirely changed the ecosystem. The free migration patterns of fish from the floodplain to the Meghna River and vice versa was disrupted, and fish production. Intensive agriculture and reduction in wetland areas have affected the habitat of migratory birds, freshwater turtles. The pressure from the increasing human population on the natural resources has affected the ecosystem. However the water quality is still favourable for many of the aquatic species like the freshwater turtles, otters, Gangetic dolphins, etc.

The Lower Meghna River conveys the combined flows of the Brahmaputra, the Ganges and the Upper Meghna rivers and the discharge into the Meghna estuary is dominated by these three major rivers reinforced by the Dhaleshwari. All the three rivers are large. The Dhaleshwari-Meghna and the Padma are each 5 km wide at the confluence. The Lower Meghna has several small chars (braid-bars) in it, which create two main channels, of which

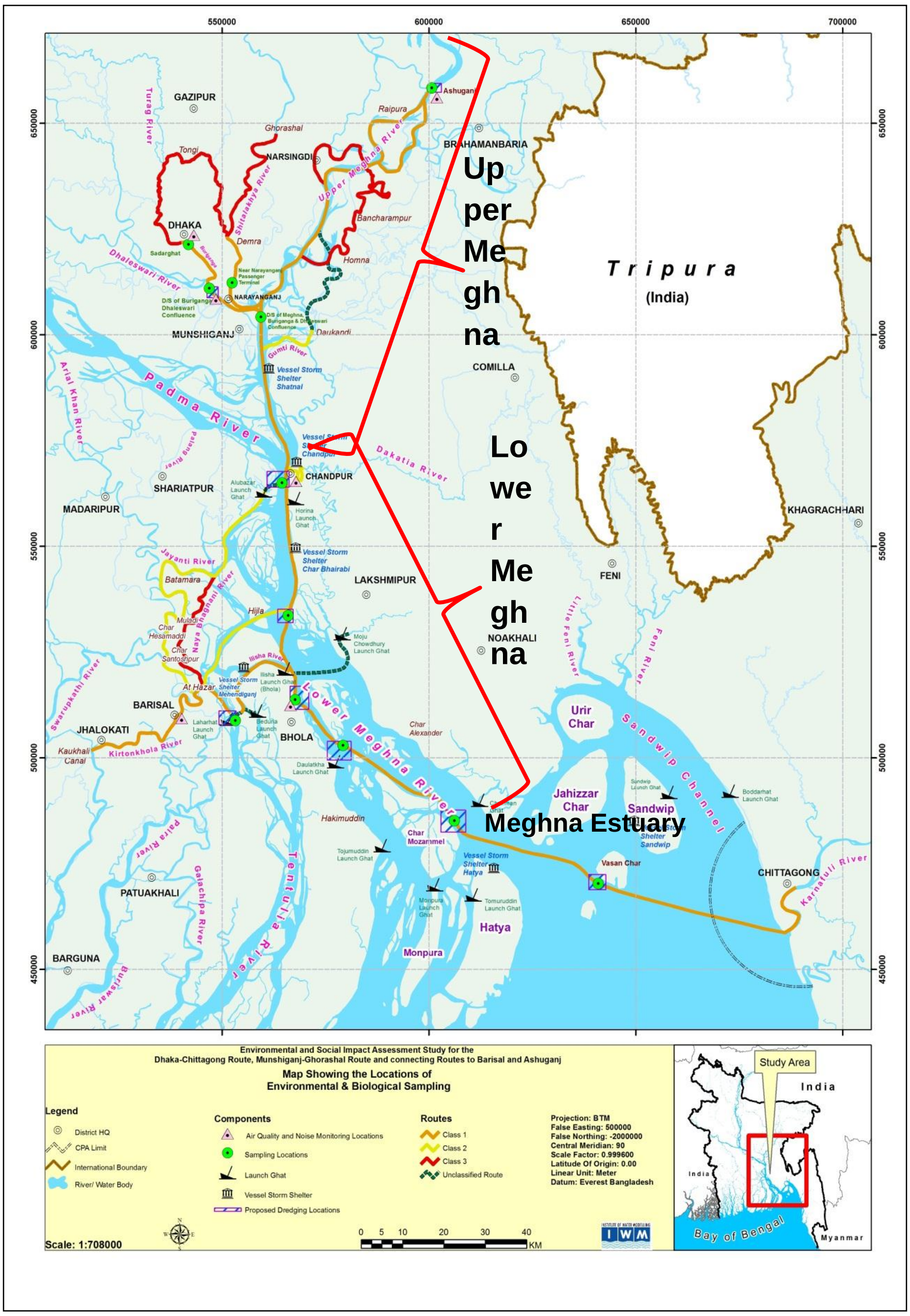


Fig. 2. Project Influence Area - particularly the Upper Meghna, Lower Meghna River and Meghna Estuary. The orange-colour line indicates the navigation route.

the large eastern one is 5 to 8 km wide. The western channel is about 2 km in width. Near Muladi the 1.5 km wide Safipur River is an offshoot from the right-bank. Further south, the Lower Meghna shifts into three channels: west to east flowing Tentulia (Ilisha) River, the Shahbazpur and the Bamni (now non-existent). The Ilisha River is a 5 to 6.5 km wide channel separating Bhola Island from the Barisal mainland. Shahbazpur Channel, 5 to 8 km wide, separates Bhola from Ramgati and Hatiya Islands and at its mouth are the Manpura Islands.

One of the obvious features of the Lower Meghna is the braided bars exposed during periods of low flow and/or dry season, which are responsible for the multi-channel cross-section. Studies of the river have shown two distinct braid bar levels, those with elevations which are very close to bank top level and lower bars which are submerged during the majority of high in-bank flows. The upper sand bars, known as either islands or attached chars, are relatively stable and vegetated and are often inhabited. They can be considered as parts of the flood plain contained within the braid belt, only submerged during over bank flows. The lower braid bars are unstable and are being continually re-worked by the river.

The effective management of flora and vegetation in project influence area is dependent upon a comprehensive knowledge and understanding of the species and communities that occur within the project's area of influence. Some of the flagship faunal species and key habitats are mentioned below.

Gangetic Dolphin/Irrawady Dolphin

The Gangetic Dolphin (*Platanista gangetica*) or 'shishu/shushuk' (in Bangla, Fig. 3) is found in most of the areas of the Ganges-Brahmaputra-Meghna river system including Nepal, India and Bangladesh. This species is rated as 'Endangered' by the International Union for Conservation of Nature (IUCN) Red List (2010) with the wild populations decreasing drastically within the range countries. These dolphins share the same ranks as the tigers and great apes that are listed as a species endangered by trade on Appendix I of Convention on International Trade of Endangered Species of Flora & Fauna (CITES). The species is listed as a 'flagship species' by World Wide Fund for Nature (WWF).

Water abstraction upstream decrease river depth and the appearance of sand bars during winter season cause danger to the dolphins as the river is divided into small segments, causing a segregation of populations in deeper pools, narrowing of the gene pool, increase in the intensity of fishing, increase in river traffic, pollution due to release of untreated effluents from industries, incidental and/or intentional capturing for oil extraction for use as fish attractant, liniment and aphrodisiac, etc., have become the major threats for its survival.

The freshwater dolphins being an iconic species for the river ecosystem serve as a link between people and freshwater and a symbol of a healthy ecosystem. The positive side for the conservation by the presence and increase in the population of dolphins will mean that rivers are clean enough to draw water supplies, there is more and diverse assemblage of fish to support people and dolphins, effluents will need to be adequately treated before release, enough water in the rivers to reduce saltwater intrusion, restoration of floodplains, etc.

Fig. 3. Gangetic Dolphin on the left and Irrawaddy Dolphin on the right

Seasonality, food availability and environmental conditions of the water are the main factors of the Ganges River dolphin for its habitat use/preference (Hussain et al. 2011). Water depth increases during the monsoon months and decreases during the winter and summer months. During the winter and summer months, dolphins usually remain concentrated in the deeper sections (*kums*) of the rivers. This was reflected in the higher number of sightings during the winter and summer months and lower number of dolphin sightings during the monsoon months in the rivers (Rashid et al. 2015). The following Table 2 gives an idea of the dolphin density in different rivers of Bangladesh and neighbouring India. Optimum water depth preferred by the Ganges River dolphin throughout the year is mostly available in sections where scours in the river exist. Secondly, most river fishes occur or should have occurred in the scours of the rivers during the winter and summer months (Hussain 2010). The dolphins feed on fishes hence distribution, composition and abundance of their prey may also play an important role in the distribution and abundance of dolphins and consequently habitat utilization. Kasuya and Haque (1972) mentioned that the area from Upper Meghna to south of Gualanda is a goldmine for the dolphins.

Table 2. Gangetic dolphin density in different rivers of Bangladesh and neighbouring India.

Author/Year	Location	Dolphin Density
Kasuya and Haque, 1972	Lower Meghna	0.22/km
Kasuya and Haque, 1972	Upper Meghna& Upstream of Bhairab Bazaar	1.43/km
Smith et al. 2006	Sunderbans, Bangladesh	0.47/km
Smith et al. 2001	Lower Sangu River, Bangladesh	1.36/km
Smith et al. 2001	Karnaphuli River, Bangladesh	0.47/km
Sharma et al. 1995	Chambal River, India	0.27/km
Sinha, 1997	Bhagirati River, India	0.37/km
Sinha et al. 2000	Downstream between Kahalgaon and Manihari [near Katihar], India	3.40/km

Sinha et al. 2000	Ganges mainstem, between Maniharighat and Buxar, India	1.50/km
Choudhary et al. 2006	Vikramshila Gangetic Dolphin Sanctuary, Bihar, India	1.80/km
Wakid, 2009	Brahmaputra [856 km], Assam, India	0.23/km
Rashid et al. 2015	Padma River: Shangram – Dhalar Char, Pabna, Bangladesh	0.53/km
Rashid et al. 2015	Jamuna River: Dhalar Char – Nagdemra, Pabna, Bangladesh	1.45/km

Accidental killing of dolphin in the form of by-catch in net fishing is a major threat for dolphins in the rivers of the project area. It was reported that accidental killing of dolphins through getting trapped or entangled in fishing nets were higher than the past. Other threats for dolphins in the rivers included oil spill from boats and ships, river erosion, low water depth during winter, use of harmful fishing gears (especially current net) and making cross dam of bamboos across rivers for fishing. As reported by local people, the practice of intentionally trapping and/or killing of dolphins in the rivers for commercial reasons is gradually gaining momentum for oil extraction. Remains of the dolphin body, particularly the head, are used in the brush pile fishery – certain sections of the river close to the banks is fenced using bamboos and piles of tree branches are used to provide a temporary refuge for the fish during the dry season when water level gets low. During dry season the fenced area is netted and fishes are caught. By putting the remains of the dolphin body and head together with the tree branches fishes are attracted by the smell as they decompose.

The Lower Meghna supports both the Ganges Dolphin and Irrawady Dolphin (Fig. 3 above). However their distribution is marked by the salinity depending on seasonal freshwater discharge. The ecological boundary follows salinity and turbidity gradients, and implies that long-term monitoring of dolphin distribution patterns may prove insightful into the impacts of declining freshwater flows on other aquatic biota (Smith et al. 2006). The narrow geographic band between the coastline and the Swatch of No Ground (southwest of the Meghna estuary) is unique habitat for the seasonally mobile population of the Irrawaddy dolphin (*Orcaella brevirostris*). Farther offshore but still occurring in habitat influenced by freshwater inputs is the Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*). Then, a relatively short distance from the fluvial habitat is the Swatch-of-No-Ground where a burst of biological productivity created by upwelling currents supports large groups of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), Pantropical spotted dolphins (*Stenella attenuata*) and Spinner dolphins (*Stenella longirostris*), as well as a possible resident population of Bryde's whales (*Balaenoptera edeni*). The Meghna estuary is occasionally visited by Whale Shark (*Rhincodon typus*).

Sea Turtles

The coastal waters and the Bay of Bengal support five species of sea turtles – Olive Ridley turtle (*Lepidochelys olivacea*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*), Loggerhead Turtle (*Caretta caretta*) and leatherback (*Dermochelys coraicea*). Among the five species female turtles of three species - Olive Ridley, Green and Hawksbill – have been recorded to nest (Rashid 1997, Rashid & Islam 2006) in the Meghna Estuary and adjoining sandy beaches of the mainland. Female turtles have often been netted by the fishermen in the Lower Meghna River. Mating has been observed in areas south of the Sandwip Island in the Lower Meghna estuary and in the Bay near the Swatch of No Ground. The males usually stay in off-shore areas for mating with the females and do not come near-shore or on the beach while the females use the favourable sandy beaches of the islands and the coastline for nesting.

Freshwater Turtles

Some of the freshwater turtle species have also been recorded in the Lower Meghna estuary. One of the global top three critically endangered turtle species – Northern River Terrapin *Batagur baska* forages in the Lower Meghna Estuary and the Sundarban. Bangladesh is the last stronghold for this species as natural population of this species has been extirpated from the other range countries – Myanmar and India. Some other endangered species like Narrow-headed Freshwater Turtle (*Chitra indica*) and Asian Giant Turtle (*Pelochelys cantorii*) also share the same habitat. Gangetic Softshell and Peacock Softshell turtles are also found in the estuary (Rashid & Swingland 1997).

The Upper Meghna and the other river network support several other species like Crowned River Turtle (*Hardella thurjii*), Three-striped Turtle (*Batagur dhongoka*), Tent River Turtle (*Pangshura tentoria*), and some of the common species like Peacock Softshell (*Nilssonia hurum*), Roofed Turtle (*Pangshura tecta*), Yellow Turtle (*Morenia petersi*) and Spotted Flapshell (*Lissemys punctata*). These freshwater turtles are in great demand locally for consumption as food by people of a particular religious faith and are collected/hunted illegally by the fishermen and some professional hunters/collectors.

Migratory/Local Resident Waterbirds

The Padma-Jamuna-Meghna Rivers as well as the Lower Meghna estuary are also key habitats for some of the migratory and local resident waterbirds, including some globally critically endangered birds. Considering the importance of the riverine and estuary ecosystems and as the staging and refuelling areas for migratory birds the BirdLife International has declared some areas as Important Bird Areas (IBA). The globally critically endangered species in the Lower Meghna estuary include spoonbill sandpiper, Asian dowitcher, Nordmann's greenshank, Bengal skimmer, black-bellied tern, oystercatcher, bar-headed geese, graylag geese, etc. The rivers support Ruddy Shelduck, Widgeon, Pintail ducks, etc.

Reed lands

Reed lands are important habitats for the small mammals, grassland birds, some reptiles and amphibians. Reedlands comprise mainly *Typha elephantina*, *Thysanclaena maxima*, *Phragmites karka*, *Cyperus* sp., etc., associated with some climbers and herbs. Some of the important reed land habitats within the project influence area have been identified (Fig. 4). No dredged materials should be disposed within the vicinity of these areas. Moreover these reeds are harvested at regular intervals by the local community members for commercial purpose (like thatching roofs) and livelihoods of many depend on the products made from these reeds like mats.

Reedlands in chars between Harina and Alubazaar ferry crossing and south-southwest of Hijla are ecologically important for both species and ecosystems. These reedlands are also playing a critical role as nursery and spawning ground for small indigenous fishes and the confluence of Padma and Meghna rivers provides the optimum habitat for other large fishes to spawn for which the reeds act as a nursery and refuge for the fingerlings. The reeds also act as the temporary staging ground of migratory birds flying further south. A large number of birds use the area as stop over for re-fuelling.

Resident birds nest and breed there mainly because of availability of plenty of foods, secured foraging grounds and nesting habitat.

Lower Meghna Estuary, mudflats

The Meghna estuary, which covers 6,000km^2, is one of the world's largest: the Ganges, Brahmaputra and Meghna rivers all flow through it before discharging their waters into the Bay of Bengal. The extreme forces of nature - tropical cyclones, storm surges, floods, extremely high river flows are constantly changing the morphology of the coastline and the off-shore islands. New chars, mudflats are being developed while some islands are eroded or totally washed out. Biologically the estuary is rich in nutrients which facilitate the production of prey items in the form of worms and other invertebrates that form the primary food for the waders. The changes provide foraging habitat and refuge for the migratory waders and other large birds.

Fig. 4. Location of reed land habitat, important for resident birds, small mammals within the Project Influence Area.

The project area down from the Ilisha Ghat to the Sandwip and Bashan Char area consist of many chars/mudflats that are important for the waterbirds and are listed as Important Bird Area by the BirdLife International. Of the nineteen (19) IBAs in Bangladesh the project area either fully or partially covers one (1) of the IBAs, namely Ganges-Brahmaputra-Meghna delta.

Hilsa

Hilsa is a major cash crop of Bangladesh and the hilsa fishery contributes to about 1% of the national GDP. In order to protect the hilsa fishery the government has declared the some areas as hilsa fish sanctuaries (Fig. 5). The project area south of Shatnal fall within the areas demarcated as protected for hilsa fishery and spawning ground. The Hilsa fish sanctuaries also comply with fishing ban period (October – no catching of brood fishes and November to March – no catching of hilsa fingerlings under 9 inches) as notified by the government under the Protection and Conservation of Fish Rules 1985.

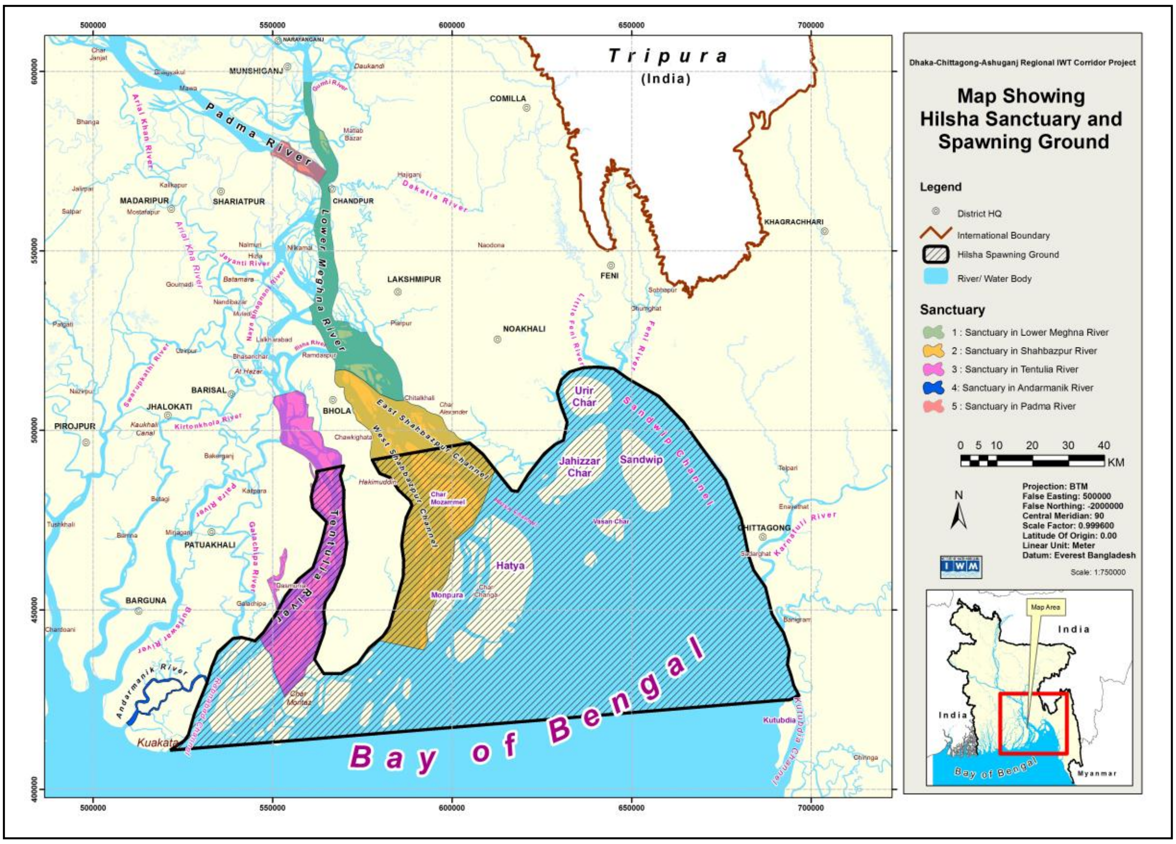


Fig. 5. Hilsa fish sanctuaries and spawning area; some sections are within the Project Influence Area.

The predicted biodiversity-related impacts resulting from the Project that were identified in the ESIA are presented in Table 3, with a breakdown of their occurrence during the various phases of the Project.

Impacts Matrix of the Proposed Intervention (Dredging)

In describing the impacts related to the engineering interventions for the project one can distinguish between the temporary impacts directly related to the dredging operation and the long-term impacts associated with the modified physical environment and a consequence of the works. In addition, a systematic distinction can be made for the components of the environment, affected by various measures or activities, i.e. between impacts on the resources system and impacts on the user system. Table xxx presents impact matrix for dredging. Many of the impacts listed can be mitigated substantially by adopting standard working procedures and ensuring responsible behaviour of the contractor. Impacts of dredging are summarized below:

- Substrate removal and thus habitat and species removal (recolonization or recovery of disturbed areas may be possible);
- Spreading of sediments and associated contaminants in the surrounding. Settlement of these suspended sediments can result in the smothering or blanketing of sub-tidal communities and/or adjacent intertidal communities;
- Alteration of the bottom topography and hydrography, and thus destruction of local habitats and the risk of direct physical/mechanical stress to benthic, demersal and/or pelagic species;
- Alteration of the sediment composition, i.e. of substrate characteristics in the surrounding of the dredging site, resulting in a change of nature and diversity of benthic and demersal communities, e.g. decline of individual density, species abundances or biomass;
- Re-suspension of sediments and short-term increases in the level of suspended sediment giving rise to changes in water quality which can effect aquatic including estuarine/marine flora and fauna, both favourably and unfavourably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants depending upon the nature of the material in the dredging area;
- Release of nutrients resulting in increase in eutrophication and direct impact on organisms due to reduced transparency and consumption of oxygen (the increase in turbidity due to re-suspension of sediments caused by dredging);
- Habitat changes from hydromorphological regimes changes;
- Effects on fish or other aquatic species like turtles or fish-eating bird and mammal species or cetaceans (dolphins) from increased turbidity as well as related effects on estuary functions, such as changes in biodiversity or reduction of spawning areas, affecting migratory or daily movement routes of fish (like hilsa), marine turtles, dolphins, etc.

Table 3. PREDICTED IMPACTS & MITIGATION MEASURES

Ecosystem/ Biodiversity –related Factors	Predicted Impacts		Mitigation Measures
	During Dredging	Post-Dredging	
Aquatic Habitat alteration: Water quality, benthic environment, transportation of dredged materials	Increase in turbidity, suspended materials, transparency hindering sunlight penetration and affecting phytoplanktons	Localized effect, recovery in a short time	Select the dredgers and dredging methods to minimize sediment dispersion during excavation and lifting process; Spoil dispersion outfall characteristics to be evaluated by collecting grab water samples during dredging operations and operations modified accordingly; Sub-surface aquatic disposal is required, minimum one metre below the water surface; Careful mapping of sensitive areas directly affected by the dredge; The exclusion criteria for dredging are; Dredge 100m away from the chars, reed lands, mudflats Contractors will avoid sensitive habitats like scours, mudflats for dredge material disposal. The
Benthic fauna	Changes in species composition Fluctuation in population Habitat alteration due to increase in depth	Changes in species composition Changes in vertical depths May impact livelihood of some people	
Aquatic Species Affected (Dolphins, turtles, etc.)	Noise and disturbance-changes in movement routes and pattern	May recover over time	
Terrestrial Habitats: Chars, Mudflats, Reeds & Grasslands	Sediment deposition	Sediments may render mudflats unsuitable for migratory birds	
Terrestrial Species	Localized disturbances due to presence of labourers, other activities	Recovery over time	

Ecosystem/ Biodiversity –related Factors	Predicted Impacts		Mitigation Measures
	During Dredging	Post-Dredging	
			exclusion criteria for disposal of dredged material are: Along the chars River confluences Low current areas Shallow areas Deeper sections of the rivers during dry season Preventative maintenance of equipment to mitigate negative environmental impacts such as leakages and spillages.
Impact on fisheries			
Predicted Impacts	**During dredging**	**Post dredging**	**Mitigation measures**
Habitat degradation of benthic invertebrates and some fishes	The nursery and rearing ground of diverse benthic invertebrates and fishes may be damaged due to the operational activities i.e., cutter head circulation, flat open scraper movement, etc.	Turbidity increases, as a result some fishes, bivalves and gastropods loss their natural habitat due to the excess alteration of optimum water quality.	To avoid this scenario, the suction pump/ cutter head of the dredgers may be controlled through pressure diminishing. Pre and post dredging sampling of mud of the dredging points can be sampled and analysed.
Habitat and feeding ground destruction of shellfishes	During this whole process the bottom dwelling crabs and other benthic	The dredging may leave them scattered and misplace the	Mitigation is not relevant to impact on shellfish

Ecosystem/ Biodiversity –related Factors	Predicted Impacts		Mitigation Measures
	During Dredging	**Post-Dredging**	
	community are compelled to shift their scavenging route and eventually affect their feeding and subsequent breeding.	populations to some extent. After the extraction of sand and mud, some artificial depressions may be created to inhabit some new organisms.	
Disruption in feeding and breeding migration	Agitating water throughout the dredging period may confuse the fish school and interrupt their migration	The new environment in the topography of water after dredging may misdirect the fish migration which will result in the unwanted dispersal of fish/fishes out of its/their natural navigation area.	A 20% leverage on the water quality standards for pH, turbidity, DO, TSS, etc., as mentioned in the ECR 1997 to be maintained
Physiological deformities in fishes	Elevated temperatures during dredging increase the metabolism, respiration and oxygen demand of fish and other aquatic life, approximately doubling the respiration for a 10° C.	The physiological changes may lead to long term deformities in fish body which ultimately can somehow affect their copulation, swimming and associated movements.	No temperature changes are expected during dredging process.
Impacts & Mitigation Measures of dredging activities			
Activities	**Impacts**		**Mitigation Measures**

Ecosystem/ Biodiversity –related Factors	Predicted Impacts		Mitigation Measures
	During Dredging	Post-Dredging	
Lifting of sediments after excavation	Due to turbidity aquatic fauna have to face several challenges (like, scarcity of food, hampering of respiration & breeding, etc.) to survive. Photosynthesis process of aquatic flora will be reduced adversely.		-Suitability of lifting on the proposed spots has to be evaluated carefully.
Transportation of sediment materials through pipes	• Pathway may be polluted and dirty due to leakage during carrying of sediments. • Great disturbance may be occurred to the terrestrial fauna. • Flora of influenced areas may be damaged.		-Carrying equipment should be well designed. -Have to make appropriate plan for transportation of sediments. -Priority should be given to the safety of wildlife during transportation.
Disposal of sediments in the river and on land	-Habitat of terrestrial flora and fauna may be occupied in a broad scale. -Natural activities of fauna (both terrestrial & aquatic) like, movement, feeding, breeding etc. may face several adverse effects. -Existence of wildlife species of the affected area may be threatened.		-Disposal of sediments should be well planned. -Activities should be performed through maintaining the natural environment of wildlife. -Proposed sites have to justify for the protection & safety of wildlife.
Impact on Benthic communities			
	Impacts		Mitigation measures

<table>
<tr><th rowspan="2">Ecosystem/ Biodiversity –related Factors</th><th colspan="2">Predicted Impacts</th><th>Mitigation Measures</th></tr>
<tr><th>During Dredging</th><th>Post-Dredging</th><th></th></tr>
<tr><td>Depth of dredged materials at Disposal Sites</td><td colspan="2">Some benthic organisms such as burrowing polychaetes, amphipods and molluscs can colonize newly deposited sediments through vertical migration, therefore, if dredged material depths are limited to within the vertical migration capacity of these organisms (20-30 cm), recovery rates may be quicker than if colonization is dependent upon the lateral migration of juveniles and adults from adjacent areas and larval settlement.</td><td rowspan="4">Management options for the permitting process can include, but are not limited to:
1) Full or partial approval of the dredged material proposed for disposal;
2) Prohibition of sediments proposed for disposal; or,
3) Special management restrictions for disposal of the suitable material (e.g., limits on disposal quantities, specification of frequency, timing, equipment, etc.).
Management actions for the disposal site following unfavourable monitoring results may include, but are not limited to: additional confirmatory monitoring to delineate the extent of the problem, capping to isolate the sediments from potential biological receptors, and/or closure of the site.</td></tr>
<tr><td>Habitat Type (disturbance history)</td><td colspan="2">Shallow benthic habitats (<20 m depth, Hall 1994) experience relatively frequent wave, wind, and current induced disturbances and thus are typically inhabited by low-diversity, selected benthic assemblages that can readily re-establish themselves under conditions of high frequency disturbances (Dauer 1984, Clarke and Miller-Way 1992, Ray and Clarke 1999). These communities are naturally held in early succession stages and therefore, are able to recover more rapidly than communities in deeper, more stable environments (Newell et al. 1998, Bolam and Rees 2003).</td></tr>
<tr><td>Sediment Type</td><td colspan="2">Rapid recolonization of soft-bottom benthic habitats is frequently associated with either unconsolidated fine grain sediments (Cruz-Motta and Collins 2004) or the rapid dispersion of fine-grained dredged material by currents (Van Dolah et al. 1984). Newell et al. (1998) characterized typical recovery times at 6-8 months for mud habitats and 2-3 years for sand and gravel substrata.</td></tr>
<tr><td>Spatial Scale of Disturbance</td><td colspan="2">The spatial scale of the dredged or disposal area may be proportional to recovery times (Zajac et al. 1998, Guerra-Garcia et al. 2003). For small-scale disturbances, the edge/surface area ratio of the disturbed area is larger than for larger disturbances, therefore colonization through adult immigration</td></tr>
</table>

Ecosystem/ Biodiversity –related Factors	Predicted Impacts		Mitigation Measures
	During Dredging	**Post-Dredging**	
	from surrounding undisturbed areas may facilitate recovery. With larger disturbed areas, the central portion of the disturbed areas is reliant upon settlement from the water column for colonization, which is very dependent on seasonal recruitment patterns and local hydrodynamics.		
Timing and Frequency of Disturbance	Avoiding dredging activities after seasonal larval recruitment periods is a common practice when possible. Deposition of sediments in several smaller units rather than one deep deposit also may be less detrimental to the benthos. In a microcosm study, sediment deposited in a single event caused more severe changes to nematode assemblages than the same amount of sediment deposited in smaller doses (Schratzberger *et al*. 2000).		

INSTITUTIONAL ARRANGEMENT

Project monitoring is the responsibility of the project implementation unit (PIU). The majority of the data for M&E is gathered during the baseline establishment. However, for long-term maintenance dredging project, several agencies/departments may be involved. Thus, one overall agency – BIWTA - must assume the overall responsibility and coordination. The M&E unit should be integrated into the management structure of the implementing agency to best serve the information needs of the project.

Institutional responsibilities for evaluations of project performance differ depending on the nature of the evaluation. For example: Interim evaluations, designed to review progress and to anticipate likely effects of the project, are carried out during the project implementation period by the PIU (Table 4). Mid-term and terminal evaluations are carried out jointly at mid-term and at the end of the project by the government and the Bank, with the government and the PIU having particular inputs. Impact evaluations, measuring direct and indirect project impacts, are normally undertaken several years after final disbursement by national authorities independent from the PIU, and/or the Bank (Operations Evaluation Department).

The Forest Department under the Ministry of Environment & Forest (MOEF) is the custodian of all wildlife (other than fishes) and mandated to enforce for protection and monitoring of biodiversity. The Department of Fisheries under the Ministry of Animal Resources is responsible for protection, enforcement, and monitoring of fishes. BIWTA does not have any personnel related to biodiversity management. In that case the BIWTA has to coordinate the monitoring work either in collaboration with the two agencies – Forest Department and Department of Fisheries. Some international and national NGOs (like IUCN, CARINAM, etc.) having capacity and expertise in biological diversity management and monitoring may be involved in biodiversity conservation and management.

All the main stakeholders are required to be familiarized and sensitized about the study results and recommendations to be implemented by the respective departments. Especially recommendations for species recovery programme, protection of habitat, routes of migration and pollution abatement, etc.

Table 4.

Institution	Responsibility
BIWTA	Coordination of monitoring activities Coordinating training in collection and analysis of monitoring data for data collectors Selection of indicator species and indicator features to be monitored M&E data collection and analysis Maintenance of information management system, including all existing information and baseline data Periodic progress reports

	Implementation of modifications as necessary
Overall Executing Agency / PIU	Coordination of M&E if more than one local executing agency Preparation of semi-annual, annual, mid-term and final reports Collaboration with other biodiversity projects Supervision of M&E personnel including recruitment and training Statement of expenditures Disbursement records Procurement record Financial and technical audits Ensuring feedback into project management Dissemination of information and lessons learned to all other interest groups, both local and global

In addition some of the activities need to be considered for the overall management of the habitat and species. To keep the sanctity of the area, the project intervention like dredging operation need to take special care and attention. The following are a few of such caring actions to be respected.

- Make people (contractor)aware about the ecological significance of the site through orientation, consultation and meeting
- Prepare, produce and communicate education and awareness materials among the workers
- Guide the workers about the DOs and DON'Ts
- Avoid all disturbances in the areas of winter birds roosts, nesting areas of birds and nursery of fish
- Dumping of all sorts of waste in the area is prohibited
- Vessel movement should ply only in the defined route to avoid disturbance to birds
- Anchoring of vessels only to pre-determined ports and jetties
- Hunting, shooting and trapping birds is not allowed
- Harvesting of reeds for any purpose is restricted.
- Making any huts and temporary shelters in the reedlands are prohibited.
- Check and control of seepage of oil and mobile to water should be maintained
- No dredge spoil should be dumped over reedlands, mudflats and wildlife habitat
- Avoid bush fire in the reedlands

REPORTING

It would be difficult to monitor and report on the status of each and every species during and post dredging period. Some of the key species, bio-indicators and/or habitats have to be selected for monitoring and reporting purpose. For example, the status of the flagship species like the Gangetic dolphin or other easily observable and monitored species need to be selected. Waterbird Census is also an important monitoring tool that could be used to report about the state of habitat, particularly mudflats, species population fluctuation and density in species composition.

Reporting is linked with the M&E activity to reflect the current status and condition of the selected habitats/species compared with the baseline data at regular intervals as determined by the PIU like six-monthly, annually, mid-term, or post-project duration.

"Biodiversity Monitoring and Evaluation Strategy"

Biodiversity monitoring provides guidelines for decisions on how to manage biological diversity in terms of production and conservation. Monitoring determines the status of biological diversity at one or more ecological levels and assesses changes over time and space. Monitoring is a vital feedback link between human actions and the environment, but incorporation of monitoring results into decision making is hampered by poor communication between ecologists and decision-makers. A global network for assessing biodiversity changes (GLOBENET) is an example to look for initiatives that attempts to address the above issues by using a simple field protocol with the aim to develop tools for assessment and prediction of the ecological effects of human-caused changes in the landscape. The protocol needs specific tools and techniques to monitor species, ecosystem and genes which are the basics of biological diversity.

Under the Project a number of biodiversity elements should be considered for conservation and protection as mentioned in the following Table 5.

Table 5. Priority biodiversity components for conservation and protection.

Species	**Ecosystems**	**PAs**
Gangetic Dolphin	Main channel and distributaries	Sanctuary
Freshwater turtles	Rivers and associated wetlands (beels, canals)	Wildlife Sanctuary
Waterbirds	Estuary, floodplains, grasslands, charlands, beels and channels	Important Bird Areas
Indigenous fish	Wetlands, Rivers	Fish Sanctuary
Wetlands plants/trees (Salix, Barringtonia, Crateva, Reeds)	Freshwater Wetlands	Wildlife Sanctuary, National Park, Community Conserved Areas (CCA)

As far as the result frame work of the project is concerned the monitoring plan needs active coordination, collaboration, consultation and information use from the above components to have an effective and practical tools.

Ideally, monitoring should be carried out prior to the commencement of management activities (the initial assessment of conservation status) and thereafter at intervals which match the management period, or more frequently. Monitoring, in this context, is a very specific activity: the performance indicators (quantified when the objectives were prepared) are measured. This is one of the most critical aspects of the adaptive process. Monitoring is linked directly to both the objectives for a feature and the associated management activities.

The results of monitoring, along with reports of management activities and any other relevant observations (including external information), are considered. The first question should always be: is there any reason to change the objective? Even when management is concerned with obtaining specified outcomes which are defined by legislation, there will occasionally be a need for revision. Objectives will need to change for many different reasons. For example, we may have got it wrong in the first instance, or the status of a species can change with time (something rare can become common and vice versa). If there is a need to change the objective in any significant way this can, of course, have implications for many of the planning stages. Each will have to be considered in sequence and, if necessary, revised.

Monitoring, surveillance and recording are all activities concerned with the collection and management of information. They are an indispensable and integral component of management planning: without information there can be no planning.

Surveillance undertaken to ensure that formulated standards (objectives) are being maintained
Monitoring should be an essential and integral component of management planning: there can be no planning without monitoring. The adaptive planning process and all other functional management planning processes are entirely dependent on an assessment of the status of the features, and this is obtained through monitoring. Monitoring is 'surveillance undertaken to ensure that formulated standards are being maintained'. The 'formulated standards' are the 'objectives with performance indicators', and these are a product of the planning process. Therefore, there can be no monitoring without planning.

The integration of monitoring in the adaptive planning process occurs when the objectives for the features are formulated. An objective must be measurable, and this is achieved by including performance indicators that are directly linked to, and part of, the objective. This process is fully described later in this guide. Two different kinds of performance indicators are used to monitor an objective. These are:

Quantified attributes with limits which, when monitored, provide evidence about the condition of a feature. (An attribute is a characteristic of a feature that can be monitored to provide evidence about the condition of the feature.)

Factors with limits which, when monitored, provide the evidence that the factors are under control or otherwise. (A factor is anything that has the potential to influence or change a feature, or to affect the way in which a feature is managed. These influences may exist, or have existed, at any time in the past, present or future). The difference between status and condition is very important. The condition of a feature is rather like a snapshot; it describes what is present at any given time, but no more. The condition that is required for a feature is defined by the objective and specifically by the attributes which are used as performance indicators. The attributes are quantified and, when monitored, they allow to differentiate between favorable and unfavorable conditions. If the feature is monitored on several occasions it is also possible to determine whether change is taking place and the direction of change, i.e. the feature can be recovering or declining.

The development of any monitoring strategy should be based on the availability of resources and on a risk assessment. What can be afforded to do, which features are the most vulnerable (i.e. most likely to change) and which need remedial management (i.e. those which should change)? Ideally, all features should be monitored to a minimum standard, even if the minimum is based entirely on expert opinion. Once the minimum is achieved for all features, the information can be used to identify the need for, and to prioritize, any additional, or more detailed, monitoring for the most vulnerable features.

In addition, where the objective is to obtain Favorable Conservation Status (FCS), the following should be considered:

For habitat features:

Has the area of the habitat been specified?

Are there sufficient performance indicators to define the quality (including ecological structure and function) of the feature?

Are there sufficient performance indicators (surrogates are acceptable) to provide the evidence that typical species are at FCS?

Are there sufficient performance indicators to demonstrate that the factors are under control? (The evidence can be direct or indirect from attributes.)

For species features:

Has the size of the population been specified, or are performance indicators that can be used to monitor population trends included?

Are there sufficient performance indicators to provide evidence that the population is sustainable in the long term?

Has the range of the population been defined, or is there a performance indictor that can be used to monitor changes in the range?

Has the habitat which supports the population been given adequate attention? (In most cases, an objective that meets this test should have been prepared for the habitats that support the species.)

Are there sufficient performance indicators to demonstrate that the factors are under control? (The evidence can be direct or indirect from attributes.)

Additional activities for biodiversity conservation & monitoring

Species Recovery

Species which are threatened with extinction and are categorized as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) by IUCN Redlist will be recovered from their threatened state. For this programme following are the activities:

- Identify and quantify the threats, the nature and degrees of the target species
- Prepare plan of action the address threats minimization
- Prepare community and ecological actions against each threats identified
- Initiate captive propagation, rearing, rescue and translocation plan if necessary
- Actions against poaching and trade in threatened species
- Facilitate proper implementation of Wildlife Act in coordination with the Wildlife Crime Control Unit of the Forest Department.

Habitat protection and Restoration

Following are activities planned for habitat protection:

- •Coordinate with FD and DOF in implementation the conservation protocol for WS, NP and ECA within project area.
- •Facilitate formulation of CMC and develop practical action Programme for PA management
- •Establish nursery and initiate Social forestry programme at river bank, charlands and in the flood plains
- •Protected areas for natural regeneration of grass and reedlands in the chars, offshore islands
- •Define sustained yield system for reed/grass harvest for charlands
- •Plantation of estuarine chars with mangroves

Community Actions

- • Organize CMC/ Youth conservation group and develop Conservation Action Programme for them
- • Organize community actions like social forestry, bird protection, threatened species protection, nature camps, rally, meeting, walkathon and seminars
- • Organize folk cultural programme focusing nature conservation
  Organize education awareness programme at Schools/NGOs
- •To produce and distribute posters and leaflets

Green Vessel for River Biodiversity Conservation

- •Build Green Vessel for patrolling, researching and protecting river and wetlands biodiversity
- •Communicate Government's Environment Conservation Message to the grass-roots people through river ways with an interactive and innovative approach
- •Organize Green Vessel Cruises for inspiring people about climate change adaptation and mitigation
- •Showcase audio-visuals on Nature/Biodiversity Conservation, CC Adaptation, Mitigation and DRR
- •Organize interactive cultural and recreational camps to inspire and make people courageous to cope with the natural calamities and enhance capacity in resilience
- •To organize campaign for protection of river and wetlands wildlife and their habitat
- •To interpret and communicate the key messages of NBSAP, BCCSAP to the people living along the bank of rivers and charlands
- •To organize children nature camp for making them acquainted with the recent environment problems and prospects of the country
- •To organize mobile cultural event focusing floods, river erosion, sedimentation, river pollution, river encroachment, river biodiversity , cyclonic storm, tidal surges, Sea-level rise, salinity intrusion and their mitigation measures

Social forest for wildlife habitat improvement

For plantation along river banks and at charlands local NGOs may be given responsibilities to establish nurseries of indigenous plant species, which would help local communities to generate income. This may require support from the local Forest Department (FD) office to train the local community members in establishing nurseries, plantation and maintenance of saplings. For the management of the plantations the Social Forestry protocols may be followed and it requires the following actions:

- Identification of community-based organization
- Memorandum of Understanding between the FD/local administration and the community-based organization
- Selection of plantation sites
- Training to CBOs
- Nursery establishment – selected indigenous species
- Plantation at selected sites
- Caring, maintenance of saplings – 5 – 10 years
- Harvesting and benefit sharing as per the agreement

Biodiversity Management Plan Implementation Budget

Component	Objectives	Output	Budget (USD)
Species Recovery	To ensure protection of threatened species like Dolphin, Marine turtles and Geese and Ducks	Reduction in population decline Habitat improvement Awareness	100,000
Species Recovery	To rear freshwater turtles and monitor lizards in captivity (village ponds /khals) and release in nature for restoration viable population	Community-based restoration of fresh water turtles and monitor lizards in project area	150,000
Protection of Migratory Birds	To organize CMC and make them aware to refrain from hunting/ trapping and shooting migratory birds	Protection of migratory birds at wintering ground of the project area Awareness	50,000
Habitat Restoration of wildlife	Community-based Plantation of river bank, charlands and embankments with indigenous plants	Restoration of degraded habitat of wildlife along river bank and char lands	200,000
Youth Nature Camp	Organize jobless youth along rivers for nature conservation awareness and education	Youth actions in river/wetlands biodiversity conservation	75,000
Education and Communication	Production of print and video materials on river biodiversity	Education and communication materials available for nature conservation camp	150,000
Green Vessel for Biodiversity Protection	Patrolling, Research and Monitoring of River Biodiversity	Ensuring Implementation of Environment and Wildlife Acts.	500,000
TOTAL			**1,225,000**

Terms of Reference

Bangladesh is a delta with hundreds of rivers flowing through it that meets the Bay of Bengal. Historically, all these rivers are used as the main transport route for both passengers and goods. Rivers and floodplains are also habitats of aquatic biological diversity. The ecology and the economy of the country in many ways depend on the biological resources of the country. Rivers are also very dynamic in terms of erosion and accretion. Almost all inland rivers are prone to massive siltation as a result the river transport system particularly the navigational routes are facing commuting problems mostly during the dry season. To improve the inland navigation route BIWTA with support from World Bank has taken a project titled “Bangladesh Regional Waterway Transport Project”.

Objective of the Study

The objective of this study is to manage the impacts of the project on biodiversity and to enhance and conserve the biodiversity within the project influence area.

Scope of Work

A detailed ESIA has been carried out to learn about the impacts of the project intervention which resulted in formulating Environmental management Plan (EMP) and Biodiversity Management Plan (BMP) to compensate and mitigate the potential negative impacts. Hence in implementing the BMP the key activities involved in the assignment are:

- Species conservation / recovery;
- Habitat protection, management and restoration;
- Community actions;
- Greening vessels for river biodiversity conservation; and
- Social forest for wildlife habitat improvement.

- Implement the biodiversity management plan into actions by involving all parties including the contractor, Department of Fisheries, Bangladesh Forest Department and Bangladesh Inland Water Transport Authority
- Implement the recommendations of the BMP at pre-dredging, dredging and post dredging stages
- Ensure protection of Important Bird Areas (IBA), Ecologically Critical Areas (ECA), Fish Sanctuaries, National Parks (NP) and other important habitats and biodiversity rich areas vide the guidelines given in BMP
- Coordinate with the contractors to ensure the implementation of DO’s and DON’Ts prepared for the operation of contractor
- Safeguard the breeding ground, foraging area and migration path of critically endangered wildlife
- Help save the reed land biota in the char lands through actions suggested in BMP
- Provide training to the stakeholders in implementation of the actions suggested in BMP
- Make plan for afforestation in the identified locations along the river courses and char lands

- Organize education and awareness campaigns for the local communities to conserve the river biological diversity
- Implement the M&E plan prescribed in the BMP
- Prepare contingency plan(s) for any actions during dredging to rescue and rehabilitate the injured wildlife
- Coordinate with other line organizations for the safety of the protected area and protected species annexed in the Wildlife (Security & Conservation) Act 2012
- Prepare reports as designed in the BMP
- Organize meetings/workshops and prepare proceedings

The BMP implementation team will be comprised of one lead River Biodiversity Specialist (RBS), one flora expert, one fauna expert and a sociologist. As identified in the BMP the first and foremost activity will be to prepare detail implementation plan of action. For this purpose, a four-member team comprising of one RBS and two biologists (1. Fauna, 1. Flora) and one sociologist will interpret the EMP/BMP and prepare the activity plan in coordination with other stakeholders. The plan will prioritize the Species Action plan (SAP) and Habitat Management Plan (HAP), Monitoring Plan (MP).

The BMP implementation team will:

Provide technical advisory services to the BIWTA and parties involved in the project on environment, forestry, agriculture and fisheries sectors to support the further development of the natural resources / biodiversity management sector and the climate adaptive livelihoods of communities in the project area.

Establish a bench mark of biodiversity of the project area on the basis of the Biodiversity Baseline Survey (BBS) survey results.

Determine the status of biological diversity at one or more ecological levels and assesses changes over time and space.

Identify and prioritize the threats of the wildlife and habitats to be intervened

Design and plan an effective protocol for timely and properly implementation of EMP and BMP

Ensure implantation of all suggested threat mitigation measures.

Bio-indicators are routinely used, but each indicator's potential to determine changes in the overall biodiversity should be rigorously tested

Conduct filed trial and validation of the indicator species based monitoring of ecosystem Health.

Prioritized the activities planned in the proposal

The project from its designing to implementation levels will follow participatory community-management approach and will involve the community people, local actors/LGI s, NGOs/CBOs for designing action plan, management of implementation, monitoring and evaluation in achieving the goals and objectives of the projects.

Build technical capacity of local level institutions for natural resources management Enhance knowledge and capacities

Expand and extend socio-economic benefits to surrounding communities, including benefits arrived out of the project intervention

Increased support for applied training at all levels and a range of other institution

Strengthening and capacity building activities.

Prepare joint monitoring plan, monitoring data format and evaluation procedure and ensure patrol and vigilance with the contractor and other stakeholders as shown in the annexes attached

Conduct survey update the state of wild flora, fauna and ecosystems, such Waterfowl Census, recording breeding and nesting activities of dolphin, turtles and reedland birds

Survey the human activities and dependence of the local community on the project area and ensure the wise use system as per the guidelines of Ramsar convention

Assess the Impact of NTFPs uses by the local community and suggest AIGA to minimize the impact

Develop and implement Community based wetlands management actions for ensuring sustainable use of aquatic biodiversity

Address within a series of short-, medium-, and long-term climate change mitigation and adaptation issues.

Increased support for applied training at all levels and a range of other institution

Strengthening and capacity building activities.

Monitoring and conducting migration of fish and ensure protection of rules and regulations of Fish Sanctuary of DOF

Prepare the sanctuary management plan for the important biodiversity area in the project area by following the IUCN-Protected Area Category and Bangladesh Wildlife Act (Conservation and Security) 2012

The consultants should have at least Masters in Natural Science, having 5 to 7 years practical experience in natural resources/biodiversity/wildlife management

The consultants should have experiences in implementation of EMP, management of biodiversity, Biodiversity Monitoring and produce reports on Flora and Fauna

Biodiversity Monitoring Plan

Biodiversity monitoring provides guidelines for decisions on how to manage biological diversity in terms of production and conservation. Monitoring determines the status of biological diversity at one or more ecological levels and assesses changes over time and space. The monitoring plan needs active coordination, collaboration, consultation and information use from the above components to have an effective and practical tool.

A clear framework, agreed among the key stakeholders at the end of the planning stage, is essential in order to carry out monitoring and evaluation systematically. This framework serves as a plan for monitoring and evaluation, and should clarify:

- What is to be monitored and evaluated?
- The activities needed to monitor and evaluate
- Who is responsible for monitoring and evaluation activities?
- When monitoring and evaluation activities are planned (timing)

- How monitoring and evaluation are carried out (methods)
- What resources are required and where they are committed

For habitat features:

Has the area of the habitat been specified?
Are there sufficient performance indicators to define the quality (including ecological structure and function) of the feature?
Are there sufficient performance indicators (surrogates are acceptable) to provide the evidence that typical species are at FCS?
Are there sufficient performance indicators to demonstrate that the factors are under control? (The evidence can be direct or indirect from attributes.)

For species features:

Has the size of the population been specified, or are performance indicators that can be used to monitor population trends included?
Are there sufficient performance indicators to provide evidence that the population is sustainable in the long term?
Has the range of the population been defined, or is there a performance indictor that can be used to monitor changes in the range?
Has the habitat which supports the population been given adequate attention? (In most cases, an objective that meets this test should have been prepared for the habitats that support the species.)
Are there sufficient performance indicators to demonstrate that the factors are under control? (The evidence can be direct or indirect from attributes.)

The contractor will perform the following activities.

1. Prepare detail methodology for additional biodiversity study based on results of exiting BBS (Biodiversity Baseline Survey) including a LFA for existing Biodiversity Management Plan (BMP)
2. Generate comprehensive information on Biodiversity of Key Ecosystems (IBA, NP and VEC)
3. Develop detailed plan of action for conservation of keystone / flagship species as identified in the BBS
4. Prepare Species conservation management plan with needed HR , logistics and finances
5. Prepare management action in protection, restoration and enhancement of habitats and migration path/corridors of wildlife.
6. Develop monitoring indicators for all activities and objectives as per WB defined guidelines
7. Prepare and submit reports as per project requirements.

Manpower and deliverables

Professional	Activities/ Responsibilities	Duration	Deliverables
River Biodiversity Specialist	Lead the team Manage the project in implementation of objectives MIS system and HR management Work Break Down Structure Office and logistics management Implementation of action plan Monitoring and Evaluation Reporting as per time schedule defined Organize, meeting, workshop, training Conduct research Coordinate with stakeholders	40 man month	- Inception report - Work plan and result –based log frame - Formation of Coordination committee and job list preparation - Orientation and familiarization of project objectives, method of action and defining job responsibilities - Grounding work at all level of implementation - Guidelines in implementation methodology - Objective-wise implementation protocol - Periodic reports - Community organization for wetlands resources management plan - Education and awareness material - Research publication/ documentation - M & E reports
Flora specialist	• Work under the guidance of the River Biodiversity Specialist • Make an inventory of the floral diversity within the project influence area to	24 man months	- Inception report for conducting the activities - Inventory list of floral species with their status - Priority locations and species of conservation with rationale

Professional	Activities/ Responsibilities	Duration	Deliverables
	improve the baseline information • Identify important floral species and locations for conservation using IUCN Redlist guidelines • Suggest conservation and management actions		- Conservation, management and monitoring plan for threatened species
Fauna specialist	• Work under the guidance of the River Biodiversity Specialist • Make an inventory of the faunal diversity within the project influence area to improve the baseline information • Identify important faunal species and locations for conservation using IUCN Redlist guidelines • Suggest conservation and management actions	24 man months	- Inception report for conducting the activities - Inventory list of faunal species with their status - Priority locations and species of conservation with rationale - Conservation, management and monitoring plan for threatened species
Community Programme Manager (Sociologist)	Work under the guidance of the River Biodiversity Specialist Develop and implement conservation	40 man months	Inception report Community consultation meeting minutes Community-led conservation program updates

Professional	Activities/ Responsibilities	Duration	Deliverables
	programmes in consultation with the flora and fauna specialists focusing on the threatened species Assist community members with social forestry initiatives Prepare awareness materials for community programs Organize regular community meetings		Monitoring reports on community-led conservation programs

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Annex F: List of Flora and Fauna Species in the Project Influence Area

Table 1: List of terrestrial Invertebrate animals observed in the project area

Scientific Name	**Local Name**	**Group (Order)**	**Group (Family)**	**Frequency of occurrence (No)**
Argiaemma	Dragon fly	Odonata	Coenagriondae	10
Macromia magnifica	Dragon fly		Corduliidae	74
Libellula pulchella	Common Pond Dragon Fly		Corduliidae	56
Melanoplus differntialis	Grasshopper	Orthoptera	Acridae	129
Stagmomantis carolina	Carolina mantid		Gryllidae	15
Microcentrum rhombifolium	Bush katydid		Tettigoniidae	10
Gryllotalpa hexadactyla	Mole cricket		Gryllotalpidae	16
Isoperla transmarina	Stonefly nymps	Plecoptera	Isoperlidae	58
Argio peaurantia	Garden spider	Araneida	Argiopidae	26
Metaphire posthuma	Earth worm	Neo-oligochaeta	Megascolecidae	78
Planorbis spp.	Terrestrial snail	Basomatophora	Planorbidae	04
Julus sp.	Common millipede	Diplopoda	Julidae	49
Scolopendra obscura	Large centipede	Chilopoda	Scolopendridae	18
Potemon mansoni	Masoni crab	Decapoda	Palaemonidae	28
Platycentropus spp.	Caddisfly	Trichoptera	Limnephilidae	25
Coriscu scurinus	Broadheaded bug	Hemiptera	Alydidae	03
Orius insidiosus	Flower bug		Cimicidae	15
Mirisdo lobratus	Meadow plant bug		Miridae	75
Pelocoris femoratus	Creeping bug		Naucoridae	40
Caloso mascrutator	Ground Beetle		Carabidae	42
Scarites subterraneus	Ground Beetles		Carabidae	18
Passalu scornutus	Passalids beetle	Coloeptera	Passalidae	06
Dynaste stityus	Rhinosor beetle		Scarabaeidae	54
Geotrupes splendidus	Trogid beetle		Scarabaeidae	16
Phanaeus carnifex	Dung beetle		carabaeidae	12
Phyllophaga sp.	White grubs		Scarabaeidae	06
Osmoderma eremicola	Hermit flower beetle		Scarabaeidae	03
Goes tigrinus	Long horned wood boring beetle		Cerambycidae	02
Basilarchia archippus	Butterflies		Nymphalidae	45
Apantesis virgo	Tiger moths		Arctiidae	27
Estigmeneacraea	Salt marsh	Lepidoptera	Arctidae	25

Scientific Name	**Local Name**	**Group (Order)**	**Group (Family)**	**Frequency of occurrence (No)**
	caterpillar			
Anomogynae limata	Phalaenid larvae		Noctuidae	04
Malacosoma amerecanum	Eastern tent caterpiller		Lasiocampidae	12
Tricho plusiasp	Cabbage lopper		Noctuidae	22
Polistes habracus	Potter wasp	Hymenoptera	Vespidae	32
Polistes fuscatus	Paper wasp		Vespidae	49
Dorylus orientalis	Red ant		Formicidae	54
Andrena wilkella	Mining bees		Andrenidae	56
Componotus compressus	Black ant		Formicidae	64
Phidippusaudax	Jumping spider	Araneida	Lycosidae	26
Misumenops sp.	Crab spiders		Thomisidae	36

Table 2: List of birds of the study area

Sl. No.	Order	Family	Scientific Name	Common Name	Status
1	Galliformes	Phasianidae	*Francolinus gularis*	Swamp Francolin	C
2	Galliformes	Phasianidae	*Coturnix coromandelica*	Rain Quail	C
3	Galliformes	Phasianidae	*Francolinus pondicerianus*	Grey Francolin	C
4	Galliformes	Phasianidae	*Coturnix coturnix*	Common Quail	C
5	Anseriformes	Anatidae	*Dendrocygna bicolour*	Fulvous Whistling Duck	C
6	Anseriformes	Anatidae	*Anser anser*	Greylag Goose	C
7	Anseriformes	Anatidae	*Anser indicus*	Bar-headed Goose	C
8	Anseriformes	Anatidae	*Tadorna ferruginea*	Ruddy Shelduck	C
9	Anseriformes	Anatidae	*Tadorna tadorna*	Common Shelduck	C
10	Anseriformes	Anatidae	*Nettapus coromandelianus*	Cotton Pygmy-goose	C
11	Anseriformes	Anatidae	*Anas acuta*	Northern Pintail	C
12	Anseriformes	Anatidae	*Anas crecca*	Eurasian Teal	C
13	Anseriformes	Anatidae	*Anas falcata*	Falcated Duck	C
14	Anseriformes	Anatidae	*Anas platyrhynchos*	Mallard	C
15	Anseriformes	Anatidae	*Anas poecilorhyncha*	Indian Spot-billed Duck	C
16	Anseriformes	Anatidae	Anas strepera	Gadwall	C
17	Anseriformes	Anatidae	*Netta rufina*	Red-crested Pochard	C
18	Anseriformes	Anatidae	*Aythya ferina*	Common Pochard	C
19	Anseriformes	Anatidae	*Aythya fuligula*	Tufted Duck	C
20	Anseriformes	Anatidae	*Mergus merganser*	Common Merganser	C
21	Turniciformes	Turnicidae	*Turnix suscitator*	Barred Buttonquail	C
22	Turniciformes	Turnicidae	*Turnix sylvatica*	Kurrichane Buttonquail	C
23	Piciformes	Picidae	*Jynx torquilla*	Eurasian Wryneck	C
24	Piciformes	Picidae	*Picumnus innominatus*	Speckled Piculet	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
25	Piciformes	Picidae	*Dendrocopos canicapillus*	Grey-capped Pygmy Woodpecker	C
26	Piciformes	Picidae	*Dendrocopos macei*	Fulvous-breasted Woodpecker	C
27	Piciformes	Picidae	*Celeus brachyurus*	Rufous Woodpecker	C
28	Piciformes	Picidae	*Picus flavinucha*	Greater Yellownape	C
29	Piciformes	Picidae	*Dinopium benghalense*	Lesser Goldenback	C
30	Piciformes	Picidae	*Dinopium javanense*	Common Goldenback	C
31	Piciformes	Megadermatidae	*Megalaima asiatica*	Blue-throated Barbet	C
32	Piciformes	Megadermatidae	*Megalaima haemacephala*	Coppersmith Barbet	C
33	Bucerotifprmes	Upupidae	*Upupa epops*	Eurasian Hoopoe	C
345	Coraciiformes	Coraciidae	*Coracias benghalensis*	Indian Roller	C
35	Coraciiformes	Alcedinidae	*Alcedo atthis*	Common Kingfisher	C
36	Coraciiformes	Alcedinidae	*Alcedo meninting*	Blue-eared Kingfisher	C
37	Coraciiformes	Alcedinidae	*Pelargopsis amauroptera*	Brown-winged Kingfisher	C
38	Coraciiformes	Helcyonidae	*Halcyon coromanda*	Ruddy Kingfisher	C
39	Coraciiformes	Helcyonidae	*Halcyon smyrnensis*	White-throated Kingfisher	C
40	Coraciiformes	Helcyonidae	*Todiramphus chloris*	Collared Kingfisher	C
41	Coraciiformes	Cerylidae	*Megaceryle lugubris*	Crested Kingfisher	C
42	Coraciiformes	Cerylidae	*Ceryle rudis*	Pied Kingfisher	C
43	Coraciiformes	Meropidae	*Merops leschenaulti*	Chestnut-headed Bee-eater	C
44	Coraciiformes	Meropidae	*Merops orientalis*	Green Bee-eater	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
45	Cuculiformes	Cuculidae	*Clamator jacobinus*	Jacobin Cuckoo	C
46	Cuculiformes	Cuculidae	*Hierococcyx varius*	Common Hawk-Cuckoo	C
47	Cuculiformes	Cuculidae	*Cuculus canorus*	Common Cuckoo	C
48	Cuculiformes	Cuculidae	*Cuculus micropterus*	Indian Cuckoo	C
49	Cuculiformes	Cuculidae	*Eudynamys scolopacea*	Asian koel	C
50	Psittaciformes	Psittculidae	*Psittacula krameri*	Rose-ringed Parakeet	C
51	Apodiformes	Apdidae	*Cypsiurus balasiensis*	Asian Palm Swift	VC
52	Strigiformes	Tytonidae	*Tyto alba*	Barn Owl	C
53	Strigiformes	Strigidae	*Otus sunia*	Oriental Scops Owl	C
54	Strigiformes	Strigidae	*Ketupa zeylonensis*	Brown Fish Owl	C
55	Strigiformes	Strigidae	*Glaucidium brodiei*	Collared Owlet	C
56	Strigiformes	Strigidae	*Athene brama*	Spotted Owlet	C
57	Caprimulgiformes	Caprimulgidae	*Caprimulgus asiaticus*	Indian Nightjar	C
58	Columbiformes	Columbidae	*Columba livia*	Common Pigeon	C
59	Columbiformes	Columbidae	*Streptopelia chinensis*	Spotted Dove	C
60	Columbiformes	Columbidae	*Streptopelia tranquebarica*	Red Turtle Dove	C
61	Columbiformes	Columbidae	*Treron bicincta*	Orange-breasted Green Pigeon	C
62	Gruiformes	Gruidae	*Anthropoides virgo*	Demoiselle Crane	C
63	Gruiformes	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	C
64	Gruiformes	Rallidae	*Porzana fusca*	Ruddy-breasted Crake	C
65	Gruiformes	Rallidae	*Gallicrex cinerea*	Watercock	C
66	Gruiformes	Rallidae	*Gallinula chloropus*	Common Moorhen	C
67	Gruiformes	Rallidae	*Fulica atra*	Eurasian Coot	C
68	Charadriiformes	Scolopacidae	*Gallinago gallinago*	Common Snipe	C
69	Charadriiformes	Scolopacidae	*Gallinago stenura*	Pin-tailed Snipe	C
70	Charadriiformes	Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	C
71	Charadriiformes	Scolopacidae	*Numenius arquata*	Eurasian	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
				Curlew	
72	Charadriiformes	Scolopacidae	*Numenius phaeopus*	Whimbrel	C
73	Charadriiformes	Scolopacidae	*Heteroscelus brevipes*	Grey-tailed Tattler	C
74	Charadriiformes	Scolopacidae	*Tringa erythropus*	Spotted Redshank	C
75	Charadriiformes	Scolopacidae	*Tringa glareola*	Wood Sandpiper	C
76	Charadriiformes	Scolopacidae	*Tringa guttifer*	Nordmann's Greenshank	C
77	Charadriiformes	Scolopacidae	*Tringa nebularia*	Common Greenshank	C
78	Charadriiformes	Scolopacidae	*Tringa ochropus*	Green Sandpiper	C
79	Charadriiformes	Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	C
80	Charadriiformes	Scolopacidae	*Tringa totanus*	Common Redshank	C
81	Charadriiformes	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	R
82	Charadriiformes	Scolopacidae	*Limnodromus semipalmatus*	Asian Dowitcher	C
83	Charadriiformes	Scolopacidae	*Calidris alba*	Sanderling	C
84	Charadriiformes	Scolopacidae	*Calidris canutus*	Red Knot	C
85	Charadriiformes	Scolopacidae	*Calidris minuta*	Little Stint	C
86	Charadriiformes	Scolopacidae	*Eurynorhynchus pygmeus*	Spoon-billed Sandpiper	C
87	Charadriiformes	Scolopacidae	*Limicola falcinellus*	Broad-billed Sandpiper	C
88	Charadriiformes	Scolopacidae	*Philomachus pugnax*	Ruff	C
89	Charadriiformes	Rostratulidae	*Rostratula benghalensis*	Greater Painted Snipe	C
90	Charadriiformes	Jacacidae	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	C
91	Charadriiformes	Burhinidae	*Burhinus oedicnemus*	Eurasian Stone-curlew	C
92	Charadriiformes	Haematopodidae	*Haematopus ostralegus*	Eurasian Oystercatcher	C
93	Charadriiformes	Recuvirostridae	*Himantopus himantopus*	Black-winged Stilt	C
94	Charadriiformes	Recuvirostridae	*Recurvirostra avosetta*	Pied Avocet	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
95	Charadriiformes	Recuvirostridae	*Pluvialis fulva*	Pacific Golden Plover	C
96	Charadriiformes	Recuvirostridae	*Pluvialis squatarola*	Grey Plover	C
97	Charadriiformes	Recuvirostridae	*Charadrius hiaticula*	Common Ringed Plover	C
98	Charadriiformes	Charadriidae	*Vanellus cinereus*	Grey-headed Lapwing	C
99	Charadriiformes	Charadriidae	*Vanellus duvaucelii*	River Lapwing	C
100	Charadriiformes	Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	C
101	Charadriiformes	Charadriidae	*Vanellus vanellus*	Northern lapwing	C
102	Charadriiformes	Dromadidae	*Dromas ardeola*	Crab-plover	C
103	Charadriiformes	Glareolidae	*Glareola lactea*	Small Pratincole	C
104	Charadriiformes	Rynchopidae	*Rynchops albicollis*	Indian Skimmer	C
105	Charadriiformes	Laridae	*Larus cachinnans*	Yellow-legged Gull	C
106	Charadriiformes	Laridae	*Larus ridibundus*	Common Black-headed Gull	C
107	Charadriiformes	Sternidae	*Sterna acuticauda*	Black-bellied Tern	C
108	Charadriiformes	Sternidae	*Sterna albifrons*	Little Tern	C
109	Charadriiformes	Sternidae	*Sterna aurantia*	River Tern	C
110	Charadriiformes	Sternidae	*Sterna hirundo*	Common Tern	C
111	Accipitriformes	Accipritidae	*Pandion haliaetus*	Osprey	C
112	Accipitriformes	Accipritidae	*Elanus caeruleus*	Black-winged Kite	C
113	Accipitriformes	Accipritidae	*Milvus migrans*	Black Kite	VC
114	Accipitriformes	Accipritidae	*Haliastur indus*	Brahminy Kite	C
115	Accipitriformes	Accipritidae	*Ichthyophaga ichthyaetus*	Grey-headed Fish Eagle	C
116	Accipitriformes	Accipritidae	*Neophron percnopterus*	Egyptian Vulture	C
117	Accipitriformes	Accipritidae	*Gyps bengalensis*	White-rumped Vulture	C
118	Accipitriformes	Accipritidae	*Circus macrourus*	Pallid Harrier	C
119	Accipitriformes	Accipritidae	*Circus melanoleucos*	Pied Harrier	C
120	Accipitriformes	Accipritidae	*Accipiter badius*	Shikra	C
121	Accipitriformes	Accipritidae	*Buteo buteo*	Common Buzzard	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
122	Accipitriformes	Accipritidae	*Aquila hastata*	Indian Spotted Eagle	C
123	Falconiformes	Falconidae	*Falco naumanni*	Lesser Kestrel	C
124	Falconiformes	Falconidae	*Falco peregrinus*	Peregrine Falcon	C
125	Falconiformes	Falconidae	*Falco severus*	Oriental Hobby	C
126	Falconiformes	Falconidae	*Falco tinnunculus*	Common Kestrel	C
127	Podicipediformes	Podicipedidae	*Tachybaptus ruficollis*	Little Grebe	C
128	Podicipediformes	Podicipedidae	*Podiceps cristatus*	Great Crested Grebe	C
129	Suliformes	Anhingidae	*Anhinga melanogaster*	Darter	C
130	Suliformes	Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	C
131	Suliformes	Phalacrocoracidae	*Phalacrocorax fuscicollis*	Indian Cormorant	C
132	Suliformes	Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	C
133	Pelecaniformes	Ardeidae	*Egretta garzetta*	Little Egret	C
134	Pelecaniformes	Ardeidae	*Ardea cinerea*	Grey Heron	C
135	Pelecaniformes	Ardeidae	*Casmerodius albus*	Great Egret	C
136	Pelecaniformes	Ardeidae	*Bubulcus ibis*	Cattle Egret	C
137	Pelecaniformes	Ardeidae	*Ardeola grayii*	Indian Pond Heron	C
138	Pelecaniformes	Ardeidae	*Nycticorax nycticorax*	Black-crowned Night Heron	C
139	Pelecaniformes	Ardeidae	*Ixobrychus sinensis*	Yellow Bittern	C
140	Pelecaniformes	Ardeidae	*Dupetor flavicollis*	Black Bittern	C
141	Pelecaniformes	Thresciornithidae	*Threskiornis melanocephalus*	Black-headed Ibis	C
142	Pelecaniformes	Thresciornithidae	*Platalea leucorodia*	Eurasian Spoonbill	C
143	Ciconiiformes	Ciconiidae	*Mycteria leucocephala*	Painted Stork	C
144	Ciconiiformes	Ciconiidae	*Anastomus oscitans*	Asian Openbill	C
145	Ciconiiformes	Ciconiidae	*Ciconia ciconia*	White Stork	C
146	Ciconiiformes	Ciconiidae	*Ciconia nigra*	Black Stork	C
147	Ciconiiformes	Ciconiidae	*Leptoptilos javanicus*	Lesser Adjutant	C
148	Passeriformes	Laniidae	*Lanius cristatus*	Brown Shrike	UC
149	Passeriformes	Laniidae	*Lanius schach*	Long-tailed Shrike	C
150	Passeriformes	Corvidae	*Corvus splendens*	House Crow	VC

Sl. No.	Order	Family	Scientific Name	Common Name	Status
151	Passeriformes	Corvidae	*Oriolus chinensis*	Black-naped Oriole	C
152	Passeriformes	Corvidae	*Oriolus xanthornus*	Black-hooded Oriole	C
153	Passeriformes	Corvidae	*Pericrocotus cinnamomeus*	Small Minivet	C
154	Passeriformes	Corvidae	*Rhipidura albicollis*	White-throated Fantail	C
155	Passeriformes	Corvidae	*Dicrurus leucophaeus*	Ashy Drongo	C
156	Passeriformes	Corvidae	*Dicrurus macrocercus*	Black Drongo	VC
157	Passeriformes	Corvidae	*Hypothymis azurea*	Black-naped Monarch	C
158	Passeriformes	Corvidae	*Terpsiphone paradisi*	Asian Paradise-flycatcher	C
159	Passeriformes	Corvidae	*Aegithina tiphia*	Common Iora	C
160	Passeriformes	Corvidae	*Tephrodornis pondicerianus*	Common Woodshrike	UC
161	Passeriformes	Muscicapidae	*Monticola solitarius*	Blue Rock Thrush	C
162	Passeriformes	Muscicapidae	*Muscicapa dauurica*	Asian Brown Flycatcher	C
163	Passeriformes	Muscicapidae	*Ficedula westermanni*	Little Pied Flycatcher	C
164	Passeriformes	Muscicapidae	*Cyornis tickelliae*	Tickell’s Blue Flycatcher	C
165	Passeriformes	Muscicapidae	*Luscinia calliope*	Siberian Rubythroat	C
166	Passeriformes	Muscicapidae	*Copsychus saularis*	Oriental Magpie Robin	C
167	Passeriformes	Muscicapidae	*Phoenicurus ochruros*	Black Redstart	C
168	Passeriformes	Muscicapidae	*Saxicola caprata*	Pied Bush Chat	C
169	Passeriformes	Muscicapidae	*Saxicola insignis*	White-throated Bush Chat	C
170	Passeriformes	Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	C
171	Passeriformes	Sturnidae	*Sturnus contra*	Pied Myna	C
172	Passeriformes	Sturnidae	Sturnus malabaricus	Chestnut-tailed Starling	UC
173	Passeriformes	Sturnidae	*Sturnus vulgaris*	Common Starling	C
174	Passeriformes	Sturnidae	*Acridotheres fuscus*	Jungle Myna	UC
175	Passeriformes	Sturnidae	*Acridotheres tristis*	Common Myna	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
176	Passeriformes	Paridae	*Parus major*	Great Tit	C
177	Passeriformes	Hirundinidae	*Hirundo daurica*	Red-rumped Swallow	C
178	Passeriformes	Hirundinidae	*Hirundo rustica*	Barn Swallow	C
179	Passeriformes	Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	C
18	Passeriformes	Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	C
181	Passeriformes	Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	C
182	Passeriformes	Cisticolidae	*Prinia gracilis*	Graceful Prinia	C
183	Passeriformes	Cisticolidae	*Prinia rufescens*	Rufescent Prinia	C
184	Passeriformes	Cisticolidae	*Prinia socialis*	Ashy Prinia	C
185	Passeriformes	Sylviidae	*Locustella naevia*	Common Grasshopper Warbler	C
186	Passeriformes	Sylviidae	*Acrocephalus agricola*	Paddyfield Warbler	C
187	Passeriformes	Sylviidae	*Acrocephalus dumetorum*	Blyth's Reed Warbler	C
188	Passeriformes	Sylviidae	*Orthotomus sutorius*	Common Tailorbird	C, VC
189	Passeriformes	Sylviidae	*Phylloscopus collybita*	Common Chiffchaff	C
190	Passeriformes	Sylviidae	*Phylloscopus fuscatus*	Dusky Warbler	C
191	Passeriformes	Sylviidae	*Abroscopus superciliaris*	Yellow-bellied Warbler	C
192	Passeriformes	Sylviidae	*Megalurus palustris*	Striated Grassbird	C
193	Passeriformes	Sylviidae	*Pellorneum palustre*	Marsh Babbler	C
194	Passeriformes	Sylviidae	*Turdoides striatus*	Jungle Babbler	C
195	Passeriformes	Alaudidae	*Mirafra assamica*	Bengal Bush Lark	C
196	Passeriformes	Alaudidae	*Mirafra cantillans*	Singing Bush Lark	C
197	Passeriformes	Alaudidae	*Calandrella raytal*	Sand Lark	C
198	Passeriformes	Alaudidae	*Alauda gulgula*	Oriental Skylark	C
199	Passeriformes	Dicaeidae	*Dicaeum concolor*	Plain Flowerpecker	C
200	Passeriformes	Nectariniidae	*Cinnyris asiaticus*	Purple Sunbird	C
201	Passeriformes	Passeridae	*Passer domesticus*	House Sparrow	VC
202	Passeriformes	Passeridae	*Motacilla alba*	White Wagtail	UC
203	Passeriformes	Passeridae	*Motacilla cinerea*	Grey Wagtail	C

Sl. No.	Order	Family	Scientific Name	Common Name	Status
204	Passeriformes	Passeridae	*Ploceus benghalensis*	Black-breasted Weaver	C
205	Passeriformes	Passeridae	*Ploceus philippinus*	Baya Weaver	C
206	Passeriformes	Passeridae	*Lonchura malacca*	Black-headed Munia	C
207	Passeriformes	Passeridae	*Lonchura punctulata*	Scaly-breasted Munia	C
208	Passeriformes	Emberizidae	*Emberiza spodocephala*	Black-faced Bunting	C
209	Passeriformes	Corvidae	*Corvus macrohynchos*	Large-billed crow	C, VC
210	Passeriformes	Corvidae	*Dendrocitta vagabunda*	Rufous treepie	UC

Table 3: List of homestead trees species observed along the river banks within the Project Impact Area (Source: Islam et al. 2013, CARINAM field survey 2015, Khan et al. 1995) [**Note:** VC - Very Common, C - Common, UC - Uncommon, R-rare, VR - Very Rare, Ex - Exotic, Mv - Mangrove species]

S.No.	**Local/English Name**	**Scientific Name**	**Status**
1.	Mahogany	*Swietenia macrophylla*	C
2.	Rain tree	*Samanea saman*	VC
3.	Raj koroi	*Albizia richardiana*	C
4.	Kala koroi	*Albizia lebbeck*	R
5.	Sada koroi	*Albizia procera*	UC
6.	Neem	*Azadirachta indica*	UC
7.	Simul	*Bombax ceiba*	UC
8.	Sonalu	*Cassia fistula*	VR
9.	Karanja	*Pongamia pinnata*	UC
10.	Payra	*Pithecellobium dulce*	UC
11.	Akashmoni	*Acacia auriculiformis*	UC
12.	Katbadam	*Terminalia catappa*	UC
13.	Bamboo grove	*Bambusa sp.*	C
14.	Babla	*Acacia nilotica*	VR, Ex
15.	Sisso	*Dalbergia sissoo*	UC, Ex
16.	Segun	*Tectona grandis*	VR
17.	Pitraj	*Aphanamixis polystachya*	UC
18.	Sonboloi	*Thespesia populnea*	R
19.	Sundari	*Heritiera fomes*	R, Mv
20.	Gewa	*Excoecaria agallocha*	R, Mv
21.	Ipil-Ipil	*Leucaena leucocephala*	R
22.	Mander	*Erythrina sp.*	UC
23.	Arjun	*Terminalia arjuna*	R
24.	Debdaru	*Polyalthia longifolia*	R
25.	Khoir	*Acacia catechu*	R

26.	Eucalyptus	*Eucalyptus camaldulensis*	R, Ex
27.	Jial badhi	*Lannea coromandelica*	R
28.	Bot	*Ficus bengalensis*	R
29.	Bohera	*Terminalia belerica*	R
30.	Ponial	*Calophyllum inophyllum*	R
31.	Coconut	*Cocos nucifera*	VC
32.	Betel nut	*Areca catechu*	VC
33.	Velvety apple	*Diospyros discolour*	VC
34.	Mango	*Mangifera indica*	VC
35.	Jackfruit	*Artocarpus heterophyllus*	VC
36.	Guava	*Psidium guajava*	VC
37.	Pummelo	*Citrus grandis*	VC
39.	Golden apple	*Spondias pinnata*	VC
40.	Tamarind	*Tamarindus indica*	C
41.	Jujube	*Zizypus Mauritania*	C
42.	Wax apple	*Syzygium samarangense*	C
43.	Carambola	*Averrhoa carambola*	C
44.	Lemon	*Citrus limon*	C
45.	Date palm	*Phoenix sylvestris*	UC
46.	Blackberry	*Syzygium cumini*	UC
47.	Monkey jack	*Artocarpus lakoocha*	UC
48.	Elephant apple	*Dillenia indica*	UC
49.	Litchi	*Litchi chinensis*	UC
50.	Indian olive	*Elaeocarpus floribundus*	UC
51.	Aonla	*Emblica officinalis*	UC
52.	Bullock’s heart	*Annona reticulate*	C
53.	Cowa	*Garcinia cowa*	UC
54.	Wood apple	*Aegle marmelos*	R
55.	Sapota	*Achras sapota*	R
56.	Pomegranate	*Punica granatum*	UC
57.	Custard apple	*Annona squamosal*	UC

58.	River ebony	*Diospyros peregrine*	R
59.	Orange	*Citrus chinensis*	R
60.	Elephant’s foot apple	*Feronia limonia*	R
61.	Rose apple	*Syzygium jambos*	R
62.	Mandar	*Erythrina variegate*	C
63.	Mandar	*Erythrina fusca*	C
64.	Dheros, Bhindi	*Abelmoschus esculentus*	UC
65.	Bunno Dheros	*Abelmoschus moschatus*	UC
66.	Jhumka	*Abutilon hirtum*	UC
67.	Jhumka	*Abutilon indicum*	UC
68.	Akashi	*Acacia mangium*	UC
69.	Patabahar	*Acalypha wilkesiana*	C
70.	Hargoza	*Acanthus illicifolius*	UC
71.	Apang	*Achyranthes aspera*	UC
72.	Raktahata	*Aerva sanguinolenta*	UC
73.	Bhatshola	*Aeschynomene indica*	C
74.	Fulkuri	*Ageratum conyzoides*	C
75.	Jat Koroi	*Albizia odoratissima*	UC
76.	Molicha	*Alternanthera philoxeroides*	C
77.	Sachisak	*Alternanthera sessilis*	C
78.	Kantamairra	*Amaranthus spinosus*	C
79.	Mairrasak	*Amaranthus viridis*	C
80.	Bel	*Aegle marmelos*	UC
81.	Fulkorai	*Albizia saman*	C
82.	Chatim	*Alstonia scholaris*	UC
83.	Ata	*Annona reticulata*	C
84.	Sharifa	*Annona squamosa*	C
85.	Royna	*Aphanamixis polystachya*	UC
86.	Chinabadam	*Arachis hypogaea*	UC
87.	Guguli	*Argyreia nervosa*	UC
88.	Batta	*Artocarpus lacucha*	UC

89.	Bilimbi	*Averrhoa bilimbi*	UC
90.	Kamranga	*Averrhoa carambola*	*C*
91.	Neem	*Azadirachta indica*	C
92.	Brammishak	*Bacopa monnieri*	C
93.	Puishak	*Basella rubra*	C
94.	Chalkumra	*Benincasa hispida*	C
95.	Kormuta	*Blumea lacera*	C
96.	Simul,Tula	*Bombax ceiba*	C
97.	Baganbilas	*Bougainvillea glabra*	C
98.	Baganbilas	*Bougainvillea spectabilis*	C
99.	Sarisa	*Brassica napus*	UC
100.	Phulkapi	*Brassica oleracea*	UC
101.	Bandhakopi	*Brassica capitata*	UC
102.	Palash	*Butea monosperma*	UC
103.	Arol	*Cajanus cajan*	C
104.	Hundal	*Calophyllum inophyllum*	C
105.	Akkan, Akanda	*Calotropis gigantea*	C
106.	Akkan	*Calotropis procera*	C
107.	Marich	*Capsicum annuum*	C
108.	Marich	*Capsicum frutescens*	UC
109.	Pepe, kokia	*Carica papaya*	C
110.	Kormocha	*Carissa carandas*	C
111.	Sonamukhi	*Cassia fistula*	UC
112.	Jhau, Popan	*Casuarina equisetifolia*	UC
113.	Nayantara	*Catharanthus roseus*	C
114.	Monkanta	*Catunaregam spinosa*	C
115.	Morogful	*Celosia cristata*	UC
116.	Adamkipata, Thankuni	*Centella asiatica*	C
117.	Thuas	*Centrostachys aquatica*	C
118.	Hasnahena	*Cestrum nocturnum*	UC

119.	Battashak	*Chenopodium album*	*UC*
120.	Asamlata	*Chromolaena odorata*	UC
121.	Tejpata	*Cinnamomum tamala*	UC
122.	Tarmuz	*Citrullus lanatus*	UC
123.	Kagazi lebu	*Citrus aurantifolia*	C
124.	Jambura	*Citrus maxima*	C
125.	Atha, hurhuria	*Cleome viscosa*	C
126.	Bamunhati	*Clerodendrum indicum*	C
127.	Bandulpata	*Clerodendrum inerme*	C
128.	Bhat	*Clerodendrum viscosum*	C
129.	Aparajita	*Clitoria tarnatea*	UC
130.	Telakucha	*Coccinia grandis*	UC
131.	Patabahar	*Codiaeum variegatum*	C
132	Paat	*Corchorus capsularis*	C
133	Tuchapat	*Corchorus olitorious*	UC
134	Dhone	*Coriandrum sativum*	C
135	Dubbecrepi	*Crassocephalum crepidioides*	UC
136	Barun	*Crateva magna*	C
137	Junjuni	*Crotalaria pallida*	C
138	Paglamarich	*Croton bonplandianus*	UC
139	Bangi	*Cucumis melo*	UC
140	Sasha	*Cucumis sativus*	C
141	Mistikumra	*Cucurbita maxima*	C
142	Sunnalata, Sarnalata	*Cuscuta reflexa*	UC
143	Sialimutra	*Cyanthillium cinereum*	C
144	Dalia	*Dahlia pinnata*	UC
145	Datura	*Datura metel*	C
146	Gajor	*Daucas carota*	C
147	Krisnachura	*Delonix regia*	UC
148	Kalla lata	*Derris scandens*	UC
149	Kalla lata	*Derris trifoliata*	UC

150	Kodaliya	*Desmodium triflorum*	C
151	Chalta	*Dillenia indica*	UC
152	Bilatigab	*Diospyros blancoi*	C
153	Kassagab	*Diospyros malabarica*	C
154	Kantamehedi	*Duranta erecta*	C
155	Kalakeccha	*Eclipta prostrata*	UC
156	Jalpai	*Elaeocarpus floribundus*	UC
157	Sadimudi	*Emilia sonchifolia*	
158	Bilati Dhone	*Eryngium foetidum*	UC
159	Eucalyptus	*Eucalyptus camaldulensis*	C
160	Kantamansa	*Euphorbia nerifolia*	UC
161	Dudialata	*Euphorbia hirta*	UC
162	Bot	*Ficus benghalensis*	UC
163	Ballagota	*Ficus erecta.*	C
164	Dumur	*Ficus hispida*	C
165	Jaggodumur	*Ficus racemosa.*	C
166	Asath, Jil	*Ficus religiosa*	UC
167	Kau	*Garcinia cowa*	
168	Gondoraj	*Gardenia jesminoides*	UC
169	Koishtuma	*Glochidion multiloculare*	
170	Gamar	*Gmelina arborea*	UC
171	Namuti	*Grangea maderaspatana*	
172	Surjamukhi	*Helianthus annuus*	UC
173	Nona hatisuri	*Heliotropium curassavicum*	UC
174	Hatisur	*Heliotropium indicum*	UC
175	Borati gas	*Hemigraphis hirta*	
176	Latkonjaba	*Hibiscus rosa-sinensis*	C
177	Mesoth	*Hibiscus sabdariffa*	
178	Alicha	*Hygrophila auriculata*	
179	Bontil	*Hygrophila salicifolia*	
180	Gol tokma	*Hyptis brevipes*	

181	Tokma	*Hyptis suaveolens*	
182	Kalmi	*Ipomoea aquatica*	C
183	Sagarna alu	*Ipomoea batatus*	
184	Dulkolmi	*Ipomoea fistulosa*	C
185	Gateful	*Ipomoea quamoclit*	
186	Rangon	*Ixora coccinea*	C
187	Beli	*Jasminum sambac*	UC
188	Jagatmadan	*Justicia gendarussa*	
189	Pathorkuchi	*Kalanchoe pinnata*	UC
190	Shim	*Lablab purpureus*	C
191	Kadhu	*Lagenaria siceraria*	C
192	Badi	*Lannea coromandelica*	
193	Lantana	*Lantana camara*	C
194	Cutra	*Laportea interrupta*	
195	Khesari	*Lathyrus sativus*	C
196	Tikadana	*Launaea aspleniifolia*	
197	Methi	*Lawsonia inermis*	
198	Murka	*Leea indica*	
199	Masur	*Lens culinaris*	
200	Rakta dron	*Leonurus sibiricus*	
201	Aul	*Lepisanthes rubiginosa*	
202	Ipil	*Leucaena leucocephala*	
203	Shet dron	*Leucas aspera*	
204	Zai gash	*Lindernia antipoda*	
205	Tisi	*Linum usitatissimum*	
206	Shunk	*Lippia alba*	
207	Meda	*Litsea monopetala*	
208	Otthuas	*Ludwigia adscendens*	C
209	Panilong	*Ludwigia hyssopifolia*	
210	Dundul	*Luffa cylindrica*	C
211	Apple	*Malus domestica*	

212	Marich jaba	*Malvaviscus arboreus*	
213	Ghora nim	*Melia azederach*	
214	Sada methi	*Melilotus albus*	
215	Pudina	*Mentha arvensis*	C
216	Pudina	*Mentha viridis*	
217	Marbel	*Meyna spinosa*	
218	Hakistani lata	*Mikania micrantha*	
219	Boro	*Mimosa himalayna*	
220	Sarmida	*Mimosa pudica*	C
221	Bakul	*Mimusops elengi*	
222	Titkorola	*Momordica charantia*	C
223	Akri	*Momordica cochinchinensis*	
224	Rangkathal	*Morinda citrifolia*	
225	Sajina	*Moringa oleifera*	C
226	Kamini	*Murraya paniculata*	
227	Paramul	*Nelsonia canescens*	
228	Kadam	*Neolamarckia cadamba*	C
229	Raktakarobi	*Nerium oleander*	UC
230	Seuli	*Nyctanthes arbor- tristis*	UC
231	Halud Hapla	*Nymphaea amazonum*	
232	Nil hapla	*Nymphaea nouchali*	
233	Lal hapla	*Nymphaea rubra*	
234	Kachuti	*Nymphoides hydrophylla*	
235	Kachuti	*Nymphoides indica*	
236	Banno tulsi	*Ocimum americanum*	
237	Tulsi	*Ocimum basilicum*	C
238	Tulsi	*Ocimum tenuiflorum*	
239	Pan tulsi	*Oenanthe javanica*	
240	Dima shak	*Oldenlandia corymbosa*	
241	Fonimonsha	*Opuntia elatior*	UC
242	Thona	*Oroxylum indicum*	

243	Amrul	*Oxalis corniculata*	
244	Patabahar	*Pedilanthus tithymaloides*	C
245	Luchipata	*Peperomia pellucida*	
246	Lalbiskatali	*Persicaria hydropiper*	
247	Biskatali	*Persicaria orientalis*	C
248	Petunia	*Petunia hybrida*	
249	Khai	*Phyla nodiflora*	
250	Horoli	*Phyllanthus acidus*	
251	Amloki	*Phyllanthus emblica*	
252	Vuiamla	*Phyllanthus niruri*	
253	Cirkuti	*Phyllanthus reticulatus*	
254	Sikimamla	*Phyllanthus sikkimensis*	
255	Futka bion	*Physalis minima*	
256	Pipul	*Piper peepuloides*	
257	Motorsuti	*Pisum sativum*	
258	Natai	*Pithecellobium dulce*	
259	Mundorokha	*Pluchea indica*	
260	Debdaru	*Polyalthia longifolia*	C
261	Kenga, koroch	*Pongamia pinnata*	UC
262	Noitaful	*Portulaca grandiflora*	
263	Nunashak	*Portulaca olearacea*	
264	Tatui	*Premna esculenta*	
265	Peyara	*Psidium guajava*	C
266	Kamranga, Chai	*Psophocarpus tetragonolobus*	C
267	Mula	*Raphanus sativus*	C
268	Sarpogonda	*Rauvolfia serpentina*	C
269	Veron	*Ricinus communis*	
270	Banna horra	*Rorippa indica*	
271	Golap	*Rosa centifolia*	UC
272	Alughanti	*Ruellia tuberosa*	
273	Datipalong	*Rumex maritimus*	

274	Chuai	*Rumex vesicarius*	
275	Pindi	*Rungia pectinata*	
276	Salvia	*Salvia splendens*	
277	Chandan	*Santalum album*	
278	Bondhone	*Scoparia dulcis*	
279	Dadmardon	*Senna alata*	
280	Til	*Sesamum indicum*	
281	Hola	*Sesbania sesban*	
282	Kureta	*Sida acuta*	
283	Pitberal	*Sida cordata*	
284	Kureta	*Sida rhombifolia*	
285	Tomato	*Solanum lycopersicum*	C
286	Begun	*Solanum melongena*	C
287	Tikbion	*Solanum myriacanthum*	
288	Putibegun	*Solanum nigrum*	
289	Kantabegun	*Solanum sisymbrifolium*	
290	Titbion	*Solanum torvum*	
291	Goal Alu	*Solanum tuberosum*	
292	Titbion	*Solanum violaceum*	
293	Bannabion	*Solanum virginianum*	
294	Kerpa	*Sonneratia apetala*	M
295	Ghuijil	*Spermacoce latifolia*	
296	Morichalata	*Sphenoclea zeylanica*	
297	Mariccha	*Spilanthes acmella*	
298	Palongshak	*Spinacia oleracea*	
299	Amra	*Spondias pinnata*	UC
300	Musarralata	*Stephania japonica*	
301	Keron	*Sterculia foetida*	
302	Horma	*Streblus asper*	
303	Mehagoni	*Swietenia mahagoni*	C
304	Relanodi	*Synedrella nodiflora*	

305	Butigajam	*Syzygium cumini*	C
306	Kawyagajam	*Syzygium fruticosum*	
307	Golapjam	*Syzygium jambos*	UC
308	Jamrul	*Syzygium samarangense*	UC
309	Tagar	*Tabernaemontana divericata*	UC
310	Haludghenda	*Tagetes erecta*	
311	Lalghenda	*Tagetes patula*	
312	Tetul	*Tamarindus indica*	R
313	Nona jau	*Tamarix indica*	
314	Bahera	*Terminalia bellirica*	UC
315	Katbadam	*Terminalia catappa*	C
316	Balai	*Thespesia populnea*	C
317	Gatika	*Thevetia peruviana*	C
318	Gulanch	*Tinospora cordifolia*	
319	Cicinda	*Trichosanthes anguina*	
320	Patal	*Trichosanthes dioica*	C
321	Jangli gagra	*Urena lobata*	
322	Maskolai	*Vigna mungo*	UC
323	Mug	*Vigna radiata*	
324	Barboti	*Vigna unguiculata*	
325	Nishinda	*Vitex negundo*	
326	Nilnishinda	*Vitex trifolia*	
327	Vimraj	*Wedelia chinensis*	
328	Gagra	*Xanthium indicum*	
329	Barai	*Ziziphus mauritiana*	
330	Rasna	*Acampe praemorsa*	
331	Rasna	*Aerides odorata*	
332	Piaj	*Allium cepa*	
333	Rashun	*Allium sativum*	
334	Mankachu	*Alocasia macrorrhizos*	
335	Hatal kachu	*Alocasia odora*	

336	Gritakumari	*Aloe vera*	
337	Tara	*Alpinia nigra*	
338	Olkachu	*Amorphophallus paeoniifolius*	
339	Jangleol	*Amorphophalus bulbifer*	
340	Anaros	*Ananus comosus*	
341	Supari	*Areca catechu*	
342	Bora bans	*Bambusa balcooa*	
343	Chikon bans	*Bambusa jaintiana*	
344	Bangla bans	*Bambusa vulgaris*	
345	Tal	*Borassus flabellifer*	
346	Goradubla	*Bothriochola pertusa*	
347	Kerat Bet	*Calamus latifolius*	
348	Bet	*Calamus viminalis*	
349	Kalabati	*Canna indica*	
350	Kew shak	*Cheilocostus speciosus*	
351	Bait	*Chrysopogon aciculatus*	
352	Narikel	*Cocos nucifera*	
353	Sada Hongais	*Coix lacryma-jobi*	
354	Kachu	*Colocasia esculenta*	
355	Kanaialata	*Commelina benghalensis*	
356	Kanaialata	*Commelina paludosa*	
357	Goron,Golras	*Crinum asiaticum*	
358	Banna halud	*Curcuma aeruginosa*	
359	Halud	*Curcuma longa*	
360	Aghnighas	*Cymbopogon citratus*	
361	Dublakher	*Cynodon dactylon*	
362	Sagarmukhi methi	*Cyperus cuspidatus*	
363	Burethi	*Cyperus imbricatus*	
364	Kathai	*Cyperus pilosus*	
365	Kaiabeda	*Cyperus rotandus*	
366	Bangalu	*Dioscorea alata*	

367	Kachuripana	*Eichhornia crassipes*	
368	Money plant	*Epipremnum aureum*	C
369	Kachu	*Homalomena aromatica*	C
370	Chon	*Imperata cylindrica*	C
371	Bonhadda	*Lasia spinosa*	
372	Guri fena	*Lemna perpusilla*	
373	Fena	*Monochoria hastata*	C
374	Kola	*Musa acuminata*	
375	Anajikola	*Musa paradisiaca*	
376	Dhan	*Oryza sativa*	C
377	Polao pata	*Pandanus amaryllifolius*	
378	Kaindan	*Panicum miliaceum*	
379	Khejur	*Phoenix sylvestris*	C
380	Futihena	*Pistia stratiotes*	
381	Rajanigonda	*Polianthes tuberosa*	
382	Uridan	*Porteresia coarctata*	
383	Rasna	*Rhynchostylis retusa*	
384	Kuyar	*Saccharum officinarum*	C
385	Kasful,Kaiccha	*Saccharum spontaneum*	C
386	Sitol pati	*Schumannianthus dichotomus*	
387	Fena	*Spirodela polyrhiza*	
388	Daripata	*Typha elephantina*	
389	Bhutta	*Zea mays*	
390	Ada	*Zingiber officinale*	C
391	Paan	*Piper betle*	UC
392	Cheena Taal	*Livistona chinensis*	R, Ex

Table 4: List of invertebrates so far recorded from Bangladesh

Comment	Phyla		No. of species recorded	References
1	Protozoa		175	Kabir, et al. (eds.), 2008
2	Prorifera		29	Kabir, et al. (eds.), 2008
3	Cnidaria		102	NCS Report, 1997 Kabir, et al. (eds.), 2008
4	Ctenophora		10	Kabir, et al. (eds.), 2008
5	Rotifera		76	Kabir, et al. (eds.), 2008
6	Gastrotricha		04	Kabir, et al. (eds.), 2008
7	Platyhelmithes		126	Kabir, et al. (eds.), 2008
8	Nematoda		176	Kabir, et al. (eds.), 2008
9	Annelida		98	Kabir, et al. (2009)
10	Echinodermata		46	NCS Report (1997); Kabir, et al. (2009)
11	Acanthocephala		28	Kabir, et al. (2009)
12	Bryozoa (Minor Phyla)		07	Kabir, et al. (2009)
13	Kinorhyncha (Minor Phyla)		02	Kabir, et al. (2009)
14	Chaetognatha (Minor Phyla)		03	Kabir, et al. (2009)
15	Mollusca		470	Siddiqui, et al. (eds.), 2007
16	Arthropoda	Crustacea (Zooplankton)	164	Bhouyain&Asmat (1992); Ahmed, et al. (2008)
17		Crustacea (Crabs)	39	Shafi&Quddus (1982); Chowdhury&Hafizuddin (1991); Ameen (2001); Siddiqui&Zafar (2002); Ahmed, et al. (2008)
18		Crustacea (Shrimps & Prawns)	62	Ahmed, et al. (2008) Hossain (2013)
19		Insecta	2360	Bhuiya, et al. 2015 (Unpublished Compilation); www.brgb.org/species

20		Arachnida (Scorpion & spiders)	431	Ahmed, et al. (2009)
Total			4408	

***Source**: Bhuiya B.A. (2014)*Number of species within different Phyla and classes may be added in due course as they are recorded.*

Table 5: List of mammals of the project area.

No	Order	Family	Species	English Name	Local Name	IUCN	CITES	Local
1	Carnivora	Canidae	*Canis aureus*	Golden Jackal	PatiShial/ Shial	VU	III	CR
2			*Vulpes bengalensis*	Bengal Fox				
3		Felidae	*Felis chaus*	Jungle cat	Ban Biral	EN		RR
4			*Felis viverrina*	Fishing cat	Meso- Biral			UR
5		Herpestidae	*Herpestes auropunctatus*	Small Indian Mongoose	Benji/ Nakul			CR
6			*Herpestes edwardsi*	Indian Grey Mongoose		VU		VU
7		Mustelidae	*Lutra perspicillata*	Smooth Otter	Ud-Biral	EN		UR
8			*Lutra lutra*	Common Otter	Ud-Biral	CR	I	RR
9		Viverridae	*Vivercula indica*	Small Indian Civet	Khatash	VU	III	UR
10			*Viverra zibetha*	Large Indian Civet	Bagdash	EN		UR
11		Muridae	*Bendicota bengalensis*	Mole Rat	Indur			CR
12			*Bendicota indica*	Greater Bandicoot Rat	Dhariindur			CR
13			*Mus booduga*	Field Mouse	Metho-Indur			CR
14			*Mus musculus*	House Mouse	NengtiIndur			CR
15			*Rattus rattus*	House Rat	Indur			CR
16			*Vandeleuria*	Longtailed	Gechonentii			VU

No	Order	Family	Species	English Name	Local Name	IUCN	CITES	Local
			oleracea	Tree Mouse	ndur			
17			*Suncus murinus*	Grey Mask Shrew	SikaIndur			C
18	Chiroptera	Megadermatidae	*Megaderma lyra*	False Vampire Bat	Dhani-Badur			UR
19		Pteropodidae	*Rousettus leschenaulti*	Leschenaults Fruit Bat	Bocha kola Badur			CR
20			*Pteropus giganteus*	Indian Flying Fox	Bara badur			VU
21			*Rhinopoma hardwickei*	Lesser Rat-tailed Bat	Badur			VU
22			*Cynopterus sphinx*	Short nosed Fruit Bat	Badur			VU
23		Vespertilionidae	*Pipistrellus ceylonicus*	KelaartsPipistrelle	KhudiChamchika			C
24	Scandentia	Platanistidae	*Platanista gangetica*	Ganges River Dolphin	Shishu/ Shushuk	EN		C
25		Delphinidae	*Orcaella brevirostris*	Irrawaddy Dolphin	IravatiShisu			
26	Soricomorpha	Soricidae	*Suncus etruscus*	Etruscan Pygmy Shrew	Chika			CR

Notes:

- **IUCN Status (Local):** VU = Vulnerable; EN = Endangered; CR = Critically Endangered; **CITES Status:** I=Threatened with Extinction; II = Tradetobe Controlled to Help Survival; II I= Protected in at Least One Country; **Local Status (Occurrence/abundance):** CR=Common Resident; C = Common; V = Vagrant, UR = Uncommon Resident; RR=Rare Resident

Table 6: List of migratory birds

Sl.	Scientific Name	English Name	Status
1	*Anas acuta*	Northern Pintail	Regular visitor
2	*Anas clypeata*	Northern Shoveller	Regular visitor
3	*Anas crecca*	Common Teal	Regular visitor
4	*Anas falcata*	Falcated Teal	Regular visitor
5	*Anas formosa*	Baikal Teal	Rare visitor
6	*Anas penelope*	Eurasian Widgeon	Regular visitor
7	*Anas platyrhynchos*	Mallard	Regular visitor
8	*Anas querquedula*	Garganey	Regular visitor
9	*Anas strepera*	Gadwall	Regular visitor
10	*Anser anser*	Greylag Goose	Regular visitor
11	*Anser fabalis*	Bean Goose	Rare visitor
12	*Anser indicus*	Bar-headed Goose	Regular visitor
13	*Aythya baeri*	Baer's Pochard	Regular visitor
14	*Aythya ferina*	Common Pochard	Regular visitor
15	*Aythya fuligula*	Tufted Duck	Regular visitor
16	*Aythya marila*	Greater Scaup	Rare visitor
17	*Aythya nyroca*	Ferruginous Pochard	Regular visitor
18	*Marmaronetta angustirostris*	Marbled Duck	Rare visitor
19	*Rhodonessa rufina*	Red-crested Pochard	Regular visitor
20	*Tadorna ferruginea*	Ruddy Shelduck	Regular visitor
21	*Tadorna tadorna*	Common Shelduck	Regular visitor
23	*Fulica atra*	Common Coot	Regular visitor
24	*Porzana porzana*	Spotted Crake	Regular visitor
25	*Porzana pusilla*	Baillon's Crake	Regular visitor
26	*Rallus aquaticus*	Water Rail	Regular visitor
27	*Actitis hypoleucos*	Common Sandpiper	Regular visitor
28	*Arenaria interpres*	Ruddy Turnstone	Regular visitor
29	*Calidris alba*	Sanderling	Regular visitor

Sl.	Scientific Name	English Name	Status
30	*Calidris alpina*	Dunlin	Rare visitor
31	*Calidris canutus*	Knot	Regular visitor
32	*Calidris minuta*	Little Stint	Regular visitor
33	*Calidris ruficollis*	Red-necked Stint	Regular visitor
34	*Calidris subminuta*	Long-toed Stint	Rare visitor
35	*Calidris temminckii*	Temminck’s Stint	Regular visitor
36	*Calidris tenuirostris*	Great Knot	Regular visitor
37	*Calidris ferruginea*	Curlew Sandpiper	Regular visitor
38	*Calidris pygmeus*	Spoonbill Sandpiper	Regular visitor
39	*Gallinago gallinago*	Fantail Snipe	Regular visitor
40	*Gallinago nemoricola*	Wood Snipe	Regular visitor
41	*Gallinago solitaria*	Solitary Snipe	Regular visitor
42	*Gallinago stenura*	Pintail Snipe	Regular visitor
43	*Limicola falcinellus*	Broad-billed Sandpiper	Regular visitor
44	*Limnocryptes minimus*	Jack Snipe	Regular visitor
45	*Limnodromus semipalmatus*	Snipe-billed Godwit	Regular visitor
46	*Limosa lapponica*	Bar-tailed Godwit	Regular visitor
47	*Limosa limosa*	Black-tailed Godwit	Regular visitor
48	*Numenius arquata*	Eurasian Curlew	Regular visitor
49	*Numenius madagascariensis*	Eastern Curlew	Regular visitor
50	*Numenius phaeopus*	Whimbrel	Regular visitor
51	*Philomachus pugnax*	Ruff	Regular visitor
52	*Scolopax rusticola*	Eurasian Woodcock	Regular visitor
53	*Tringa erythropus*	Spotted Redshank	Regular visitor
54	*Tringa glareola*	Wood Sandpiper	Regular visitor
55	*Tringa guttifer*	Nordmann’s Greenshank	Regular visitor
56	*Tringa nebularia*	Greenshank	Regular visitor
57	*Tringa ochropus*	Green Sandpiper	Regular visitor
58	*Tringa stagnatilis*	Marsh Sandpiper	Regular visitor
59	*Tringa totanus*	Common Redshank	Regular visitor

Sl.	Scientific Name	English Name	Status
60	*Xenus cinereus*	Avocet-sandpiper	Regular visitor
61	*Haematopus ostralegus*	Eurasian Oystercatcher	Regular visitor
62	*Recurvirostra avosetta*	Pied Avocet	Regular visitor
63	*Charadrius alexandrinus*	Kentish Plover	Regular visitor
64	*Charadrius dubius*	Little Ringed Plover	Regular visitor
65	*Charadrius hiaticula*	Common Ringed Plover	Regular visitor
66	*Charadrius leschenaultii*	Greater Sand Plover	Regular visitor
67	*Charadrius mongolus*	Lesser Sand Plover	Regular visitor
68	*Charadrius placidus*	Long-billed Plover	Regular visitor
69	*Dromas ardeola*	Crab Plover	Rare visitor
70	*Pluvialis dominicus*	Pacific Golden Plover	Regular visitor
71	*Pluvialis squatarola*	Grey Plover	Regular visitor
72	*Vanellus cinereus*	Grey-headed Lapwing	Regular visitor
73	*Vanellus gregarius*	Sociable Lapwing	Regular visitor
74	*Vanellus leucurus*	White-tailed Lapwing	Regular visitor
75	*Vanellus vanellus*	Northern Lapwing	Regular visitor
76	*Anous tenuirostris*	Lesser Noddy / Whitecapped Noddy	Rare visitor
77	*Chlidonias hybridus*	Whiskered Tern	Regular visitor
78	*Chlidonias leucopterus*	White-winged Tern	Regular visitor
79	*Larus argentatus*	Herring Gull	Regular visitor
80	*Larus brunnicephalus*	Brown-headed Gull	Regular visitor
81	*Larus ichthyaetus*	Pallas's Gull	Regular visitor
82	*Larus ridibundus*	Black-headed Gull	Regular visitor
83	*Stercorarius parasiticus*	Parasitic Skua	Rare visitor
84	*Sterna caspia*	Caspian Tern	Regular visitor
85	*Sterna fuscata*	Sooty Tern	Rare visitor
86	*Sterna hirundo*	Common Tern	Reglar visitor
87	*Sterna sumatrana*	Black-naped Tern	Rare visitor
88	*Podiceps cristatus*	Great Crested Grebe	Regular visitor
89	*Botaurus stellaris*	Great Bittern	Regular visitor

Sl.	Scientific Name	English Name	Status
90	*Ciconia ciconia*	White Stork	Rare visitor

Table 7: List of reptilian species identified in the study areas

No	Order	Family	Species	English Name	Local Name	IUCN	CITES	Local
1	Testudines (Chelonia)	Trionychidae	*Nilssonia gangetica*	Ganges Softshell Turtle	Ganga Kasim	EN		CR
2			*Lissemys punctata*	Spotted Flap-shell Turtle	SundhiKasim	VU		CR
3		Bataguridae/ Geoemydidae	*Morenia petersi*	Yellow turtle	HaldhiKaitta			CR
4			*Geoclemys hamiltonii*	Spotted Pond Turtle	KaloKasim			
5			*Hardella thurjii*	Crowned River Turtle	Kali Kaitta			
6			*Kachuga kachuga*	Red Crowned Roofed Turtle	AdhiKoriKaitta			
7			*Pangshura tecta*	Indian Roofed Turtle	KoriKaitta			CR
8			*Pangshura tentoria*	Indian Tent Turtle	MajhariKaitta	VU		CR
9			*Pangshura smithii*	Brown Roofed Turtle	Vital Kaitta	VU	II	UR
10		Chelonidae	*Chelonia mydas*	Green Turtle	SabujKachim			
11			*Lepidochelys olivacia*	Olive Ridley Turtle	JalpairongaKachim			
12			*Caretta caretta*	Logger-head Turtle	Mugur-mathaKachim			
10	Squamata	Agamidae	*Calotes versicolor*	Common Garden Lizard	Roktochusha			C
11		Scincidae	*Mabuya carinata*	Common skink	Anjon/Anchil		III	CR
12			*Sphenomorphus maculatus*	Spotted Litter Skink	ChitritoBuno Anchil			CR
13		Gekkonidae	*Gekko gecko*	Tokay Gecko	Takkok			C
14			*Hemidactylus brookii*	Oriental Leaf-Toed Gecko	ChotoTiktiki	VU	I	CR
15			*Hemidactylus flaviviridis*	Yellow-bellied House Gecko	GodaTiktiki	EN	I	RR
16			*Hemidactylus frenatus*	Common House Lizard	DakcharaTiktiki			CR
17		Varanidae	*Varanus*	Bengal	PainnaShap	EN		CR

No	Order	Family	Species	English Name	Local Name	IUCN	CITES	Local
			bengalensis	Monitor				
18			*Varanus flavescens*	Yellow Monitor	HaldeyGui-Shap	EN		CR
19		Colubridae	*Amphiesma stolatum*	Striped Keelback	Dora-shap	EN		UR
20			*Atretium schistosum*	Olive Keelback	Mete-Shap			C
21			*Enhydris enhydris*	Common Smooth Water Snake	Paina-shap	EN	II	C
22			*Lycodon aulicus*	Common Wolf Snake	ShadaraonGharginniShap	VU	II	RR
23			*Xenocrohis piscator*	Checkered Keelback Water Snale	DhoraShap			
24			*Ptyas mucosus*	Indian Rat Snake/Western Rat Snake	DarajShap		I	UR
25			*Dendrelaphis pictus*	Dora GechoShap	Common Bronzeback tree snake			
26		Elapidae	*Naja kaouthia*	Monocllate Cobra	GokhraShap	VU		
27			*Naja naja*	Spectacled Cobra	KhoiaGokhra Shap	VU		
28			*Bungarus caeruleus*	Common Indian Krait	Kalkeotey	VU		
29			*Bungarus fasciatus*	BandedKrait/	ShankaniShap	EN		
30		Typhlopidae	*Typhlops jerdoni*	Jerdons Blind Snake	ShoroDumukha Shap		II	CR
31			Typhlopidae	*Typhlops acutus*	Blind Snake	NO		
32	Crocodylia	Crocodylidae	*Gavialis gangeticus*	Gharial	Ghot Kumir/ Ghorial	EN		

Notes:

- **IUCN Status (Local):** VU = Vulnerable; EN = Endangered; CR = Critically Endangered
- **CITES Status:** I=Threatened with Extinction; II=Trade to be Controlled to Help Survival; III=Protected in at Least One Country
- **Local Status (Occurrence/abundance):** CR = Common Resident; C = Common; UR = Uncommon Resident; RR = Rare Resident

Annex G: Resettlement Policy Framework

Government of The People's Republic of Bangladesh
Ministry of Shipping

Bangladesh Regional Waterway Transport Project 1
(Chittagong-Dhaka-Ashuganj Corridor)
World Bank-Assisted

Resettlement Policy Framework (RPF)


February 2016

Bangladesh Inland Water Transport Authority (BIWTA)

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Glossary of Terms

AD	Alluvion-Diluvion
ARIPO	Acquisition and Requisition of Immovable Property Ordinance
BBS	Bangladesh Bureau of Statistics
BIWTA	Bangladesh Inland Water Transport Authority
BP	Bank Policy
CCL	Cash Compensation under Law
CENA	Capacity Enhancement Needs Assessment
CLAC	Central Land Allocation Committee
CMP	Current Market Price
DC	Deputy Commissioner
DEPTC	Deck and Engine Personnel Training Centre
DoA	Department of Agriculture
DoF	Department of Fisheries
EA	Environmental Assessment
EC	Entitlement Card
ECoPs	Environmental Code of Practices
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMIS	Environmental management Information System
EP	Entitled Person
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGD	Focus Group Discussions
GMP	Gender Mainstreaming Plan
GoB	Government of Bangladesh
GP	Gram Parishad
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
HCG	House Construction Grant
HDA	Homestead Development Allowance
HH	Households
HIES	Household Income and Expenditure Survey
IDA	International Development Association
ILO	International Labour Organization
INGO	Implementation NGO
IWM	Institute of Water Modelling
IWT	Inland Water Transport
KII	Key Informants Interview
LA	Land Acquisition
LAD	Least Available Depth
LAP	Land Acquisition Proposal
MEAL	Monitoring Evaluation Audit Learning
MoL	Ministry of Land
MoS	Ministry of Shipping
NGOs	Non-governmental Organizations

PAPs	Project Affected Persons
PAVC	Property Assessment and Valuation Committee
PBCs	Performance-Based Contracts
PCR	Physical Cultural Resources
PFS	Price of Fish Stock
PMU	Project Management Unit
PWD	Public Works Department
RA	Rental Allowance
RAP	Resettlement Action Plan
RIS	River Information Systems
RPF	Resettlement Policy Framework
RSC	Resettlement Sub-committee
SIA	Social Impact Assessment
SMP	Social Management Plans
STG	Structure Transfer Grant
UP	Union Parishad
VNR	Vested Non-Resident
WB	World Bank

Executive Summary

Introduction

The proposed 'Bangladesh Regional Waterway Transport Project 1' aims to develop the IWT routes and infrastructure between Chittagong – Dhaka – Ashuganj IWT Corridor, including branches to Ghorashal (via Narayanganj) and Barisal. The World Bank is considering financing of this Project. The implementing agency for this project is Bangladesh Inland Water Transport Authority (BIWTA). The key components of this project with potential environmental impacts are the following:

Component 1: Improved Inland Waterway Navigation (US$ 215 million)
Component 2: Improved Services at Priority Inland Waterway Terminals and Landing Ghats/Stations (US$75 million)
Component 3: Institutional Capacity Development and Sustainability (US$ 70 million)

Social Impact Assessment

For Component 1 on improvement of inland water ways, a detailed Environmental and Social Impact Assessment (ESIA) has been prepared. This Resettlement Policy Framework (RPF) is developed to (i) ensure all relevant social issues are mainstreamed into the design and implementation of the proposed subcomponents or subprojects. This details the guidelines to be followed for the major activities to be carried out for SIA (including RAP) of specific subprojects. The preparation of RPF has used a time tested methodology of review, data collection, analysis, consultation and framework preparation. This RPF is applicable for the whole project covering all 3 components.

Policy and Regulatory Framework

In Bangladesh Land acquisition is governed by the Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance II of 1982). There is no national policy in Bangladesh governing social effects of infrastructure development projects on the project area communities. However, the Constitution of Bangladesh provides some rights to the affected persons, communities and groups those are not upheld in the Ordinance II of 1982. The other relevant acts are National Land use Policy, 2001, Bangladesh Labour Act 2006, etc.

Among the World Bank Safeguards, from a social perspective, the Involuntary Resettlement (OP/BP 4.12) is triggered. This policy includes safeguards to address and mitigate the impoverishment risks due to involuntary resettlement. From the social safeguards perspective, the other triggered polices are, public consultation and disclosure requirements of The World Bank, which needs to be met with.

Overall Project and Components

The Chittagong – Dhaka – Ashuganj Regional IWT Corridor Project (the Project) consists of the three components; 1) Improved Inland Waterway Navigation (US$ 215 million), 2) Improvements in Terminals and Landing Stations (US$ 75 million) and 3) Institutional Capacity Development and Sustainability (US$ 70 million). The typical facilities to be built at these terminals on the water side will include bank protection works, jetties and pontoons; and on the landside will include office buildings, passenger facilities, parking areas and widening of access roads. The facilities shall specifically incorporate the needs of women users (such as toilet facilities for women, women-only waiting rooms) and less abled users, and address safety-related issues for all users. All terminals will be provided with separate ticket counters, waiting rooms and toilets for women passengers, and ramps for movement of disabled peoples. The typical facilities to be built at cargo terminals on the water side will include bank protection works and jetties; and on the landside will include office buildings, passenger facilities, parking areas and widening of access roads. All terminals will be provided with separate ticket counters, waiting rooms and toilets for women traders, and ramps for movement of disabled peoples. All the landing stations will be provided with drinking water facilities, and separate waiting rooms and toilets for women passengers.

The engineering designs and ESIA studies for the Component 2 works will be carried out during the first year of implementation of the Project and civil works will be carried out over a period of four years after completion of the engineering designs. The overall cost of the Project is US$ 360 million, and cost of the Component 2 works is 75 million US$.

Socio-Economic Baseline

Bangladesh's geographical Location is at Latitude between 20°34' and 26°38' North and Longitude between 88°01' and 92°41' East. Bangladesh has an area of 147,570 sq. km. (land: 133,910 sq km, water: 10,090 sq km). It has a coastline of 580 km. Bangladesh has 7 Divisions; Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Barisal and Rangpur, 64 Districts and 487 Sub districts/Upazillas. The project area passes through 10 Districts covering 17 Upazilas (Sub-district) including Dhaka.

Bangladesh has a population of 150 million (2011 Census Report by BBS). The present Population Growth Rate of Bangladesh is 1.59%. The present literacy rate is about 50% among which the male literacy is 50% and female literacy is 46%. Bangladesh is predominantly a Muslim populate (86.6%) followed by Hindus (12.1%), Buddhists (0.6%), Christians (0.4%) and others (0.3%). The sex ratio is 99.68%. The predominant ethnic group is Bengalis (98%) followed by other indigenous minority (2%) including Chakmas, Marmas, Santals, Garos, Manipuri, Tripura, and Tanchangya. The GDP is $1,044 (per capita in 2013). The poverty level is at 25% (People living with $2 per day).

The principal rivers are Padma, Meghna, Jamuna, Surma, Brahmaputra, Most parts of Bangladesh are less than 12 m (39.4 ft) above sea level, and it is estimated that about 10% of the land would be flooded if the sea level were to rise by 1 m (3.28 ft). The temperature ranges are in winter 11° C - 20° C (October - February) and in summer 21° C - 38° C (March - September). The rain fall range is 1,100 mm to 3,400 mm (June - August). The Humidity is highest 99% (July) and lowest 36% (December & January).

The principal crops are Rice, Jute, Tea, Wheat, Sugarcane, Pulses, Mustard, Potato, Vegetables. The Principal Industries aer Garments & Textiles (2nd largest in the world), Tea, Ceramics, Cement, Leather, Jute (largest producer in the world), Chemical, Fertilizer, Shrimp Processing, Sugar, Paper, Electric and Electronics, Medicine, Fishing.

Most of the people near river side depend on their sources of livelihood by river correlated activities. Here the major sources of livelihood are carrying people and goods by boat, day laboring, selling of vegetables and other raw materials, selling clothes, rickshaw or van pulling, whole and retail selling of fruits, etc. There are a huge number of hotels/ restaurant in this ghats.

At the vessel shelter locations, the survey finds that 13.22% people are leading their livelihood by business, 1.99% by rickshaw or van puller, 7.25% by fishing (fisherman). Almost all of the sampled female population (33.15%) are housewives, except 0.18% teacher and 0.54% fisherwomen.

At the ferry ghats, 19.23% of the sampled population is businessmen, 7.07% are rickshaw or van pullers, 1.11% are boatmen, 7.22% are fishermen and many other common occupational groups. There are also 34.07% women who are housewives, this is similar to the vessel shelters and launch routes. About 8.89% of people are unemployed in the locatinos.

Similar other regions of this lower middle income country, in the project area too, the efforts of women in socio-economic development and well-being of their family and surroundings is rather unrecognized. The study findings indicate that the project sites offer minimal opportunities to women. In addition to that, the study also reveals that decision making role of women in the household is negligible with only 1.03% households being headed by women. On the contrary, better communication and transport facility may create more choices for their economic pursuit. Majority of the participants believed that the project will bring more employment opportunities to women in addition to education, which will play a role in gender balance and enhance their role in business. Other than that, some respondents also highlighted that with better transport and communication facility, women will be able to receive better medical facility and overall situation for women will be developed.

Consultations

Field surveys, consultations with different stake holders, a national consultation workshop and two regional public consultations were carried out to develop a comprehensive Resettlement Policy Framework (RPF) for the Project. All the stakeholders and community correspondents appreciated the project. The concern of the consultation participants were mainly focused on improvement and extension of terminals, safety and security of passengers, impact on livelihood, dredging and environmental issues including management of dredged materials.

Impacts

Most of the terminals are on GoB land, but proposed launch terminal facilities will require approximately **2.093** ha land acquisition. The proposed 06 vessel shelters are planned to be constructed on public land to avoid any negative impacts on the population near project sites. At most of the project locations, land belongs to BIWTA. This land is used for common purposes such as Ghats for boats, by the nearby communities. There are Persons without title to the land on the BIWTA land with shop and residences. Places of worship are built on BIWTA Land. BIWTA has built shops and leased them to shop keepers. This will lead to loss of livelihoods. At some locations access to common property resources such as Burial grounds will get restricted due to the present interventions. At some locations access granted to cultural practices such as immersion of ashes of the dead in rivers at certain ghats, will be impacted. Further access infrastructure such as roads will cause impacts as the present roads are narrow and they need to be widened for optimizing the capacity of the facilities built.

As per the ESIA, there are no small ethnic communities; indigenous people, at the project locations.

The key social impacts due to project interventions are Land acquisition and subsequent resettlement, Loss of Livelihoods, Inconvenience and nuisance during construction, Loss of access to CPRs and Likely increase in transport costs.

For each of these sub-projects an RAP will be prepared, where required during the planning and design stage. The following social management measures are proposed in this Resettlement Policy Framework:

- Development and adopting a Resettlement Policy Framework (RPF) to be used for all sub-projects under this project. This RPF should serve as a guide for further SIA studies and for preparation of RAPs/ ARAPs under this project.
- Integrate the rehabilitation of livelihoods into design of terminals and other infrastructure facilities. Designs to consider the following:
    - Livelihoods: such as integrating shops and vendors
    - Facilities for women such as: separate counters, waiting areas, sanitation, seating arrangements
    - Facilities for disabled
    - Arrangements to continue cultural practices
    - Design and general arrangement to be ready for impact identification and resettlement plan preparation
- Alternate temporary transit arrangements before resettlement
- Resettlement Policy Framework with clear entitlements
- Grievance Redressal Mechanism
- Community Engagement in planning and implementation
- Gender Mainstreaming Plan
- Disclosure: disclosure of resettlement plans

Resettlement Policy Framework

The primary objective of this RPF is to improve the standard of living of the affected population. The other objectives of this RPF are to; a) Ensure the principles of Social Justice is adhered to at all times, b) Avoid or minimize any negative impacts on the communities, c) If land is required for project facilities, then same may be purchased under Willing Buyer-Willing Seller norm, d) Assist affected population in improving their living standards, income earning capacity, and production levels, etc., e) Encourage and enable community participation in planning and implementing project components and f) Provide assistance to affected communities in redressing their grievances.

This RPF addresses social issues such as Land Procurement, Community Engagement, Special Attention to Women and Other Vulnerable Groups and Grievance Redressal.

This RPF specifies procedures for a) Buying Land under Willing Buyer and Willing Seller concept and registration and mutation of records and b) for land Acquisition using National Policy. When land needs to be acquired as per the Act, the RPF has set the procedures to be followed by project. Compensation norms are set ensuring that the properties (land, structure, and non-structured assets) to be affected by the project will be compensated at their full replacement cost determined by a legally constituted Resettlement Sub-committee (RSC) as per structure and mandated outlined in the RAP. The payment of compensation and other assistance, target replacement of productive assets and restoration of loss of income and workdays by the relocated households, especially the vulnerable households will be ensured by this committee. Compensation and other cash assistance will be paid through bank bills (cheques) payable to Bank accounts opened by the affected persons eligible for compensation and assistance under RAP. The Bank account will be in the joint name of husband and wife as the case may be. Compensation under law (CUL) will be paid through two different channels as per provision of RAP. CUL will be paid by Deputy Commissioner mandated for acquisition of land for the PMU while PMU will directly pay the remaining as per requirement of the RAPs directly to the project affected persons. PMU with the help of the project consultants will advise, assist, and monitor the affected persons receiving compensation and other cash assistance for better use of the money.

Regardless of their tenure status to the lands used for project component, the project affected persons/ households will be eligible for compensation and assistance. All PAPs irrespective of their title will be entitled to compensation and assistance based on loss and impact categories identified through census survey in respect of the policy guidelines adopted for the project. Nevertheless, eligibility to receive compensation and other assistance will be limited by the cut-off date. The absence of legal title will not bar PAPs from compensation and assistance, as specified in the entitlement matrices. An Entitlement Matrix has been prepared for the project on the basis of field study and consultation with government officials as a part of preparing the resettlement policy framework. A person could be eligible for compensation/entitlement in more than one category of losses and in more than one mouza. DCs will pay CCL for each mauza separately for one person whose lands/assets have been acquired in more than one mauza.

Community Engagement, Stakeholder participation and Vulnerables

BIWTA will ensure the engagement of target communities through continued consultations for planning and full community management of implementation and monitoring of sub-project activities. Consultations will be held at regular intervals with target communities, GS/ GP members, Women, etc.

BIWTA recognizes the fact that affected communities are primary and key stakeholders of the project. Hence, the BIWTA would ensure that these stakeholders are consulted on issues and they participate in all the sub-project activities including planning and implementation. The BIWTA would address the legitimate concerns of community members and provide opportunities and avenues for consultation and their participation. In order to provide a sense of ownership and ensure sustainability, the community members would be a part of the decision making process. The project has a commitment for community participation in each of the sub-projects taken up.

The vulnerable groups include Women Headed Households, Destitutes, Below Poverty Line families, Old Aged, Differently Abled, Chronically Ill and Orphans. It is envisaged that in the course of conducting Social Assessment and preparing and implementing Social Management Plans, interests of these vulnerable groups would be adequately addressed and protected.

Grievance Redressal

The Project will establish a project level Grievance Redress Mechanism (GRM) which will be implemented by Project Implementation Unit (PIU) at BIWTA with an aim to respond to queries or clarifications about the project, resolve problems with implementation and addressing complaints and grievances. The GRM will focus on corrective actions that can be implemented quickly and at a relatively low cost to resolve identified implementation concerns before they escalate to the point of harm or conflict. GRM will serve as a channel for early warning, helping to target supervision to where it is most needed and identify systemic issues. The GRM will directly focus on and seek to resolve complaints (and requests for information or clarification) that pertain to outputs, activities and processes undertaken by the Project, i.e., those which (i) are described in the Project Implementation Manual; (ii) are funded through the Project (including counterpart funds); and (iii) are carried out by staff or consultants of the organization, or by their partners and sub-contractors, directly or indirectly supporting the project.

GRM will be implemented in two phases: 1) Phase 1 to support safeguards implementation, 2) Phase two of GRM will cover all components and overall project implementation. A formal grievance redress process for phase two will be outlined in the project's operational manual and a protocol will be set up and distributed to project staff and implementers. The project level protocol will build on existing GRM system developed by BITWA and experience of the initial GRM protocol which supports implementation of the safeguards explained below. The GRM will be IT based supported by toll free helpline. It is envisage that the Project Implementing Unit (PIU) will have a dedicated person who can oversee the preparation of the guidelines and rollout of the project GRM. The Secretary of BITWA will be responsible for overseeing the overall GRM.

The aggrieved parties will access to legal system. Information on how to submit complaints to the World Bank's Grievance Redress Service is available at http://www.worldbank.org/GRS. Information on how to submit complaints to the World Bank Inspection Panel is available at www.inspectionpanel.org.

Institutional Arrangements

BIWTA will arrange for RPF/ RAP/ ARAP implementation and monitoring mechanism. The Project Implementation Unit (PIU) will have a Environmental and Social Cell in the PIU. A Joint Director of BIWTA will head the Environmental and Social Cell of BIWTA. Two Deputy Directors, one each in charge for Environment and Social aspects of the project. The Deputy Director Social will be assisted by a Senior Land Acquisition and Resettlement Specialist and two other consultants each in charge for Community Engagement and Gender. The ESIA consultants will conduct ESIAs for sub-projects and prepare RAPs. The Supervision Consultants and Contractors will have Environmental and Social Specialists to supervise and implement RAP/ARAP provisions. NGOs will be commissioned for implementation of RAPs/ ARAPs. M&E Consultants will do the quarterly monitoring and mid-term and end-term impact evaluation and assessments.

An M&E Consultants will be commissioned to conduct quarterly monitoring and evaluation and report to BIWTA. They will visit about an appropriate percentage of all category sub-projects, as decided by BIWTA. The M&E Consultants will conduct mid-term and end-term evaluation of RAPF/ RAP/ ARPA implementation. BIWTA will send quarterly Monitoring Reports on RPF compliance to The World Bank.

The total administrative budget for RPF implementation and social management activities under this project has been worked out as US$. 3.8 Million. These costs need to be included in the respective sub-projects' budgets.

1. Introduction

1.1 Introduction

Bangladesh lies predominately within the Bengal basin, the world's largest delta formed by Ganges, Brahmaputra (Jamuna) and Meghna river system and its tributaries and distributaries. Its riverine area covers some 9,384 sq. km and includes some 700 rivers, streams and canals with a total length of about 24,000 km. Of this, approximately 5,923 km have been classed and are navigable during the monsoon (wet) period, shrinking to about 3,865 km in the dry periods- mainly on those parts of the rivers subjected to tidal influence. Navigation is complicated by the braided nature of the rivers, which are characterized by high sediment delivery and - due to extremely low gradients - very low sediment throughput. This makes the rivers extremely sensitive to flooding with rapid geometry (boundary and channel) changes. Problems of navigation are compounded by the growth of inland water vessel size and the Inland Water Transport (IWT) fleet now comprises dry and liquid bulk ships of up-to 3,000 deadweight tons, mainly trading on the class 1 river routes. Moreover, the size of the IWT fleet is growing and currently there are over 22,300 registered vessels which carry over 50% of all freight traffic and one quarter of all passenger traffic. In addition, there are some 750,000 country (traditional) boats, a substantial part of which have been mechanized. Approximately 65% of these are passenger boats, where demand is predominantly generated by rural communities, a substantial proportion of which only has access to river transport.

1.2 Project Background

Dhaka – Chittagong and Dhaka - Ashuganj IWT Corridors are highest priority routes for domestic trade and Bangladesh-India bilateral trade. About 80% of country's IWT transport is routed through these corridors and daily about 200,000 passengers use these routes. Inland river terminals (ports) at Dhaka, Narayanganj, Chandpur and Barisal along these routes play very important role in transporting and handling passenger and cargo. The annual passenger and trade volumes in these routes are given in Table 1. Food grains, fertilizers and consumer goods are the main commodities which are transported by cargo vessels and cargo-cum-passenger launches. The cargo terminal at Ashuganj is a key terminal for Bangladesh–India trade and it is connected by road to the north eastern states of India.

Table 1: Annual Passenger and Cargo Details in Major River Ports

Port	2011-2012		2012-2013		2013-2014	
	Passenger (in million)	Cargo (in million tonne)	Passenger (in million)	Cargo (in million tonne)	Passenger (in million)	Cargo (in million tonne)
Dhaka (Sadharghat)	*19.05*	*6*	21.11	6.7	*20.55*	*7.53*
Narayanganj	23.13	10.53	22.72	12.76	24.17	13.61
Chandpur	2.1	0.42	2.27	0.47	2.28	0.5
Barisal	5.75	0.6	5.81	0.66	6.47	0.68

Source: BIWTA

The facilities built at these terminals are not sufficient to meet the growing demand of IWT as they lack in adequate facilities for berthing, parking and storage areas, and passenger comfort. The port facilities at Sadharghat terminal at Dhaka and surrounding areas are highly congested with commercial and residential development leading to traffic congestion and inefficient use of port facilities, and also there is no space around the current terminal for further expansion. The Government of Banlgadesh (GoB) would like to augment and facilities at Sadhargaht terminal in Dhaka by building a new passenger terminal at Shashanghat, develop a cargo terminal at Panagaon, and augment and modernize the existing facilities at Ashuganj, Narayanganj, Chandpur and Barisal river terminals.

In addition to river terminals, there are a number of landing stations along Dhaka-Chittagong – Ashuganj corridor which are very important for people living in the rural and remote areas. The landing stations (also known as launch ghats) are berthing points of high importance for the local communities that they serve, yet lack proper infrastructure and other essential facilities such as toilets and drinking water, as well as basic safety features for users, and many are in a highly dilapidated state. They usually consist of one pontoon with shore connection to embark and debark passenger and cargo. They play an important role in the lives of the rural people, as without them vessels would not berth and they would not receive much needed food, medicines, fuel and other consumer essentials.

1.3 The Proposed Project

The project will provide US$ 360 million in IDA funds to finance interventions aimed at improving IWT for cargo and passengers along the heavily trafficked Chittagong-Dhaka-Ashuganj Regional Corridor. Main interventions include: navigation channel maintenance and improvement; navigation safety improvements; the construction and modernization of select river terminals; development of River Information Systems (RIS); institutional capacity development; and, funding for research and development and feasibility studies for continuing sector improvement to ensure future IWT sustainability. This includes work on sector policies and strategies needed to: improve revenue collection and management; incentivize public and private sector investments especially related to container transport; and, mitigate and improve IWT's impact on the social and physical environment. The Project consists of three components as follows:

1.3.1 Component 1: Improved Inland Waterway Navigation (US$215 million)

This component shall include work to maintain and increase advertised depths and to delineate channel routes through provision of long-term navigation Performance-Based Contracts (PBCs). The 6 or 7-year Performance-Based Contracts will depart from the current practice of payments based on dredging volume which is unreliable and does not assure depth, and instead commits the contractors to guarantee Year-Round Least Available Depth. A Supervision/Performance Monitoring Consultant will be contracted to monitor the performance of the contractors for the PBCs. Only selective and limited dredging of problem areas such as on chars and sand bars is expected to maintain navigability as most of the river route has the required depth. In addition, six vessel shelters will be developed within remote cyclone areas on the Project Corridor route allowing vessels to seek shelter from inclement weather.

1.3.2 Component 2: Improved Services at Priority Inland Waterway Terminals and Landing Ghats/Stations (US$75 million)

This component supports the development of two cargo terminals, four passenger terminals and 14 landing ghats. The facilities shall specifically incorporate the needs of women users (such as toilet facilities for women, women-only waiting rooms) and less abled users, and address safety-related issues for all users. BIWTA will also make suggested changes to operational guidelines to improve safety and using inland water transport services. All investments under this component will also aim to enhance the climate change resiliency of terminals and landing stations, such as through design adaptations to account for the expected increased variation in river flows, more intense or frequent extreme storm events, etc.

The cargo terminals include: (i) development of a new common user general cargo terminal with access infrastructure at on the Buriganga River adjacent to the existing Pangaon container terminal; and, (ii) Rehabilitation and modernization of the existing general cargo terminal at Ashuganj.

The passenger terminals include: (i) the development of a new passenger terminal at Shashanghat in Dhaka District; (ii) rehabilitation of the passenger terminal at Narayanganj; (iii) rehabilitation of the passenger terminal at Chandpur; and, (iv) extension of the existing passenger terminal at Barisal.

1.3.3 Component 3: Institutional Capacity Development and Sustainability (US$70 million)

A series of activities are proposed that will support BIWTA's overall enhancement of its management systems and human resources capacity for modern, efficient, and high quality management of the IWT sector in line with international standards. This in turn is critical for the long-term sustainability of the investments supported through the project, as well as the sector's ongoing attractiveness to users, its potential for green innovations in support of national climate mitigation targets, and its resilience to changing conditions including those posed by climate change. Activities to be supported include: (i) the development of River Information Systems to help BIWTA improve data collection for the planning, maintenance and development of IWT, as well as enhance climate resiliency of the IWT sector in Bangladesh by creating a more systematized baseline understanding of river hydrology and navigational implications, and provision of a Traffic Monitoring System for passengers and cargo; (ii) improvement of Human Resources capacity for better management of the IWT sector through upgrading and modernizing the IWT Deck and Engine Personnel Training

Centre (DEPTC)) into a regional IWT Training Center with open access to all users in the Region and the world; (iii) commissioning of a study to propose an institutional structure and reforms needed to develop an effective Search and Rescue organization; (iv) support for environmental and social sustainability, climate change resiliency, and "greening" of IWT; (v) a project preparation facility to finance feasibility, surveys, design and safeguards studies for continuous sector development; and, (vi) support for the Project Management Unit including the hiring of key staff and procurement of selected systems needed for implementation of the Project.

1.4 Social Impact Assessment of the Project

For Component 1 on improvement of inland water ways, a detailed Environmental and Social Impact Assessment (ESIA) has been prepared and presented separately. For other project activities with potential safeguards implications – including improvement of river terminals and landing stations (Component 2), minor civil works associated with modernization of the DEPTC, and the water hyacinth biogas pilot, river training pilots, vessel fleet greening pilots, and future project preparation studies (Component 3) -- given that these interventions will be designed in detail only during project implementation, the social assessment has been carried out using a framework approach. A Resettlement Policy Framework (RPF) and Environmental Management Framework (EMF), which is presented separately, have been developed to (i) ensure all relevant environmental and social issues are mainstreamed into the design and implementation of the proposed subcomponents or subprojects under Component 1 (dredging, navigational aids and cyclone vessel shelters) Component 2 (terminals and landing stations), Component 3 (DEPTC training center modernization, various IWT sustainability pilot schemes and future project preparation), (ii) consider in an integrated manner the potential environmental and social risks, benefits and impacts of the proposed subprojects and identify measures to avoid, minimize and manage risks and impacts while enhancing benefits, (iii) ensure compliance with national and World Bank requirements, and (iv) guide conducting the detailed ESIAs of the subprojects where required.

This RPF presents detailed guidelines for the major activities to be carried out for SIA (including RAP) of specific subprojects that have not yet been fully designed and planned during the project preparation stage, and for which construction will only get underway in year 2 or beyond of project implementation. These guidelines include: (i) Social Screening (identification of possible impacts) (ii) Description and establishment of "Social Baseline" against which impacts of the proposed sub-project would be evaluated after identifying influence area for different sub-projects; (iii) analysis of alternatives; (iv) identification of major sub-project activities during both construction and operational phases; (v) assessment, prediction and evaluation of impacts of project activities on the social baseline; (vi) carrying out public consultations; and (vii) identification of mitigation measures and preparation of impact specific Social Management Plans (SMP) and/or Resettlement Action Plans (RAPs) including monitoring requirements.

More specifically, the present RPF includes the following coverage for Components 1, 2 and 3 of the proposed project:

- For Component 1 activities, consultants have already carried out an overall ESIA for dredging and navigational aids activities. For cyclone shelters, the required ESIA is included in the ESIA to be carried out for component 2 (as given in below bullet point) activities.
- For Component 2 activities, consultants (independent from design consultants) will be hired by BIWTA to carry out the detailed SIAs of river terminals and landing stations. Terms of reference for carrying out these SIA studies are given in Annex 2 for terminals and in Annex 3 for landing stations. The detailed scope of work for river terminal and landing works for SIA studies are given in Annex 4
- For additional activities under Component 3 with potential safeguards implications, this RPF outlines basic screening criteria, assessment process, and institutional responsibilities and budget to ensure that appropriate management measures are defined, incorporated into design and implemented and monitored as applicable. Expected issues for these components are as follows:
- For the potential minor civil works under Component 3 related to upgrading/retrofitting and modernizing the existing DEPTC, specific scope of activities is not yet defined, but is expected to entail only minor interior renovations and installation of equipment within existing building footprints. As such, a full SIA is not expected to be necessary. Nonetheless, basic Social Management Plans presented in this RPF needs to be implemented. Activities such as the water hyacinth biogas pilot, river training pilots, and vessel fleet greening pilots – potential negative impacts are expected to be minor given the small pilot scale of the investments. Nonetheless, this RPF lays out the requirements to ensure that appropriate screening, and implementation of relevant social management and mitigation measures as necessary, will be carried out.
- Future project preparation studies under Component 3 will meanwhile not themselves cause environmental or social impacts; however, the future investment activities which may follow from the studies – including river maintenance dredging or other investments on additional IWT corridors in Bangladesh -- would likely entail impacts. Therefore, in parallel to detailed feasibility and design studies, independently commissioned ESIA studies in line with applicable World Bank safeguard policy and national requirements on environmental and social assessment and mitigation will be carried out through this project. This RPF specifies the institutional mechanisms to ensure this.

1.5 RPF Study Methodology

This RPF has been prepared by Bangladesh Inland Water Transport Authority under the guidance of Ministry of Shipping[1], Government of Bangladesh.

The methodology followed in preparing the RPF for Component 2 activities (river terminals and landings) consists of the following steps:

- Review of the project details and meeting/discussions with various stakeholders including local communities
- Review of the policy and regulatory requirements
- Reconnaissance field visit and initial scoping and screening of the identified proposed investment sites to determine the key social parameters and aspects that are likely to be impacted by the project activities
- Collecting and analysis of baseline social data with the help of secondary literature review and field data collected under Component 1
- Consultations with the stakeholders including beneficiary/affected communities and developing the consultation process
- An initial assessment of the potential and likely impacts of the project activities
- Prepare an outline social management plan
- Compilation of the present RPF.

Since the details of the scope of proposed activities under Components 3 are mostly not specified at this stage, the methodology for developing RPF sections on these components is proportionally more simplified, with primary focus on the concepts of social assessment and management to be followed.

1.5.1 Contents of the RPF Report

Chapter 2 reviews the prevailing WB policies and national regulatory requirements relevant to social assessment. Chapter 3 presents a simplified description of the project, its various components and other salient information relevant for social assessment. Description of the baseline social conditions is presented in Chapter 4. Screening and assessment of potential social issues as well as the appropriate mitigation measures to address these negative impacts have been presented in Chapter 5 under the Resettlement Policy Framework (RPF). Finally, Chapter 6 includes the data sheets, formats, terms of references, etc. under annexures.

[1] The MoS has appointed Dr. Bokepalli Kanaka Durga Raja, an individual International Social Consultant to help prepare the RPF.

Figure 1: Locations of Proposed Terminals and Landing Stations in Component 2 of the Project

2. Policy and Regulatory Framework

2.1 Introduction

This chapter deals with the laws, regulations and policies, of Government of Bangladesh, and the World Bank, related to social issues. Only the laws, regulations and policies relevant to the project are discussed here. This sections needs to be updated as when new laws, regulations and policies are made and enforced or the existing ones are revised.

2.2 Social Policies, Laws and Regulations of GoB

Infrastructure development projects using lands in Bangladesh are designed and implemented under the legislative and regulatory framework to compensate the affected persons due to land acquisition using the power of eminent domain. Whenever it appears to the Government that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, the property is acquired using existing laws and regulations. Land acquisition is governed by the Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance II of 1982). This ordinance supersedes earlier laws including the Land Acquisition Law of 1894 and others that have been in force between 1947 and 1982. There is no national policy in Bangladesh governing social effects of infrastructure development projects on the project area communities. However, the Constitution of Bangladesh provides some rights to the affected persons, communities and groups those are not upheld in the Ordinance II of 1982 which is the instrument followed for land acquisition. The active instruments under the legislative and regulatory framework in Bangladesh are discussed below:

2.2.1 Constitutional Provisions

The fundamental rights under the Constitution indicate the general guidelines for a policy on resettlement/rehabilitation of citizens adversely affected (whatever be the mechanism) due to any activity of the State. Article 40 of the constitution states categorically that every citizen has the right to practice any lawful occupation which implies that anything impeding such right (a) should not be done or (b) there should be supplementary measures to make good the losses incurred by the citizen. Resettlement and rehabilitation of adversely affected people due to infrastructure projects very clearly falls within this requirement for supplementary measures. However, as per Article 42, sub-clause 2, no law with provision of compensation for acquisition of land can be challenged in a court on the ground that such compensation has been inadequate. However, under World Bank OP 4.12 Involuntary Resettlement, every affected person will have access to a project specific Grievance Redress Mechanism for dispute resolution before the matter is moved to the courts. Complaints, the resolution process and the outcome will be reviewed by the project proponents as well as the Bank. Until the dispute is resolved the funds for the disputed asset must be held in an escrow account (top-up payments due from the project agency can be held until the project closes; the amount placed with the DC may be held for 10 years or more if necessary).

2.2.2 The Acquisition and Requisition of Immovable Property Ordinance, 1982

The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance, 1982 (Ordinance II of 1982 with amendments up to 1994) and other land laws and administrative manuals relevant to land administration in Bangladesh. According to the Ordinance, whenever it appears to the Government of Bangladesh that any property in any locality is needed or is likely to be needed for any public purpose or in the public interest, the Government can acquire the land provided that no property used by the public for the purpose of religious worship, graveyard and cremation ground. The 1982 Ordinance requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, houses); and (ii) any other damages caused by such acquisition. The Deputy Commissioner (DC) determines (a) market value of acquired assets on the date of notice of acquisition (based on the registered value of similar property bought and/or sold in the area over the preceding 12 months), and (b) 50% premium on the assessed value (other than crops) due to compulsory acquisition. The 1994 amendment made provisions for payment of crop compensation to tenant cultivators. The law specifies methods for calculation of market value of property based on recorded prices obtained from relevant Government departments such as Registrar (land), Public Works Department (structures), Department of Forest (trees), Department of Agriculture (crops) and Department of Fisheries (fish stock). Given that people devalue land during title transfer to minimize tax payment, compensation for land paid by DC including premium largely remains less than the actual market price.

The Ministry of Land (MOL) is authorized to deal with land acquisition. The MOL delegates some of its authority to the Commissioner at Divisional level and to the Deputy Commissioner at the District level. The Deputy Commissioners (DCs) are empowered by the MOL to process land acquisition under the Ordinance and pay compensation to the legal owners of the acquired property. Khas (government owned land) lands should be acquired first when a project requires both khas and private land. If a project requires only khas land, the land will be transferred through an inter-ministerial meeting following the acquisition proposal submitted to DC or MOL as the case may be. The DC is empowered to acquire a maximum of 50 standard bigha (6.75 ha) of land without any litigation where the Divisional Commissioner is involved for approval. Acquisition of land more than 50 standard bigha is approved from the central land allocation committee (CLAC) headed by the chief executive of the Government of Bangladesh proposed by the MOL.

The land owner needs to establish ownership by producing record-of-rights in order to be eligible for compensation under the law. The record of rights prepared under

143 or 144 of the State Acquisition and Tenancy Act 1950 (revised 1994) are not always updated and as a result legal land owners have faced difficulties trying to "prove" ownership. The affected person has also to produce rent receipt or receipt of land development tax, but this does not assist in some situations as a person is exempted from payment of rent if the area of land is less than 25 bighas (3.37 ha).

2.2.3 Other Relevant Acts

2.2.3.1 National Land-use Policy, 2001

The Government of Bangladesh has adopted national Land use Policy, 2001. The salient features of the policy objectives relevant to the proposed are as follows:

- To prevent the current tendency of gradual and consistent decrease of cultivable land for the production of food to meet the demand of expanding population;
- To ensure that land use is in harmony with natural environment;
- To use land resources in the best possible way and to play supplementary role in controlling the consistent increase in the number of land less people towards the elimination of poverty and the increase of employment;
- To protect natural forest areas, prevent river erosion and destruction of hills;
- To prevent land pollution; and
- To ensure the minimal use of land for construction of both government and non-government buildings.

2.2.3.2 The East Bengal State Acquisition and Tenancy Act 1950 (Act XV of 1951)

The East Bengal State Acquisition and Tenancy Act 1950 (Act XV of 1951) provides the ownership of diluvion land (eroded into river) and alluvion land (accreted in situ). According to sections 86, 87, 88 and 89 of the act, the "original" owner(s) of private land eroded into rivers can claim the land if it reappears in a natural process within 30 years from the date of erosion provided, the total land holding of the original owner(s) does not exceed 60 standard bighas (8 ha). If land is developed artificially and not naturally, the government will enjoy absolute ownership of the land and no case can be filed at the court of alluvion land after 12 months of public notice by collector regarding possession of the land. If a land emerges from the river or sea and that was never owned by any private people, the government will possess the land. The line that demarcates the diluvion land into the river is referred to as alluvion-diluvion line (AD line) to be established and declared by the concerned Deputy Commissioner in a given year. Land on the riverside of the AD line is public land and that on the country side is governed by recorded ownership.

2.2.3.3 Bangladesh Labor Act, 2006

This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. In the chapter VI of this law safety precaution regarding explosive or inflammable dust/ gas, protection of eyes, protection against fire, works with cranes and other lifting machinery, lifting of excessive weights are described. And in the Chapter VIII provision safety measure like as appliances of first aid, maintenance of safety record book, rooms for children, housing facilities, medical care, group insurance etc. are illustrated.

2.2.3.4 Regulation Related to Children

The Employment of Children Act 1938

This act allowed for children aged 15 or up to work in the railway industry and in transporting goods in port jobs. It also allowed for children aged 15–17 to work night shifts that may last until the morning under certain stipulations such as resting for 13 consecutive hours, working under someone that is 18 years or older, or serving an apprenticeship. It prohibited children under 12 from working in hazardous industries but did not mention protection for children between the ages 12–18.

The Factories Act 1965

This act prohibited children under 14 to work in or be present in factories. Factories was defined as any place with more than 10 people employed. It also listed various protections for children from hazardous machines and operations. It prohibited any work duration of longer than 5 hours between 7pm to 7am. It also states the weight lifting limits for types of workers (male, female, child).

Shops and Establishment Act 1965

This act defined a shop or establishment as a place that employs 5 or more people. This act prohibited children under the age of 12 from working in any establishment. It allowed children aged 12–18 to work in establishments but limited the number of work hours to a maximum of 7 hours a day.

The Constitution Of People's Republic of Bangladesh

The Constitution of Bangladesh while guaranteeing the fundamental rights for the people prohibits all forms of forced labor under Article 34. Article 34 lays down that 'all forms of forced labor are prohibited and any contravention of this provision shall be an offense punishable in accordance with law'.

National Child Labour Elimination Policy 2010

The main objective of this policy is to make meaningful changes in the lives of the children by withdrawing them from all forms of child labour including the hazardous work and worst forms of child labour.

The Children Act 2013

The Children Act 2013 repealed the previous Children Act 1974 which was inconsistent with international standards particularly with the UN Convention on the Rights of the Child 1989. Section 4 of this Act provides that notwithstanding anything contained in any other law for the time being in force every person shall be deemed to be a child who is below the age of 18 years. Though there is no specific provision prohibiting child labor it proscribes and punishes some serious offenses against children including exploitation of children (section 80).

Bangladesh has ratified both the Minimum Age Convention(C138) of the International Labour Organization(ILO), and the ILO Worst Forms of Child Labour Convention(C182). In addition, the country also ratified the UN Convention on the Rights of the Child.

2.2.3.5 Regulation Related to Women

A number of existing laws has been amended and new legislations made to prevent woman and female child abuse in Bangladesh. Notables among these legislations are: dowry prevention act, prevention of marriage of minor girls, women and children repression prevention, etc.

Women and Children Repression Prevention Act, 2000
Under this act, Women Abuse Prevention Cell and rehabilitation centers for abused women have been established to give legal assistance and counseling for prevention of women and children abuse. Over and above, the District and Sessions Judge has fund to defray the cost as legal fee and other costs.

Domestic Violence (Prevention and Protection) Act, 2010
This act was passed for establishing equal rights of women and children as prescribed in the constitution of Bangladesh for ensuring protection of women and children from family violence. Domestic Violence Prevention and Protection Rules, 2013 were framed for implementing this act.

Citizenship Act (amended), 2009
The provision for giving citizenship by mother to child was made by the national parliament by amending the citizenship act in 2009.

Mobile Court Act, 2009
The executive magistrate was given power to take steps by linking Section 509 of the Bangladesh Penal Code in the schedule of Mobile Court Act to resist and prevent eve teasing and sexual harassment of the girls and women.

There are other acts such as Women and Children Violence Protection Law, 2000, Child Marriage Control Act, 2013 (Draft), Domestic Violence Act, 2010, etc.

Bangladesh is also a signatory state to the UN Charter on Prevention of All Forms of Discrimination to Women, 1979 and the Child Rights Charter 1989.

2.3 Operational Policies and Directive of The World Bank

The World Bank has developed a number of Safeguard Policies to ensure that all possible impacts are considered and mitigation measures are spelled out prior to the implementation of any proposed project. These policies ensure that the quality of operations is uniform across different settings worldwide. If the decision is taken that a Safeguard Policy should be applied, mitigation measures and plans must be developed and in place before the implementation of a proposed project.

The Bank requires screening and classification for all investment projects proposed for Bank financing, to help ensure that they are environmentally and socially sound and sustainable. Screening and classification take into account the environment and social aspects; including especially involuntary resettlement and presence of Indigenous Peoples; cultural property; and trans-boundary and global environmental aspects. The relevant and applicable safeguards policies of the World Bank are also reviewed. The below table describes the relevant safe guard policies of the World Bank and discusses their applicability to the project.

2.3.1 Applicable World Bank Policies to Component 2 investments

The applicable World Bank policies for subprojects under Component 2 of the Project are given in Table 2.

Table 2: Operational Policy and Directives of World Bank

Directive	Policy	Applicability for Project
Environmental Assessment	OP/BP 4.01	Triggered.
Natural Habitats	OP/BP 4.04	Triggered.
Indigenous People	OP/BP 4.10	Not Triggered. Based on the ESIA, there are no indigenous people in the project area.
Physical Cultural Resources	OP 4.11	Triggered.
Involuntary Resettlement	OP/BP 4.12	Triggered. Land is required for project infrastructure facilities. First option would be to reduce land requirement and the next would be to go for government land. In case of private land acquisition the affected people will be compensated at replacement cost. Those who lose their livelihoods will be rehabilitated with their living standards restored or increased (in case of below poverty line people) as per the RPF. Affected people, women and other vulnerabels will be engaged fully in the project activities as per RPF.
Forests	OP/BP 4.36	Not triggered.
Pest Management	OP 4.09	Not triggered.
Safety of Dams	OP/BP 4.37	Not triggered.

Projects in International Waterways	OP/BP/GP 7.50	Triggered.
Projects in Disputed Areas	OP/BP 7.60	Not triggered.
Access to Information		The RPF will be disclosed in country (on BIWTA website and in hard copy in locally accessible locations in the project area, including BIWTA offices at all the existing and proposed terminals, shelters and landing stations) and also sent to WB InfoShop. All these instruments will be translated into Bangla (local language) prior to disclosure and disclosed through above channels.

2.3.2 Involuntary Resettlement (OP/BP 4.12)

The World Bank's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.[2]

The overall objectives of the Policy are given below.

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

2.3.3 Public Consultation and Disclosure Requirements by The World Bank

The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. Accordingly, it is Bank's policy to be open about its activities and to welcome and seek out opportunities to explain its work to the widest possible audience.

[2] Excerpts from WB OP 4.12.WB Operational Manual. December 2001.

2.3.3.1 Consultations

The present project is categorized as Category A project. For all Category A and B projects the borrower should consult all the stakeholders including the project-affected groups and local non-governmental organizations (NGOs) about the project's environmental and social aspects and takes their views into account. The borrower should initiate such consultations as early as possible. For Category A projects, the borrower should consult these groups at least twice: (a) shortly after environmental and social screening and before the terms of reference for the ESIA are finalized; and (b) once a draft ESIA report is prepared. In addition, the borrower should consult with such groups throughout project implementation as necessary to address ESIA related issues that affect them.

2.3.3.2 Disclosure

For a Category A project, the borrower should provide relevant information on project interventions in a timely manner prior to consultation and in a form and language that are understandable and accessible to the groups being consulted. The borrower should provide a summary of the proposed project's objectives, description, and potential impacts for the initial consultation. For consultation after the draft ESIA report is prepared, the borrower should provide a summary of the ESIA's conclusions. In addition, for a Category A project, the borrower makes the draft ESIA report available at a public place accessible to project-affected groups and local NGOs. The borrower also ensures that ESIA reports for Category A subprojects are made available in a public place accessible to affected groups and local NGOs. Both the SIA and RPF will be translated into Bangla. In addition any RAP prepared will be translated into Bangla. All these documents, both in Bangla and English, will be made available to interested public through BIWTA website and in hard copies at all project offices. Public availability of the ESIA report for Category A project in the borrowing country and official receipt by the Bank are prerequisites to Bank appraisal of these projects.

In addition, consultations have been held while preparing EMF as well as RPF. Public consultations were held in Ashuganj and Barisal on 17th and 18th November 2015. A national workshop was held on 14th October 2015. Community-level focus group discussions and meetings were also held at various terminal and landing station locations. A summary of consultations held and key issues raised are presented in Chapter 4. Additional workshops and consultation events will be held when ESIAs are conducted for the planned sub-projects, to disclose and get feedback ESIAs EMPs and RAPs, and this document will be updated progressively based on feedback received.

The EIA, EMF, SIA and RPF will be disclosed in country (on BIWTA website and in hard copy in locally accessible locations in the project area, including BIWTA offices at the existing terminals) and also sent to WB InfoShop.

3. Project Description

3.1 Description of Overall Project and Its Components

The project will provide US$360 million in IDA funds to finance interventions aimed at improving IWT for cargo and passengers along the heavily trafficked Chittagong-Dhaka-Ashuganj Regional Corridor. Main interventions include: navigation channel maintenance and improvement; navigation safety improvements; the construction and modernization of select river terminals; development of River Information Systems (RIS); institutional capacity development; and, funding for research and development and feasibility studies for continuing sector improvement to ensure future IWT sustainability. This includes work on sector policies and strategies needed to: improve revenue collection and management; incentivize public and private sector investments especially related to container transport; and, mitigate and improve IWT's impact on the social and physical environment. The Project consists of three components as follows:

3.1.1 Component 1: Improved Inland Waterway Navigation (US$215 million)

This component shall include work to maintain and increase advertised depths and to delineate channel routes through provision of long-term navigation Performance-Based Contracts (PBCs). The 6 or 7-year Performance-Based Contracts will depart from the current practice of payments based on dredging volume which is unreliable and does not assure depth, and instead commits the contractors to guarantee Year-Round Least Available Depth. A Supervision/Performance Monitoring Consultant will be contracted to monitor the performance of the contractors for the PBCs. Only selective and limited dredging of problem areas such as on chars and sand bars is expected to maintain navigability as most of the river route has the required depth. In addition, six vessel shelters will be developed within remote cyclone areas on the Project Corridor route allowing vessels to seek shelter from inclement weather.

3.1.2 Component 2: Improved Services at Priority Inland Waterway Terminals and Landing Ghats/Stations (US$75 million)

This component supports the development of two cargo terminals, four passenger terminals and 14 landing ghats. The facilities shall specifically incorporate the needs of women users (such as toilet facilities for women, women-only waiting rooms) and less abled users, and address safety-related issues for all users. BIWTA will also make suggested changes to operational guidelines to improve safety and experiences using inland water transport services. All investments under this component will also aim to enhance the climate change resiliency of terminals and landing stations, such as through design adaptations to account for the expected increased variation in river flows, more intense or frequent extreme storm events, etc.

The cargo terminals include: (i) development of a new common user general cargo terminal with access infrastructure at on the Buriganga river adjacent to the existing Pangaon container terminal; and, (ii) Rehabilitation and modernization of the existing general cargo terminal at Ashuganj.

The passenger terminals include: (i) the development of a new passenger terminal at Shashanghat in Dhaka District; (ii) rehabilitation of the passenger terminal at Narayanganj; (iii) rehabilitation of the passenger terminal at Chandpur; and, (iv) extension of the existing passenger terminal at Barisal

3.1.3 Component 3: Institutional Capacity Development and Sustainability (US$70 million)

A series of activities are proposed that will support BIWTA's overall enhancement of its management systems and human resources capacity for modern, efficient, and high quality management of the IWT sector in line with international standards. This in turn is critical for the long-term sustainability of the investments supported through the project, as well as the sector's ongoing attractiveness to users, its potential for green innovations in support of national climate mitigation targets, and its resilience to changing conditions including those posed by climate change. Activities to be supported include: (i) the development of River Information Systems to help BIWTA improve data collection for the planning, maintenance and development of IWT, as well as enhance climate resiliency of the IWT sector in Bangladesh by creating a more systematized baseline understanding of river hydrology and navigational implications, and provision of a Traffic Monitoring System for passengers and cargo; (ii) improvement of Human Resources capacity for better management of the IWT sector through upgrading and modernizing the IWT Deck and Engine Personnel Training Centre (DEPTC)) into a regional IWT Training Center with open access to all users in the Region and the world; (iii) commissioning of a study to propose an institutional structure and reforms needed to develop an effective Search and Rescue organization; (iv) support for environmental and social sustainability, climate change resiliency, and "greening" of IWT; (v) a project preparation facility to finance feasibility, surveys, design and safeguards studies for continuous sector development; and, (vi) support for the Project Management Unit including the hiring of key staff and procurement of selected systems needed for implementation of the Project.

3.2 Locations of Component 2

Locations of the proposed terminals and landing stations, in terms of their geographical coordinates, under Component 2 of the Project are given in Table 3 and are shown in Figure 1.

Table 3: Locations of Terminals and Landing Stations under Component 2 of the Project

Item	Name	Position	
		Latitude	Longitude
1 Passenger Terminals			
1.1	Sashanghat	23°41'24.55"N	90°25'34.72"E
1.2	Narayanganj	23°36'58.86"N	90°30'20.53"E
1.3	Chandpur	23°13'59.61"N	90°38'54.65"E
1.4 (recently added)	Barisol		
2 General Cargo Terminals			
2.1	Ashuganj	24°02'34.42"N	91°00'04.58"E
2.2	Pangaon	23°39'30.79"N	90°27'14.68"E
3 Launch Ghats (Landing Stations)			
3.1	Bhairab	24°02'35.76"N	90°59'20.62"E
3.2	Alubazar	23°10'58.57"N	90°34'50.32"E
3.3	Horina	23°09'51.20"N	90°38'32.33"E
3.4	Hijla	22°54'18.07"N	90°31'48.32"E
3.5	Moju Chowdhury	22°52'23.10"N	90°46'56.25"E
3.6	Ilisha (Bhola)	22°47'31.72"N	90°38'33.30"E
3.7	Beduria	22°42'17.22"N	90°33'52.70"E
3.8	Laharhat	22°41'18.11"N	90°29'22.62"E
3.9	Boddarhat	22°39'16.72"N	90°53'57.36"E
3.10	Daulatkha	22°36'11.99"N	90°45'06.14"E
3.11	ChairmanGhat (CharBata)	22°31'19.37"N	91°05'22.23"E
3.12	Sandwip	22°29'03.26"N	91°26'01.06"E
3.13	Tojumuddin	22°24'31.93"N	90°51'36.21"E
3.14	Monpura	22°19'35.89"N	90°58'28.40"E

3.3 Proposed Developments in Passenger Terminals

Details of existing facilities and the proposed facilities to be built in the three passenger terminals are given in Table 4. Typical facilities to be built at these terminals on the water side will include bank protection works, jetties and pontoons; and on the landside will include office buildings, passenger facilities, parking areas and widening of access roads. All terminals will be provided with separate ticket counters, waiting rooms and toilets for women passengers, and ramps for movement of disabled peoples.

Table 4: Existing and Proposed Facilities in Passenger Terminals

Passenger Terminal	Existing Facilities	Proposed Facilities
Sashanghat Passenger Terminal Located 2.5 km downstream of the Sadharghat terminal at Dhaka on the Buriganga River	Greenfield site. There are no existing facilities.	Based on existing concept design drawings (which will be reviewed and potentially adapted / modified during the detailed design phase), proposed facilities to be developed include: • A Six storied terminal building, with a total floor are of approximately 20,000 square meters; • A quay wall (bank protection) of approximately 250 m length • Three terminal pontoons of approximately 200m length and five steel gangways • A parking yard of approximately 2,000

		square meters • new landside pedestrian and vehicle access roadways • pedestrian and vehicle turn-outs, drop-off, collection and waiting facilities
Chandpur Passenger Terminal. Located on Lower Meghna River	Established in 1995. Existing facilities include a walkway (167 m^2), steel jetty – 2 nos, steel spud – 6 nos., pontoon – 4 nos., passenger waiting shed (74 m^2) and parking yard (8010 m^2)	Based on existing concept design drawings (which will be reviewed and potentially adapted / modified during the detailed design phase), the proposed facilities include: • Land development (21,669 m^3), • 3-storied terminal Building (4061 m^2), • Bank protection (253 m), • Boundary wall (231 m), • RCC Ramp- 3 nos, • Steel gangway – 3 nos, • Spud and spud ring -22 nos. Terminal pontoon -4Nos, • Steel jetty (267.65m^2). • Widening of 265 m of access road
Barisal Passenger Terminal Located on Kirtonkhola River (Lower Meghna Tributary)	Established in 1964. Existing facilities included: two storied terminal building, passenger waiting space, 6nos. of pontoons, 4 nos. of gangway, cargo shed, transit shed, parking yard and access road.	The proposed facilities include: • Extension of existing terminal building (346 m^2), • construction of 4 storied multipurpose building for port facilities (5600 m^2), • RCC Ramp 2 nos., • Steel Gangway 2 nos., and • bank Protection works
Narayanjang Passenger Terminal Located on Sitalakya River	Established in 1972. Existing facilities include a single storied building, 4 pontoons, 3 gangways, an RCC jetty and an administrative office. Existing facilities also include cargo handling facilities with 4 pontoons.	The proposed facilities include • extension of existing terminal building, • RCC ramps and • 2 steel gangways.

3.4 Proposed Developments in Cargo Terminals

Details of existing facilities and the proposed facilities to be built in the two cargo terminals at Pangaon and Ashuganj are given in Table 5. Typical facilities to be built at these terminals on the water side will include bank protection works and jetties; and on the landside will include office buildings, passenger facilities, parking areas and widening of access roads. All terminals will be provided with separate ticket counters, waiting rooms and toilets for women traders, and ramps for movement of disabled peoples.

Table 5: Existing and Proposed Facilities in Cargo Terminals

Cargo Terminal	Existing Facilities	Proposed Facilities
Pangaon Cargo Terminal Located next to existing Pangaon Container terminal on Buriganga River.	Greenfield site. No existing facilities.	Based on existing concept design drawings (which will be reviewed and potentially adapted / modified during the detailed design phase), The proposed facilities include: • Two berths, constructed on RCC piles with a suspended deck – total length 190m; • An apron area of approximately 2,750 square meters • An open storage area of 2,220 square meters; • A transit Shed of 1,500 square meters; • Vehicle parking areas of 500 square meters; and • A new port road of 400m length together with a gate house.
Ashuganj Cargo Terminal Located on Upper Meghan River	Established in 2004 primarily for use by. Existing facilities include: office (150 m^2), RCC Jetty (425 m^2), steel jetty (90 m^2), pontoons – 2nos., gangway, warehouse (225 m^2), parking area (1000 m^2)	Proposed facilities include: • office building, RCC Jetty (425 m^2), • steel jetty – (2x45m), • pontoon- 2nos., • gangway – 2nos., • bank protection, • warehouse (225 m^2), and • parking area (2000 m^2)

3.5 Proposed Developments in Landing Stations

Details of existing facilities and the proposed facilities to be built in the 14 landing stations are given in Table 6. All the landing stations will be provided with drinking water facilities, and separate waiting rooms and toilets for women passengers.

Table 6: Existing and Proposed Facilities in Landing Stations

Landing Station/ Launch Ghat	Existing Facilities	Proposed Facilities
Bhairab Bazar	Established in 2004. Daily about 300 to 400 passengers use this launch ghat. Existing facilities include two pontoons and one gangway.	The proposed facilities include two pontoons and one gangway.
Alubazar	This is a ferry terminal established in 2001. Daily traffic include 3 launches, 4 ferries and 15 local boats. Daly weight of goods transported is 20 t. Existing facilities include: shore connection seri -1, pontoon -1, steel jetty, ferry ghat with pontoon.	0.18 ha of addition land acquisition required for proposed facilities, which include: • Shore connection seri-4 • Steel jetty -45m^2 • Steel spud – 4nos • Approach Road -372m^2 • Passenger waiting sheed-75m^2 • Parking yard – 1860m^2 • Toilet complex – 42m^2 • Bank protection -200m^2
Horina	This is a ferry terminal established in 2001. Daily traffic includes 2 launches	0.093 ha of addition land acquisition required for proposed facilities, which include:

	and 4 ferries. Approximate daily weight of goods transported is 15 t. Existing facilities include a ferry ghat with a pontoon	• Shore connection seri-4 • Steel jetty -45.00m² • Steel spud – 4nos • Approach Road -372m² • Bank protection -200m²
Hijla	The average daily traffic at this launch ghat is 150 passengers and 10 boats. Approximate daily weight of goods transported is 3t. Existing facilities include a shore connection seri and a pontoon	0.12 ha of addition land acquisition required for proposed facilities, which include: • Passenger waiting shed:125 m² • Parking yard : 2500 m² • Toilet complex: 75 m² • Access road: 1000 m² • Deep tube-well: 01 No
Ilisha (Bhola)	The average daily traffic at this launch ghat is 251 passengers and 12 vessels. Approximate daily weight of goods transported is 19t. Existing facilities include 2 shore connection seris and a pontoon	0.30 ha of addition land acquisition required for proposed facilities, which include: • Passenger waiting shed:125 m² • Parking yard : 2000 m² • Toilet complex: 75 m² • Access road: 2000 m² • Deep tube-well: 01 No
Moju Chowdhury	A ferry ghat established in 2008. Daily traffic is 2 ferries, 2 sea trucks and a launch. Approximate daily weight of goods transported is 20t. Existing facilities include a shore connection seris, a pontoon, and a passenger waiting shed (55 m²)	Area required proposed facilities in 0.5 ha but land acquisition is not required. The proposed facilities include: • Shore connection seri-4 • Steel jetty -45 m² • Steel spud – 4nos • Approach road • Passenger shed • Parking yard • Bank protection
Laharhat	The average daily traffic at this launch ghat is 277 passengers and 13 vessels. Approximate daily weight of goods transported is 21 t. Existing facilities include: • Passenger waiting shed : 125 m² • Parking yard : 3375.00 m² • Toilet complex: 75.00 m² • Access road: 2000.00 m² • Deep tube-well: 01 No • Shore connection sheri-01 • Pontoons- 01	Area required proposed facilities in 0.28 ha but land acquisition is not required. The proposed facilities include: • Passenger waiting shed: 125 m² • Parking yard : 1500 m² • Toilet complex: 75 m² • Access road: 2000 m² • Shore connection sheri-01 • Pontoons- 01
Beduria	The average daily traffic at this launch ghat is 81 passengers and 13 vessels. Approximate daily weight of goods transported is 6 t. Existing facilities include a shore connection seri and a pontoon	Area required proposed facilities in 0.047 ha but land acquisition is not required. The proposed facilities include: • Passenger waiting shed:125 m² • Parking yard : 2000 m² • Toilet complex: 75 m² • Access road: 2000 m² • Deep tube-well: 01 No
Daulatkha	The average daily traffic at this launch ghat is 1000 passengers and 4 vessels. Approximate daily weight of goods	Area required proposed facilities in 0.12 ha but land acquisition is not required. The proposed facilities include:

	transported is 730 t. Existing facilities include a 22 m jetty and 1 pontoon	• Passenger waiting shed:125 m^2 • Parking yard : 2000.00 m^2 • Toilet complex: 75.00 m^2 • Access road: 2000.00 m^2 • Deep tube-well: 01
Tojumuddin	The average daily traffic at this launch ghat is 307 passengers and 4 vessels. Approximate daily weight of goods transported is 23 t. Existing facilities include 2 shore connection seris and a pontoon	Area required proposed facilities in 0.12 ha but land acquisition is not required. The proposed facilities include: • Passenger waiting shed:125 m^2 • Parking yard : 2000.00 m^2 • Toilet complex: 75.00 m^2 • Access road: 2000.00 m^2 • Deep tube-well: 01 No • Pontoons- 01
Monpura	The average daily traffic at this launch ghat is 207 passengers and 2 vessels. Approximate daily weight of goods transported is 9.5 t. Existing facilities include: • Pontoons-1 • Sheri - 02 • Transit shed • RCC Jetty 625.00 M	Area required proposed facilities in 0.12 ha but land acquisition is not required. The proposed facilities include: • Passenger waiting shed:125 m^2 • Parking yard : 2000.00 m^2 • Toilet complex: 75.00 m^2 • Access road: 2000.00 m^2 • Deep tube-well: 01 No • Shore connection
Chairman Ghat (Char Bata)	The average daily traffic at this launch ghat is 620 passengers 2 launches, 6 local boats and 12 speed boats. Approximate daily weight of goods transported is 18 t. Existing facilities include: • Steel Jetty (12m) 1Nos • Spud 2 Nos • Pontoon 1Nos • Waiting Shed 45 m^2	0.5 ha of addition land acquisition required for proposed facilities, which include: • Passenger Terminal 120 m^2 • Parking Yard 550 m^2 • Deep tube well -1nos • Approach Road 450 m^2 • Bank Protection 290 m^2
Sandwip RCC Jetty	The average daily traffic at this RCC Jetty is 200 passengers 2 steamer, 10 local boats and 30 speed boats. Approximate daily weight of goods transported is 30 t. Existing facilities include: • RCC Jetty 750m • Waiting shed 60 m^2 • Parking yard 200 m^2	Area required proposed facilities in 1 ha but land acquisition is not required. The proposed facilities include: • CC Jetty 30m • Harbour Basin • Passenger Terminal 125 m^2 • Parking Yard 550 m^2 • Deep tube well 1nos • Approach Road 450 m^2 • Bank Protection 2000 m^2
Boddarhat Launch ghat	The average daily traffic at this RCC Jetty is 150 passengers 2 launch and 10 local boats. Approximate daily weight of goods transported is 30 t. Existing facilities include: • RCC Jetty 750m • Waiting shed 60 m^2 • Parking yard 200 m^2	0.4 ha of addition land acquisition required for proposed facilities, which include: • Shore connection seri-4 • Steel jetty -185.00m^2 • Steel spud – 4nos • Approach Road -150m^2 • Passenger waiting sheed-100m^2 • Parking yard – 4048m^2 • Toilet complex – 42m^2 • Bank protection -200m^2

3.6 Description of Typical Construction Works

3.6.1 Landside Construction

Landside or onshore construction typically includes site preparation and development, the removal of any existing vegetation, filling of the land above the flood levels, and the grading and excavation of soils for the installation of structural foundations and site utilities that are typical of industrial development projects. Port development may include construction of new infrastructure and/ or rehabilitation of existing infrastructure, such as piers and buildings. Landside facilities typically include:

- Cargo storage and handling facilities (e.g. crane tracks and bridges for loading/ unloading cargo, pipelines, roads, and other areas for cargo distribution, storage and stacking areas, and warehouses;
- Facilities for embarking/ disembarking of passengers (e.g. parking areas and administration buildings);
- Vessel support facilities (e.g. to store and supply water, power, food and oil/ used oil);
- Drainage networks;
- Waste collection facilities;
- Terminal administration buildings with water supply facilities, toilets and watering rooms (separately for women passengers and traders), and ramps for disabled people;
- Equipment maintenance and repair facilities (e.g. vehicle maintenance bays); and
- Widening of access roads.

3.6.2 Waterside Construction

Waterside facilities include berthing facilities (e.g. harbor basins, approaches, and access channels), cargo handling and ferry facilities (e.g. goods transfer quays and piers, shoreline protection, and landing bridges). Bank protection works and Installation of pier columns/ piles and construction of harbor basins and access channels may require excavation of river bed sediment and underlying material. Dredgers will be used for excavation and vibratory pile drivers will be used for construction of pier columns. Uncontaminated dredged material will be used for raising of the land at the terminal site or used to construct breakwaters and other features, or can be disposed of in open water through submerged discharge. Contaminated material will be placed in a confined disposal facility.

3.7 Description of Typical Operations at Terminals

3.7.1 Landside Operations

Land-based operations at terminals include cargo handling; material and fuel storage and handling; passenger embarking/ disembarking; ship support services; waste and wastewater management; vehicle and equipment maintenance; and buildings and grounds maintenance.

Cargo handling includes unloading, storage/ stacking and loading of dry and liquid cargo. Cargo typically includes containers, dry bulk, liquid bulk, and general cargo. Cargo handling includes use of vehicular traffic such as harbor vessels, trucks, buses, terminal trucks, and track cranes. Bulk cargo may be transferred using cranes with grab buckets and front-end loaders, or pneumatic continuous ship loaders and unloaders, or belt conveyors.

Terminal operations generate and manage their own waste and wastewater. Solid waste may be generated from property upkeep and administrative operations while wastewater may originate from storm drainage and from domestic wastewater and sewage. However, the most significant sources of wastes and wastewater are ships and there will be receiving facilities for these and other waste streams.

3.7.2 Waterside Operations

Waterside operations may include maintenance dredging for routine removal of material/ sediment in harbor basins, and access channels. This activity is important to maintain or improve depths and widths and ensure safe access for the ships as well as efficient navigation depth in the neighbourhoods and dock gates to ensure access to basins and dry docks. Maintenance dredging may take place annually or once every few years, depending on the terminal. The terminals at Chandpur and Barisal may require maintenance dredging annually but other terminals may require dredging once in a few years. In addition the water side operations will include small scale maintenance and repair works for vessels, which are mostly related to engine repairs. No repainting works will be carried out these terminals.

3.8 Implementation Schedule

The engineering designs and ESIA studies for the Component 2 works will be carried out during the first year of implementation of the Project and civil works will be carried out over a period of four years after completion of the engineering designs.

BIWTA will procure consulting firms for preparation of detailed engineering designs and to carry out environmental and social assessment of the proposed Component 2 works. The ESIA consultants will be independent of Engineering Design Consultants but both consultants will coordinate each other while planning and design of the facilities.

3.9 Cost of the Project

The overall cost of the Project is US$ 360 million, and cost of the Component 2 works is 75 million US$. Detailed break up of Component 2 works are given in Table 7.

Table 7: Cost of Component 2 Works

Works Description	**Amount in million US$**
Development of a new common user general cargo terminal at Pangaon	20
Rehabilitation and modernization of the existing general cargo terminals at Ashuganj and Bhairab	10
Development of a new passenger terminal at Shashanghat	10
Upgrade of existing passenger terminals at Narayanganj, Chandpur, and Barisal	15
Upgrade of 14 Existing Landing Stations/ Launch Ghats	15
Design, Supervision, Safeguards Services As Needed, and Other Unanticipated Activities relating to River Port Terminals	5
Total	75

4. Socio-Economic Baseline

4.1 Introduction

Bangladesh is Located in the north-eastern part of South Asia. The majestic Himalayas stand some distance to the north, while in the south lays the Bay of Bengal. West Bengal borders on the west and in the east lies the hilly and forested regions of Tripura, Mizoram (India) and Myanmar. These picturesque geographical boundaries frame a low lying plain of about 1,47,570 sq. km., crisscrossed by innumerable rivers and streams. Mighty rivers are Padma (Ganges), Brahmaputra (Jamuna), Meghna and Karnafuli.

Bangladesh's geographical Location is at Latitude between 20°34' and 26°38' North and Longitude between 88°01' and 92°41' East. Bangladesh has an area of 147,570 sq. km. (land: 133,910 sq km, water: 10,090 sq km). Bangladesh is bounded by North - India (West Bengal and Meghalaya), West - India (West Bengal), East - India (Tripura and Assam) and Myanmar and South-Bay of Bengal. It has total of 4,246 km border (border countries: Burma 193 km, India 4,053 km). It has a coastline of 580 km. Bangladesh terrain is mostly flat alluvial plain and hilly in southeast.

Bangladesh has 7 Divisions; Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Barisal and Rangpur, 64 Districts and 487 Sub districts/Upazillas.

Bangladesh has a population of 150 million (2011 Census Report by BBS). The present Population Growth Rate of Bangladesh is 1.59%. The present literacy rate is about 50% among which the male literacy is 50% and female literacy is 46%. Bangladesh is predominantly a Muslim populate (86.6%) followed by Hindus (12.1%), Buddhists (0.6%), Christians (0.4%) and Others (0.3%). The sex ratio is 99.68%.

The predominant ethnic group is Bengalis (98%) followed by other indigenous minority (2%) including Chakmas, Marmas, Santals, Garos, Manipuri, Tripura, and Tanchangya.

4.1.1 Economy

Bangladesh is one of the members of the Developing 8 and considered as the Next Eleven Economy of the world in 20 coined by Goldman Sachs. The GDP is $1,044 (per capita in 2013). The poverty level is at 25% (People living with $2 per day).

4.1.2 Rivers

The principal rivers are Padma, Meghna, Jamuna, Surma, Brahmaputra, Karnaphuli, Teesta, Sitalakhya, Rupsha, Madhumati, Gorai, Mahananda etc.

Bangladesh is dominated by the low-lying Ganges Delta, but has highlands in the north and southeast. The Ganges delta is formed by the confluence of the Ganges (local name Padma or Pôdda), Brahmaputra (Jamuna or Jomuna), and Meghna rivers and their respective tributaries. The Ganges unites with the Jamuna (main channel of the Brahmaputra) and later joins the Meghna, finally flowing into the Bay of Bengal. The alluvial soil deposited by the rivers when they overflow their banks has created some of the most fertile plains in the world. Bangladesh has 57 trans-boundary rivers, making water issues politically complicated to resolve – in most cases as the lower riparian state to India. Most parts of Bangladesh are less than 12 m (39.4 ft) above sea level, and it is estimated that about 10% of the land would be flooded if the sea level were to rise by 1 m (3.28 ft).

4.1.3 Climate

The temperature ranges are in winter 11° C - 20° C (October - February) and in summer 21° C - 38° C (March - September). The rain fall range is 1,100 mm to 3,400 mm (June - August). The Humidity is highest 99% (July) and lowest 36% (December & January).

4.1.4 Agriculture

The principal crops are Rice, Jute, Tea, Wheat, Sugarcane, Pulses, Mustard, Potato, Vegetables.

4.1.5 Industry

The Principal Industries are Garments and Textiles (2nd largest in the world), Tea, Ceramics, Cement, Leather, Jute (largest producer in the world), Chemical, Fertilizer, Shrimp Processing, Sugar, Paper, Electric and Electronics, Medicine, Fishing. The principal exports are Garments, Knitwear, Frozen Shrimps, Tea, Leather and Leather products, Jute and Jute products, Ceramics, IT Outsourcing, etc. The principal Imports: Wheat, Fertilizer, Petroleum goods, Cotton, Edible Oil etc. The principal Minerals: Natural gas, Oil, Coal, White clay, Glass sand, etc.

4.2 Socio-Economic Baseline of Project Area – ESIA Study

This section provides an overview of demographic trends, sources of livelihood, land use, agriculture, fisheries, public health, communications, social infrastructure, gender issues, cultural resources, demand for dredged material, and other relevant issues. The study route has been divided in terms of the river route and launch terminals, proposed 6 storm vessel shelters and 3 ferry crossing routes. The river routes include Dhaka and surrounding to Bhairab Bazaar and Chandpur. Dhaka is the major urban center for business development, urbanization, export-import and industrialization of the country. Shadarghat, Bhairab, Ashuganj and Chandpur are the most important and busiest business and river transport routes of the country. The baseline information indicates that regions nearer to the main land enjoy better privilege in terms of education and medical services, employment opportunity and other advantages. On the other hand, some Char and Islands in the coastal area along the proposed river routes are still facing lack of basic civic amenities i.e. education, health services, electricity, road communication, gas connection, etc.

4.2.1 Demography

The project area passes through 10 Districts covering 17 Upazilas (Sub-district). Dhaka, the capital of Bangladesh is the largest city in Bangladesh and highest densely populated which has experienced an extremely rapid population growth after the independence, from only 1.6 million in 1974 to about 15.4 million in 2011. Dhaka's density is estimated at 115,000 per square mile or 44,000 per square kilometer, with slum (informal dwelling) densities reported as 4,210 per acre, or 2.7 million per square mile (1 million per square kilometer).

Although only the southern part; near the launch terminals will be included as project sites and area of influence, as no discrete information were found from secondary sources for the southern part, the demographic information demonstrates information on the whole metropolitan city.

Again, the population of Keranigong Upazila is 794,360 and it is the highest among the Upazilas in study area. On the other hand, Monpura Upazila of Bhola District has the lowest population that is 17,080. Population density is the highest and lowest respectively in Dhaka (30551) and Monpura (205). The average household size is 4.72 except Dhaka Metropolitan. The largest household size is 8.42 in Dhaka Metropolitan. Again, Tozumuddin and Keranigong Upazilas have 4.42 house hold size. These two Upazilas are the lowest number of house hold size in the total study area. It indicates that Dhaka city being the capital; people from all parts of the country migrate to Dhaka in search of employment, education and all other facilities. The city is growing at a rate of 6% every year. On the contrary Monpura and other char Upazilas offer less opportunity and people migrate out of these places to areas with better opportunities.

Among the ten districts, literacy is highest in Dhaka (74.6) and Barisal Sadar Upazila that is 69.3% and the lowest is Monpura under Bhola District that is 32.1%.

The table underneath demonstrates some key demographic information and literacy rates across impact Upazilas based on secondary sources (BBS, GOB Web portal, etc.).

4.2.2 Livelihood Sources in various locations

Most of the people near river side depend on their sources of livelihood by river rrelated activities. For example, Shadarghat (in Dhaka); provides for about 300-400 boatmen, who are depending on river related transport. There are also a large number of labours in this ghat. Here the major sources of livelihood are carrying people and goods by boat, day laboring, selling of vegetables and other raw materials, selling clothes, rickshaw or van pulling, whole and retail selling of fruits, etc. There are a huge number of hotels/ restaurant in this ghat area. There are a variety of livelihoods in this ghat.

A large number of people are engaged in Munshigang Sadar launch ghat as day labour. Again vegetables sellers, other raw materials and business men present in Munshigong Sadar launch ghat. There is a big market in Bhairab Bazar launch ghat. There are about 700 business units/shops in this ghat. And a massive number of people, about 10, 000, are crossing one end to another by using this ghat for livelihoods.

At Harina ferry ghat, approximately 500 fishermen are leading their lives by catching fishes from the river. At Chairman ghat (Boyar char) there is a large number of fishermen (about 15,000-20,000). This is the highest number of fishermen at a single location along the proposed routes. There is a large vegetable market in Chandpur Sadar launch ghat with associated businesses. There are about 1,000 business shops located here. These vegetables are mostly being carried by boat from adjacent Chars. Once again, Ashuganj, Mozu Chowdhury Ghat, etc. play a major role in transporting construction materials and receiving imported goods. Each ghat provides for livelihoods for 2,000-3,000 families including 300-600 shops around the ghats and thousands of day laborers working around the area. For example, the Mozu Chowdhury ghat itself has 500-600 shops catering to several needs of the people visiting ghat. There are 600-700 shops as per ESIA study at Harina.

Ashuganj ferry ghat has about 1,500-2,000 labourers working each day, along with number of people engaged in transporting goods from neighbouring country India. Many vendors (such as vegetables, raw materials, and other things) come to all ghats, jetties, terminals etc. to buy and sell their daily necessaries. There are about 1,000 shops in Batakandi Bazar, under Comilla district and a huge number of people have established other related businesses there.

Dakatia Mohana at Chandpur Sadar is a recognised tourist spot. It also provides livelihoods opportunities to local people, labourers, entrepreneurs and small traders. Chandpur provides livelihoods to a large number of peoples as fishermen, fish sellers, vegetables vendors, etc. The people who are living in the banks of river along the route are collecting fishes as a source of livelihood. Some boatmen are running their occupation as '*majhi*'.

About 16.31%of total population of Dhaka, Munshigong, Gagaria and Chandpur launch route are business men, 5.70% are into fishing, 8.21% are working as day labour, 1.14% operating boat (boatman) etc. About 8.67% people are unemployed. Women are mostly housewives (33.87% of total population).

At the vessel shelter locations, the survey finds that 13.22% people are leading their livelihood by business, 1.99% by rickshaw or van puller, 7.25% by fishing (fisherman).

Almost all of the sampled female population (33.15%) are housewives, except 0.18% teacher and 0.54% fisherwomen.

At the ferry ghats, 19.23% of the sampled population is businessmen, 7.07% are rickshaw or van pullers, 1.11% are boatmen, 7.22% are fishermen and many other common occupational groups. There are also 34.07% women who are housewives, this is similar to the vessel shelters and launch routes. About 8.89% of people are unemployed in these locations.

4.2.3 Land Use

Land use pattern adjacent to the river route has different scenarios for rural and urban sites. Terminals are established in urban or semi urban areas that have developed the Ghat areas as commercial centers of the region with shops and markets. These terminals generate sources of livelihoods for thousands of households. On the contrary, the terminals in rural regions with minimal transportation facilities are mostly surrounded by fallow land, cultivable land, ponds, ditches and canals. For example, Doulotkhan (Bhola), Sandwip, Tojumuddin, Laharhat, etc. have fewer shops and commercial entities compared to other terminals. Almost 65% of the private lands around the Ferry Ghats a Launch Ghats are found to be used for agricultural production. Majority of the titleholders use their land for commercial purposes. Majority of the non-titleholders are using GoB land for business and other purposes.

4.2.4 Gender Issues

Similar to many other regions of this lower middle income country, in the project area too, the efforts of women in socio-economic development and well-being of their family and surroundings is rather unrecognized. The sample population in this assessment study has been chosen mostly from river terminals and bordering shops and business centers, where majority are male employers or workers. However among the total household population of the survey, 45% were female. The study findings indicate that the project sites offer minimal opportunities to women. In addition to that, the study also reveals that decision making role of women in the household is negligible with only 1.03% households being headed by women.

On the contrary, better communication and transport facility may create more choices for their economic pursuit. The figure 2 gives expectations of the survey respondents. Majority of the participants believed that the project will bring more employment opportunities to women in addition to education, which will play a role in gender balance and enhance their role in business. Other than that, some respondents also highlighted that with better transport and communication facility, women will be able to receive better medical facility and overall situation for women will be developed.

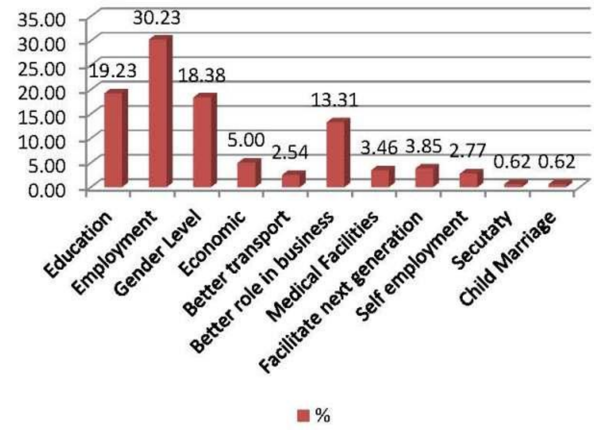

Figure 2: Project role in women empowerment;

The baseline information in the study area indicates that the project site lacks higher education as well as proper health service facilities. Special focus should be paid on sanitation facilities across river route. In addition to that, men and boys are enjoying the most of the recreational facilities compared to women, girls and children. Again, women's movement is mostly induced by household work (by the river) and socialization (ceremonies in community centers).

4.3 Consultations

Field surveys, consultations with different stake holders, a national consultation workshop and two regional public consultations were carried out to develop a comprehensive Resettlement Policy Framework (RPF) for the Project. Consultation meetings were held during the field visits to identify issues and problems to enable the institution to corrective measures and to identify lessons and opportunities to enhance Project implementation mechanism.

4.3.1 Objectives of Consultations

The GoB as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline conditions, understand perceptions of the community regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders is an integral part of the environmental and social assessment process. During the preparation of the present RPF, initial consultations with the key stakeholders have been carried out to obtain their views on the Project interventions. Additional consultations have been held on this draft RPF as well as the full draft SIA for the Component 1 on 17th and 18th November 2015 at Ashuganj and Barisal, respectively. This process will be continued during the subsequent SIAs of the subprojects. The consultation process has been conceived, planned, and initiated with the following key objectives:

- To provide key project information and create awareness among various stakeholders about project intervention;
- To share the terms of reference of the current SIA and RPF for the Component 1;
- To have interaction for primary and secondary data collection with project beneficiaries, affected persons and other stakeholders;
- To identify environmental and social issues such as displacement, safety hazards, employment, and vulnerable persons;
- To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and project level;
- To involve project stakeholders in an inclusive manner; and
- To receive feedback from primary stakeholders on mitigation and enhancement measures to address the environmental and social impacts of the project.

4.3.2 Methodology and Tools for Consultation

The consultation and participation process undertaken so far has adopted a highly participatory approach fully involving all the stakeholders, both primary and secondary. The various tools used for consultations included household level interviews, focus group discussions (FGD), stakeholders consultation meetings, issue specific consultation meetings, open meetings, and workshops. Newspaper notifications are given before conducting regional workshops in Ashuganj and Barisal.

4.3.3 Consultation Meetings and FGDs

A total of 24 consultation meetings were held in the project areas. Both male and female stakeholders were consulted through these meetings. Additionally, teachers, businessmen, village leaders, and local government members, farmers, and fishermen were consulted individually. Female heads of the households were also interviewed. List of consultation meetings and details of participants are given in Table 8. Details of consultations meetings carried out national level in Dhaka and regional level in Ashuganj and Barisal are given in Table 9. The information on project interventions and the findings of environmental and social assessment were also be disclosed through newspapers and electronic media (e.g. internet and TV).

Table 8: Details of Consultation Meetings at the Project sites

S.No.	Venue	Date & Time	Numbers of male Participants	Numbers of Female Participants
1.	Sadar Ghat , Ward No – 37, Thana : Kotwali, District: Dhaka.	17.09.2015 10 AM	31	3
2.	Aganagar Ward No - 05, Thana: Keraniganj, District: Dhaka.	17.09.2015 12 PM	48	3
3.	Jinjira Bottola Union: Jinjira, Thana : Keraniganj, District: Dhaka.	17.09.2015 2 PM	21	3
4.	Munshiganj Launch Ghat Ward No – 03 Thana: Munshiganj Sadar, District: Munshiganj.	18.09.2015 10 AM	58	6
5.	Munshiganj Ferry Ghat , Thana : Munshiganj Sadar, District: Munshiganj.	18.09.2015 12.00 PM	42	3
6.	Narin Pur Ward No - 04, Thana: Titas, District: Comilla.	18.09.2015 3 .00 PM	19	4
7.	Batakandi Bazaar Ward No - 03, Thana : Titas, District: Comilla.	18.09.2015 5.00 PM	60	3
8.	Bhairab Bazaar Launch Ghat Ward No - 01, Thana: Bhairab, District: Kishorganj.	20.09.2015 10. 00 AM	39	0
9.	Ashuganj Ferry Ghat Ward No - 03, Ashuganj, District: Brahmanbaria.	20.09.15 12 .00 PM	38	1
10.	Shatnol Launch Ghat Ward No- 05, Thana : Matlab Uttar, District: Chandpur.	01.10.2015 12.30 PM	19	2
11.	Horina Ferry Ghat, Ward No- 13, Thana: Chandpur, District: Chandpur.	01.10.2015 4 .00 PM	23	0
12	Horina Ferry Ghat (Fisherman), Ward No- 13, Thana: Chandpur, District: Chandpur.	01.10.2015 5.00PM	47	4
13.	Boro Station Mul Head, Ward No- 07, Thana: Chandpur, District: Chandpur.	02.10.2015 11.00AM	15	2
14.	Boro Station (Camp Office), Ward No- 07, Thana : Chandpur, District: Chandpur.	02.10.2015 12.30 PM	15	2
15.	Char Bhairabi, Ward No – 06, Thana: Haimchar, District: Chandpur.	02.10.2015 6 .00 PM	39	2
16.	Moju Chawdhury Ghat, Ward No- 20, Union: Chor Romoni, Thana : Lakshmipur.	03.10.2015 12.30 PM	20	1
17.	Boyar Chor, Chairman Ghat (Fisherman), Union: Horini, Thana: Hatia,	04.10.2015 10.30 AM	17	3

	District: Noakhali.			
18.	Chairman Ghat, 1 No Horini, Thana : Hatia, District: Noakhali.	04.10.2015 12.30 PM	29	2
19.	Tojumuddin Launch Ghat, Ward No-05, Thana: Tojumoddin, District: Bhola.	04.10.2015 1 .00 PM	15	4
20.	Kaliganj Launch Ghat, Ward No-04 Ulania, Thana: Mehendiganj, District: Barisal.	06.10.2015 12.00 PM	9	0
21.	Chadpur Launch Ghat, Ward No. 07, Thana- Chandpur, District: Chandpur.(KII)	02.10.2015 10.00 AM	3	0
22.	Dawlat Khan Launch Ghat, Ward No- 08, Thana: Dawlat Khan, District: Bhola. (KII)	04.10.2015 12.30 PM	11	3
23.	Veduria Ferry Ghat, Ward No -06, Thana: Bhola Sadar, District: Bhola.(KII)	05.10.2015 12 .00PM	11	0
24.	Lahar Hat, Union: Kaunia, Thana- Bondar Thana, District: Barisal.(KII)	05.10.15 2.00 PM	3	0
Total	632	48		
Grand Total	680			

Table 9: Details of National and Regional Consultations

Location	Date	Male Participants	Female Participants	Total Participants
Dhaka	14 Oct 2015	122	05	127
Ashuganj	17 Nov 2015	67	09	76
Barisal	18 Nov 2015	30	00	30

4.3.4 Key Findings of the Consultations

All the stakeholders and community correspondents appreciated the project. The concern of the consultation participants were mainly focused on improvement and extension of terminals, safety and security of passengers, impact on livelihood, dredging and environmental issues including management of dredged materials. The summary of points discussed in these consultation meetings are given in Table 10.

Table 10: Summary of Consultations

S. No.	Venues of Meeting	Findings
1.	Sadar Ghat, Dhaka	Around 30,000 businessmen depend on this ghat. Approach road is narrow. River is polluted. Toilets facilities in the terminals and water vessels are not good enough for the female.
2.	Aganagar Ghat, Dhaka	There is no launch terminal, water is polluted and around 1000 businessmen depend on this ghat. Dredging is necessary on urgent basis. Development of this ghat can increase business.
3.	Jinjira	Depth of the river is not enough and water is polluted extremely. Lots of

	Bottola, Dhaka	businessmen do their business through the rived. Lots of products are supplied from this area to all over Bangladesh
4.	Munshiganj Launch Ghat	Existing about 300 boats and 200-250 boatmen. Maximum people are businessmen and day laborers. Approximately 1,000 business institutions have been established around the launch Ghat. About 20,000 people live near the riverside. Everyday a lot of loaded trawlers and boats move through the river. Char has arisen in the Shitalakhya and Dhaleshwari river estuary. Dredging is needed and at the time of dredging it is needed to establish sanctuary for the fishes. The waste material from dredging need to removed away from the ghat so that it cannot come back into the river again. The dredging should be done during the winter.
5.	Munshiganj Ferry Ghat	There are not many activities seen in this ghat. Around 100 businessmen depend on this ghat. Water is polluted due to the cement factories. Polluted industrial waste directly goes to river.
6.	Naranpur, Comilla	People have welcomed the project. If the ghats are maintained properly, more people will be travelling through the river routes. Toilet facilities and security are needed to be improved for the river users/ passengers.
7.	Batakandi Bazar	There are no ghats in this area. They suggested that if there is one ghat established in this area, businessmen and local people will be benefitted. There are lots of seasonal crops in this area and it is really expensive to transport through the road. River erosion is also a major problem in this area.
8.	Bhairab Bazaar Launch Ghat	They don't have any route to transport goods to Chittagong and Dhaka. During the winter time, it is hard to use the routes. Dredging the river route of Shurma, Doulatkhan and Chatak is urgent. Development of ghat is urgent as well. There is no signaling system here.
9.	Ashuganj Ferry Ghat	Near about 1,500-2,000 laborers depend on this ghat for their livelihood. They have a good communication with India through this ghat to carry their goods. The ghat is well known for the transportation of different goods and products, Many mills & factories have been built around the Ghat, as a result all the chemical contaminants of the factories directly go to the river. It is basically the cargo port. Dredging is necessary and Businessmen want to buy dredged materials.
10.	Shatnall Vessel shelter	Constructing the vessel shelter will change the livelihood of this community. People welcomed this project. Present launch ghat is really small and there is no jetty and passengers waiting room. River erosion in this area is also a major problem.
11.	Harina Ferry Ghat	Approximately 500 fishermen depend on this river for their daily earning. There are about 8,000-10,000 people living on this river embankment. Ferry moves to Harina and Alur bazaar from this ghat. A lot of raw materials are transported regularly through this ghat. Dredging is urgently required here. Due to massive river erosion, ghat has been changed 7 to 8 times. There is no jetty also.
12.	Harina Ferry Ghat (Fishermen)	Around 700 people are fishermen in this area. If the river transport and security are improved, their livelihoods will be changed. Ghats and connecting routes are needed to develop. Dredging is also required.
13.	Chandpur launch Ghat	This is one of the most important ghats in Bangladesh. It maintains a good communication route all over Bangladesh through this river. Everyday about 120-150 launches move through this ghat. There are approximately 1,000-1,200 business institutions around this ghat. Every day about 20,000-25,000 people passes through this ghat. The depth of river is well enough. Facilities for women needed to be improved.
14.	Boro Station Mul Head , Dakatiya	If the vessels shelter is constructed here, business activities and tourism will be increased. Regular maintenance of the vessels shelter is important. It can also be used as terminal all the year round.
15.	Chandpur city	Local elites welcomed this project and they suggested that connecting road to any

	(KII)	ghats/terminals is necessary to improve. Security in the river is also important to increase the numbers of passengers.
16.	Char Bhairabi	There is no government land at the river bank. There is no passenger shade and electricity supply. A vessel shelter at the opposite side of the ghat will lead to change the livelihoods of the community.
17.	Moju Chowdhury Ghat	There are about 500-700 permanent shops and 300 temporary shops depends on this ghat. Hilsha fish is available here. Development of this ghat is really important. Dredging is necessary and businessmen love to buy the dredged materials.
18.	Boyar Char, Chairman Ghat (Fisherman Community)	There are 1,500 fishermen live here and they are dependent on the river. A lot of fishes are supplied from here to the entire Bangladesh by water ways. River sand quality is much better in this region. The land is cultivated with two crops in this area. Such as paddy, wheat, maize, sugarcane, vegetables etc. River transport cannot move without high tide so, dredging is essential.
19.	Chairman Ghat (Owner Association)	Approximately 15,000-20,000 fishermen live in this area. There is about 600 business units around this place. About 2,000-2,500 homestead surrounding the Ghat. There is abundance of Hilsha fish. Now this Ghat is remained as unused for 20 hours. Dredging is necessary. Improvement of the ghat is also necessary.
20.	Doulat khan launch ghat	About 95% people go through on waterways. The launch move to Noakhali, Alexander, Dhaka, Monpura, Hatiya, Doulatpur etc. from this Ghat. Goods are unloaded here from Cargos. There is river erosion record and threat and it is increasing day by day. There is no traffic signalling light and jetty. The people requested for an approach road to the terminal. There is no passenger waiting room. Development of the ghat is badly needed. Ghat development is important for better business environment.
21.	Tajumuddin launch Ghat	Everyday 400-500 people use this route. Most of the passengers go to the Dhaka and Chittagong. The people use this Ghat to go Jahir uddin, chor mozammel, kolatoli, monpura from this ghat. People also come from 15 K.M away to use this Ghat. In this area there are no other means of communications without Water ways. Dredging is essential and river erosion is common here. Navigability of the river is too low.
22.	Bheduriya ferry Ghat	People can travel to Khulna and Barisal from here through water ways. It is a busy ferry Ghat, everyday ferries are crossing the river up to 7-8 times. There are almost 200-300 business units/shops here. It has also a good communication through river way with Chittagong. Navigation difficulty during the low tide is remarkable. So, dredging is essential. No signal system is available at this Ghat. Need proper management of traffic light. When the terminal is developed, more business institutions will be established.
23.	Lahar hat (vatikana)	About 400-500 people use this Ghat every day. This Ghat is center of 200-250 business institution. Most of the people in this region are Labour and businessman. Almost 200 km distance will be reduced, if the launch or ferry uses this route to go to Chittagong. Communication among Paira, Mongla and Chittagong ports is easier through Laharhat. The whole route is needed to be dredged with a proper planning.
24.	Kaliganj Launch Ghat Vessel Shelter	All the ships from Chittagong use this route for everyday movement. They use Elisha- Barishal- Hatiya- Monpura-Hijla-Noakhali-Chandpur route for their communication. About 100% people depend on this route for their daily activities. No jetty is available in the ghat. Dredging is essential in the 3 km run up to Gobindopur Char. The present condition of Ghat should be improved as early as possible. If the Ghat can be improved, there must be a chance of increasing business sector. A vessel shelter can be made in the "Village Asha" adjacent to the launch Ghat of Ulania bazaar.

4.4 Project Impacts

Most of the terminals are on GoB land, but proposed launch terminal facilities will require approximately **2.093**[3] ha land acquisition. The proposed 6 vessel shelters are planned to be constructed on public land to avoid any negative impacts on the population near project sites.

At most of the project locations land belongs to BIWTA. This land is used for common purposes such as Ghat for boats, by the nearby communities. There are Persons without title to the land on the BIWTA land with shops and residences. Places of worship are built on BIWTA Land. BIWTA has built shops and leased them to shop keepers. This will lead to loss of livelihoods. At some locations access to common property resources such as Burial grounds will get restricted due to the present interventions. At some locations access granted to cultural practices such as immersion of ashes of the dead in rivers at certain ghats, will be impacted. Further access infrastructure such as roads will cause impacts as the present roads are narrow and they need to be widened for optimizing the capacity of the facilities built.

As per the ESIA, there are no small ethnic communities; indigenous people, at the project locations.

The following are the key social impacts due to project interventions:

1. Land acquisition and subsequent resettlement
2. Loss of Livelihoods
3. Inconvenience and nuisance during construction
4. Loss of access to CPRs
5. Likely increase in transport costs

For each of these sub-projects an RAP will be prepared, where required during the planning and design stage.

4.4.1 Proposed Management Measures

The following social management measures are proposed in this Resettlement Policy Framework:

- Development and adopting a Resettlement Policy Framework (RPF) to be used for all sub-projects under this project. This RPF should serve as a guide for further SIA studies and for preparation of RAPs under this project.
- The design will consider minimization of land acquisition and related impacts; and provides for access to graveyards, ash immersion points and other such traditional and cultural locations.

[3] BIWTA

- Integrate the rehabilitation of livelihoods into design of terminals and other infrastructure facilities. Designs to consider the following:
  - Livelihoods: such as integrating shops and vendors
  - Facilities for women such as: separate counters, waiting areas, sanitation, seating arrangements
  - Facilities for disabled
  - Arrangements to continue cultural practices
  - Design and general arrangement to be ready for impact identification and resettlement plan preparation
- Alternate temporary transit arrangements before resettlement
- Resettlement Policy Framework with clear entitlements
- Grievance Redressal Mechanism
- Community Engagement in planning and implementation
- Gender Mainstreaming Plan
- Disclosure: disclosure of resettlement plans

5. Resettlement Policy Framework (RPF)

5.1 Introduction

The Government of Bangladesh through the Ministry of Shipping has mandated the BIWTA to finance and develop IWT infrastructure. Now BIWTA aims to promote environmentally sound and sustainable, socially acceptable and economically viable IWT infrastructure sub-projects. BIWTA believes that each of these sub-projects will improve the living standards and the environment of populations of the locations and surrounding areas.

5.2 RPF - Objectives

The primary objective of the RPF is to provide guidelines for preparing mitigation plans. Another objective of this RPF is to improve the standard of living of the affected population. The other objectives of this RPF are to;

- Ensure the principles of Social Justice is adhered to at all times
- Avoid or minimize any negative impacts on the communities
- If land is required for project facilities, then same may be purchased under Willing Buyer-Willing Seller norm.
- Land acquisition using National Policy as and when required
- Assist affected population in improving their living standards, income earning capacity, and production levels, etc.
- Encourage and enable community participation in planning and implementing project components
- Provide assistance to affected communities in redressing their grievances

This RPF will address the following social issues:

- ❖ Land Procurement
- ❖ Community Engagement
- ❖ Special Attention to Women and Other Vulnerable Groups
- ❖ Grievance Redressal

5.3 Resettlement Policy Framework

BIWTA will use the following principles to minimize adverse impacts on affected persons and their community:

- Avoid or minimize acquisition of private lands and use as much public land as possible;
- Avoid or minimize displacement of people from homesteads, land valued higher in terms of productivity and uses, buildings/structures that are used for permanent business and/or commercial activities, dislocation of Avoid or minimize acquisition of private lands and use as much public land as possible;

- Avoid or minimize displacement of people from homesteads, land valued higher in terms of productivity and uses, buildings/structures that are used for permanent business and/or commercial activities, dislocation of Persons without title to the land /encroachers; and impacts on community facilities, such as educational institutions, places of worship, cemeteries, etc., and buildings/structures that are socially and historically important.
- Where the portion of a plot remaining after acquisition becomes economically unviable, the landowner will have the option to offer the entire plot for acquisition.
- The policy principles adopted are inclusive and cover both titled and non-titled persons. The affected without title will also be entitled for resettlement benefits.

Where adverse impacts are found unavoidable, project will plan to mitigate them in accordance with the following principles:

i. Resettlement of the project-affected persons will be planned and developed as an integral part of the project design.
ii. Absence of legal titles in cases of public land users will not be considered a bar to resettlement and rehabilitation assistance, especially for the socio-economically vulnerable groups.
iii. Vulnerability, in terms of socio-economic characteristics of the project affected persons/ households, will be identified and mitigated according to the provisions of RPF.
iv. Homestead-losers, including the poor and vulnerable households squatting on public lands, will be compensated for their physical assets on the lands and assisted during relocation.
v. People squatting on public lands under acquisition (without any legal agreement for right to use the land) will qualify for financial or any other form of assistance including relocation provided the project interventions affect significantly on their livelihood (lose more than 10% of their income) and cannot survive without income from the affected land/property.
vi. Assets like equipment, machinery or parts/ components thereof that can be dismantled and moved away intact will not be eligible for compensation, but the owners will be paid the actual costs of dismantling and moving them.
vii. Where the project activities cause community-wide impacts affecting community facilities, access to common property resources, etc., PMU will rebuild them with Project finances or provide alternatives in consultation with the user communities.

As per the impacts of the sub-projects, i.e., if the number of PAPs exceeds 20, then a comprehensive Social Impact Assessment needs to be conducted and a Resettlement Action Plan (RAP) needs to be prepared, following the guidelines given in this RPF. When the impacts are limited, i.e., if the number of PAPs are less than 20, then an Abbreviated Resettlement Action Plan (ARAP) needs to be prepared, following the guidelines given in this RPF.

5.4 Buying Land – Willing Buyer and Willing Seller

When buying land is an easier alternative to land acquisition, BIWTA will use this options as being used by other departments under similar projects. Under the willing buyer and willing seller norm, suitable land is identified by BIWTA. After this, BIWTA representative will approach the land owner and obtain his/her consent. The willing sellers convey their readiness to sell the land in writing to BIWTA. With the local existing market price for similar land is taken as the starting point, and then a price is negotiated with the seller. The Price needs to be at least equal to the prevailing and actual market price in the area, not that of the registration value at the DC's office. After negotiating the price, BIWTA will obtain necessary internal approvals. Meanwhile BIWTA will verify the land ownership, possession, interested parties, documents, etc. with the help of Land Office. After completion of verification, BIWTA and seller both will communicate this decision to Land Office, Department of Land. The seller with the assistance of Surveyor from local registration office, gets the land surveyed and demarcated in the presence of adjoining land owners. Disputes and claims, if any will be resolved then and there. After verification, BIWTA calls a meeting with the seller where all the information about the land is shared and discussed and if seller agrees, then BIWTA will proceed further to purchase the land. The entire process of consultation, negotiation, agreement, transfer of land documents will be recorded by the BIWTA and will be available for review by the World Bank. At any point of time during the process, the seller will have the right to refuse to sell.

5.4.1 Registration and Mutation of Records

As a first step towards purchase, a Baina deed is prepared, if necessary, and registered with the local Land Office. This deed is signed by BIWTA and Seller and token advance is given to seller by BIWTA. This Baina deed is valid for 3 months. The deed is registered with Land Registraton Office after paying necessary fee. Once the registered deed is received, it is kept in the BIWTA office. After Baina deed, the BIWTA will erect signboards saying that BIWTA is the owner of the land along with land transaction information. Within 3 months, a sale deed is prepared and registered with Land Registration Office. During registration the remaining amount is paid through cheque to the seller. BIWTA receives the sale deed from the Land Registration Office. This deed is kept at the BIWTA local office. Later the Land Dept updates their records, through mutation, once the BIWTA applies for mutation. From then on land belongs to concerned BIWTA.

5.5 Land Acquisition

When land needs to be acquired as per the Act, the following procedures will be followed:

- BIWTA produces Land Acquisition Proposal (LAP) to DCs with Administrative Approval from the Ministry of inland water transport on the acquisition.

- DCs carry out feasibility study of the acquisition and submit the proposal with the feasibility report to the Ministry of Land (if the land is more than 16.67 acres) or to the Divisional Commissioner (if the land is less than 16.67 acres) for approval of each case.
- Upon approval of the LAPs from Ministry of Land (MOL) or from Divisional Commissioner, as the case may be, DC serves notice under section 3 of the Acquisition and Requisition of Immovable Property Ordinance (ARIPO), 1982 to the recorded owner of the affected property for public appraisal.
- Acquiring Body (DC) and Requiring Body (here BIWTA) representatives conduct joint verification of the affected property within 3 days of serving notice u/s-3 and wait 15 days to receive any complain from land owners.
- After that the DC serves notice u/s 6 for entertaining claims from the potential affected persons.
- On the basis of joint verification survey data DC writes letter to Public Works Department (PWD) with information of affected structures, list of trees to the Forest Department and type of crops to the Agriculture Department for valuation as per government rule.
- DC also collects recorded land price from the concerned Sub-register's office for 12 months previous time from the date of notice under section 3.
- The DC prepares award for compensation in the name of recorded owner.
- Upon placement of fund, the DC serves notice u/s 7 to the titled DPs for receiving Cash Compensation under Law (CCL) within 15 days from the date of issuing notice u/s 7.
- The affected people are noticed to produce record of rights to the property with updated tax receipt of land, declaration on non-judicial stamp paper, photograph etc. before Land Acquisition section of DC office with the claim.
- Upon fulfillment of the criteria of the DC office i.e. requisite papers and document the LA section disburse CCL in the office or at field level issuing prior notice to the DPs.
- Local Government Institutions representative identifies the affected people during receiving CCL.
- As per ARIPO 1982, DC pays compensation to the legal owner of the properties for land, structure, trees and crops.
- After receiving CCL from the LA office and obtaining clearance from the Treasury Section of the DC the entitled person (EP) deposits the CCL to his own bank account.
- One copy of the CCL will be submitted to the BIWTA office for additional payment of compensation as per RAP
- The BIWTA (or its representative; consultant or NGO) will devise ID number for the CCL holder and prepare entitled persons file and entailment card (EP & EC) for payment
- The BIWTA will prepare ID card with photograph of the EP.

- The ID card will be jointly signed by the BIWTA and its representative and photograph will be attested by the concerned UP Chairman/ Mayor or Ward Councilor of the Municipality.
- The BIWTA/ BIWTA Representative will prepare necessary documents and papers (payment debit voucher, etc.) and submit to BIWTA field office along with EP payment list (indent) and EP-EC
- BIWTA field office makes the payment to EP.

5.5.1 Compensation Payment Norms

BIWTA will ensure that the properties (land, structure, and non-structured assets) to be affected by the project will be compensated at their full replacement cost determined by a legally constituted Resettlement Sub-committee (RSC) as per structure and mandated outlined in the RAP. The payment of compensation and other assistance, target replacement of productive assets and restoration of loss of income and workdays by the relocated households, especially the vulnerable households will be ensured by this committee. Compensation and other cash assistance will be paid through bank bills (cheques) payable to Bank accounts opened by the affected persons eligible for compensation and assistance under RAP. The Bank account will be in the joint name of husband and wife as the case may be.

Cash Compensation under Law (CUL) will be paid through two different channels as per provision of RAP. CCL will be paid by Deputy Commissioner mandated for acquisition of land for the PMU while PMU will directly pay the remaining as per requirement of the RAPs directly to the project affected persons. PMU with the help of the project consultants will advise, assist, and monitor the affected persons receiving compensation and other cash assistance for better use of the money.

5.5.2 Eligibility for Compensation and Assistance

Regardless of their tenure status to the lands used for project component, the project affected persons/ households will be eligible for assistance. However, a title would be required for payment of compensation for land. Pending further investigations to identify other impacts and impacted persons, PMU will mitigate impacts on the following:

i. **Private Landowners:** Persons who have legal rights to the acquired lands and other assets, such as houses, other structures, trees, etc. built and grown on them.
ii. **Persons without title to the land (Squatters):** Socio-economically vulnerable persons/ households including informal settlers, who do not have legal rights to the lands, but use them for residential, commercial or livelihood purposes. They will not be compensated for land, but for the assets built and grown on the land.
iii. **Owners of Displaced Businesses:** Compensation for income loss from businesses that are: (i) displaced from private lands and those belonging to requiring body and other public agencies and (ii) required to close down temporarily during

implementation of the civil works. In both cases, compensation/assistance will apply to the actual owners of the affected businesses.

iv. **Women headed and other vulnerable households:** Women heading the households and the households having income level up to area specific poverty line per year[4], physically challenged, elderly members, etc. will be eligible for a special assistance of one-time cash grants.

v. **Employees of Affected Businesses.** Persons who are employed in the affected businesses enterprises being operated on private or public lands.

vi. **Rental Income Earners.** Rental income from built premises situated on private lands by any displaced persons and on public land by vulnerable displaced persons[5].

vii. **Communities and Groups.** Where local communities and groups are likely to lose income earning opportunities or access to crucial common property resources used for livelihood purposes.

5.5.3 Compensation Principles and Standards

The following principles and standards will be used to determine compensation and assistance for persons/ households in the different impact categories:

Acquired lands and other assets

a. Replacement costs based on current market price to be collected from the different cross sections of the people for an equal amount of land of same use and quality.
b. Replacement costs of houses/structures and other immovable built items (e.g. water supply, sanitation, drainage, etc.), at current market prices of the same building materials plus the current costs of labor to build them.
a. Current market prices of trees and other assets, which are irreplaceable. Price of fruit trees will be determined considering the maturity and harvest price of fruits.
b. Current market prices of crops in the field or on trees, if the lands are used before harvest.
c. If the acquired land is agricultural and amounts to 10% or more of the total productive land owned by the affected household, a transition allowance at three times the value of the crops produced in a year on the acquired land.

[4] According to Bangladesh Bureau of Statistics (BBS,) the consumption expenditure for upper poverty line used in HIES 2010 that considered the minimum size of upper poverty line of BDT 1311 in rural and maximum size of upper poverty line of BDT 2038 in urban area. Acknowledging this, specific poverty lines will be derived according to HH size in particular area with rationales to inflation rates.

[5] Non-vulnerable PAPs those earn rental income by erecting buildings/structures on public lands will be ineligible for compensation/assistance, if the loss constitutes less than 30% of his/her total household income from all sources or the incumbent is not dependent on the rental income from this structures for his/her livelihood irrespective of size of the loss

5.5.3.1 Displacement from Homesteads

a. **Displaced from private lands:** Relocation assistance to the affected households who can arrange their relocation on their remaining land or by purchasing alternative lands. The land owners will be paid compensation for land and structure.
b. **Displaced from public lands:** Relocation assistance for Persons without title to the land and unauthorized occupants in their self-relocation process by their own. They will receive cash compensation for their structure at replacement cost, transfer and reconstruction grants, and other cash entitlements plus salvageable materials at no cost. This will be decided case by case during implementation.

5.5.3.2 Loss of Business, Employment and Rental Income

Temporarily closed businesses: Where business activities come to a complete closure temporarily during construction, the owners will be paid for income loss at rates based on average daily net income for the minimum number of days needed to reopen the individual businesses or to complete the civil works but not over 30 days. This will be applicable to owners opting for temporary relocation too.

Partially affected businesses: Where business premises are partially dismantled and the remainder is structurally safe and useable, compensation, calculated as above, for the minimum number of days needed to repair and reopen the individual businesses or to complete the civil works but not over 30 days.

Businesses completely displaced from present premises: Owners of affected business will be compensated for loss of income for 60 days in case of small businesses and 45 days in case of large scale business based on average daily net income from the business. They will be assisted in relocating their business in new locations. Owners of businesses opting for permanent relocation will be entitled for this assistance.

Loss of employment income from displaced businesses (Temporary or Permanent): Persons who have been continuously employed by the displaced or temporarily closed businesses for at least six months up to the day of the PAP census (cut-off date) will be compensated for the period until their employers restart their operations, or for a maximum of 30 days at the rate of current daily wage rate in the Project area. The daily wage paid by the employers will be the basis for assessing wage rates for the employees.

Loss of income from rented-out premises: Three months' rent at the current rates for loss of rental income from premises affected on private lands and vulnerable households on public lands. PAPs' land holdings and total income from all sources have to be captured during RPF implementation for determining vulnerability.

5.5.4 Eligibility and Entitlement Matrix

5.5.4.1 Eligibility Criteria

All PAPs irrespective of their title will be entitled to compensation and assistance based on loss and impact categories identified through census survey in respect of the policy guidelines adopted for the project. Nevertheless, eligibility to receive compensation and other assistance will be limited by the cut-off date. The absence of legal title will not bar PAPs from compensation and assistance, as specified in the entitlement matrices.

PAPs with titles will receive compensation under law and those without title will receive cash entitlements under the RPF policy. Title owners will receive additional compensation on top of DC's payment dispossession. Vulnerable PAPs will qualify for additional assistance to facilitate their relocation and restore their livelihood status. Non-vulnerable households with structures affected will be entitled to compensation for structures and assistance for shifting and reconstruction of the same.

5.5.4.2 Compensation and Entitlements

An Entitlement Matrix has been prepared for the project on the basis of field study and consultations with all stakeholders, in particular the PAPs and government officials, as a part of preparing the resettlement policy framework. A person could be eligible for compensation/entitlement in more than one category of losses and in more than one mouza. DCs will pay CCL for each mauza separately for one person whose lands/assets have been acquired in more than one mauza[6]. Entitle matrix is given below under table 11:

[6] The awards or CCLs are determined under units of Mauza (minimum boundary under land administration system in Bangladesh). As a result, a person becomes entitled to as many awards or CCLs as the number of mauzas where his/her property is acquired. The awards are paid separately for each mauza and each category of losses i.e. land, structure, trees, etc.

Table 11: Entitlement Matrix

Entitled Person	Entitlement	Application Guidelines	Responsibility
• A.1 : Loss of Agricultural Land	•	•	•
• Legal owner(s), as determined by DC • Co-sharers of the acquired land	• Cash Compensation under Law (CUL), which includes 50% premium • Compensation for standing crops • Other compensation and benefits as per LA law	• Market prices of land determined by the DC. • One month's advance notice to be issued in time to harvest standing crops. • Standing crops (if any) will be assessed at the time of taking over land by DC.	• BIWTA is responsible for overall execution and coordination, • DC will pay CUL to all legal owners • BIWTA to inform PAPs of RAP policies, assist in updating records, etc.
A.2 : Loss of Homestead Land	•	•	•
• Legal owner • Co-sharers	• Cash Compensation under Law (CUL), which includes 50% premium on market price.	• Market prices of land • Rental Allowance	• Same as A.1
A.3: Loss of Ponds and Fish Stock	•	•	•
• Legal owner of the pond, • Legal tenant as per registered lease.	• Cash Compensation under law (CUL), which includes 50% premium and cost of digging. • If the pond is under lease compensation from DC as per lease conditions.	• Market price for pond. • If the fishpond is on public land or on vested land and under lease from GoB, the PAP is entitled to compensation for existing fish stock at current market price as per law.	• DC will pay CUL to all legal owners, genuine lease holders and those with the legal evidence of interest in the lands. • DC will determine CUL of fish stock and market price of pond with assistance from concerned departments.
A-4: Loss of Houses/Structures Used for Living and Commercial Activities	•	•	•
• Legal owner as determined by DC	• Cash Compensation under law (CUL), which includes 50% premium.	• Legal Owners: Applies to all houses/structures standing on the acquired private lands at the time of issuance of Notice-3.	• DC will pay CUL for structures to all legal owners, • DC will determine CUL

A-5: Loss of Trees, Bamboo and Banana Groves	•	•	•
• Legal owners as determined by DC • People with valid lease • Groups sponsored by public agencies/ NGOs.[7]	• Timber trees and bamboos: Compensation under law (CUL) at market price. • Fruit-bearing trees (without timber value) and banana groups: Compensation under law (CUL) at market price.	• Estimated market value of different species of trees as per LA law, based on categorization as per Divisional Forest Office. • Where ownership is in group, compensation will not be paid to any individual or the sponsoring agency, but market price of trees will be paid to group members as per their share.	• DC will determine market price of trees • BIWTA to inform PAPs of RAP policies, assist in updating records, • DC will determine CUL based on price provided by Forest Department.
A-6: Loss of Standing Crops	•	•	•
Cultivator (person who planted the crop) whether owner, legally recognized lease holder, tenant, sharecropper, etc. as identified by DC	• Compensation for standing crops	• Estimated market value at harvest, to be determined by DC • Advance notice to be issued in time to harvest the standing crop.	• DC will determine market price of crops with assistance from Department of Agriculture Extension and Marketing Department at district level
B: ADDITIONAL COMPENSATION/GRANTS	•	•	•
B.1 Loss of Agricultural Land	•	•	•
• Legal owner(s), as determined by DC • Co-sharers/ to be determined by title deeds/records by DCs. **Current owners and users of vested property (land) or without lease (to be identified by the PAVC during survey).**	• Compensation Top-up on CUL to reach Replacement Cost, where applicable. • Transition allowance (TA) for two crops @ BDT 300/dec/ crops • Rental allowance for vested and non-resident (VNR) property (without lease) equivalent to DC's rate fixed for legally leased VNR.	• Current market prices of land determined by the PAVC • Replacement Cost includes current market price (CMP) plus stamp duty and registration cost for titling. @ 10 % of CMP • One month's advance notice • Compensation Top-up will be paid by BIWTA and calculated when CUL is less than Replacement Cost.	• BIWTA is responsible for overall execution and coordination • DC will pay CUL to all legal owners, and those with the legal evidence of interest in the lands. • BIWTA will determine Replacement Cost with assistance from the projects' Property Assessment and Valuation

[7]NGOs or public agencies enter into contracts with groups of community peoples under the Social Forestry Rules 2004 (revised March 2010) for social forestation on slopes of flood embankments, roads, railway embankment, riversides or any other public spaces. These groups are not owner of the land but get a share of the revenues from the planted trees (sale of logs and residues) as they are also responsible to nurse the trees under the contract.

		• TA will be paid to a person losing any quantity of productive land area @ BDT 300 per decimal/crop for two times	Committee and the RAP Implementing Agency
B.2 : Loss of Homestead Land	•	•	•
• Legal owner(s), as determined by DC • Co-sharers to be determined by title deeds to be determined by DC • Current owners and users of vested property (land) without lease	• Compensation Top-up on CUL to reach Replacement Cost, where applicable. • Homestead Development Allowance (HDA) for title holders and persons without title to the land • Restoration of pre-acquisition level basic utilities (water supply, sanitation, electricity, etc.) at relocated site. • Rental allowance (RA) for comparable living accommodations to owner users of lands.	• Current market prices of land determined by the PAVC to be the basis for determining Replacement Cost and Compensation Top-up. • Replacement Cost includes current market price and stamp duty & registration cost for titling @ 10% of CMP. • Compensation Top-up will be paid by BIWTA • HDA for titled holder @ BDT 20,000 for each HH and for Persons without title to the land it is BDT 50 per square feet of floor area of affected primary structure • Rental Allowance (RA) will be determined by PAVC and paid to owner users of vested property without lease.	• BIWTA is responsible for overall execution and coordination, ensuring GOB's support and timely financial disbursements. • DC will pay CUL to all legal owners • DC will determine CUL and BIWTA will determine Replacement Cost with assistance from the projects' Property Assessment and Valuation Committee.
B.3: Loss of Ponds and Fish Stock	•	•	•
Legal owner of the pond to get compensation for land area, while Persons without title to the land to get compensation for fish stock.	• Compensation Top-up payment on CUL to reach Replacement Cost • Market price of fish stock (PFS) and PAPs are allowed to harvest and take away the fish stock.	• If the fishpond is on public land or on vested land and not under lease from GoB, the PAP is entitled to compensation for existing fish stock at current market price	• BIWTA is responsible for overall execution and coordination, ensuring GOB's support and timely financial disbursements. • BIWTA will determine current market price of fish stock and Replacement Cost of pond with assistance from the PWD.
B.4: Loss of Houses/Structures Used for Living & Commercial Activities	•	•	•
• Legal owner as determined by DC	• Compensation Top-up payment on ODC's CUL to reach the replacement cost	• Legal Owners: Applies to all houses/structures standing on the acquired private lands at the	• BIWTA to inform PAPs of RAP policies, assist in updating records,

	• Structure Transfer Grant (STG) • House Construction Grant (HCG) • Vulnerable and female headed households will get special cash assistance. • All house/structure owners are permitted to take away the salvageable building materials free of cost.	time of issuance of Notice-3. • Persons without title to the land will be paid compensation (replacement cost) for all structures built on public lands. • Shiftable Structure - Structure transfer grant (STG) for shiftable structures will be @ 10% (ten percent) of the replacement cost of structures and House construction grant (HCG) @ 10% (ten percent) of the replacement cost of structures; • Non-Shiftable Structure - STG only for non-shiftable structures @ 10% of replacement cost of the structure. • Vulnerable households: One-time cash assistance @ BDT 5,000 (five thousand). • Women headed vulnerable households without adult male members to shoulder household responsibilities will get additional one-time cash assistance of BDT 5,000 (five thousand). • Small mobile structures on wooden or bamboo legs (poles not fixed on ground) which can be shifted without dismantling (structures on legs) are not eligible for compensation (small pan-bidi shops, groceries, tea stalls, etc.) but will be assisted in finding alternative location and given Structure Transfer Grant (STG) to cover any damage and cost of shifting @ 10% (ten percent) of the replacement cost of structures. • Tenants of residential or commercial premises will be eligible for shifting grant of BDT 5000 (five thousand) for shifting of belongings and one month rental allowance @ BDT 3000 (three thousand).	pay Top-up, HCG, STG, HDA and SGB, and monitor and report progress on RAP implementation. • BIWTA will determine Replacement Cost of structures with assistance from the PWD.

• Non-titled persons and Persons without title to the land those own houses/structures built on public lands/BIWTA's lands (shops and residences)	• Replacement cost of structures determined by PAVC. • Structure transfer grants (STG) and House construction grant (HCG) for houses/structures. • Eligible for plot of 4.00 decimal at CUL value in the RS if they desire so. • Homestead Development Allowance (HDA) for land development • Vulnerable and female headed households will get special cash assistance. • All house/structure owners are permitted to retain the salvageable building materials.	• Same as above	• Same as above
• B.5: Loss of Trees, Bamboo and Banana Groves	•	•	•
• Legal owners Socially recognized owners, such as Persons without title to the land • People with valid lease from GOB agencies. • Groups sponsored by public agencies/ NGOs.[8]	• Compensation Top up (if any) on DC's CUL for timber trees, bamboo, fruit bearing trees (with timber), etc. and 30% of timber value in case of fruit bearing trees. • Banana groves: Compensation Top up on DC's CUL estimated for one time crop of each grown-up tree on private land or current market value planted on government land (not covered by DC). • Trees grown under public/NGO sponsored program	• Estimated market value of different species of trees, based on categorization as per Divisional Forest Office. • Value of fruits for the grown up (big and medium) trees will be calculated as 30% of timber value for one year. • Where ownership is in group, compensation will not be paid to any individual or the sponsoring agency.	• BIWTA to inform PAPs of RAP policies, assist in updating records, pay market price Top-up, HCG, TRG, and CS, and monitor and report progress on RAP implementation. • DC will determine CUL and BIWTA will determine Replacement Cost of structures with assistance from the projects' Property Assessment and Valuation Committee

[8] NGOs or public agencies enter into contracts with groups of community peoples under the Social Forestry Rules 2004 (revised March 2010) for social forestation on slopes of flood embankments, roads, railway embankment, riversides or any other public spaces. These groups are not owner of the land but get a share of the revenues from the planted trees (sale of logs and residues) as they are also responsible to nurse the trees under the contract.

• B 6: Loss of Standing Crops	•	•	•
• Cultivator whether owner, lease holder, tenant, sharecropper, etc. (formal or informal arrangements) identified by Census and verified by PAVC.	• Compensation Top up (if any) on DC's CUL for legal owner and market price of crops planted on GoB land by local people • Cultivator will retain the crops and plants.	• Estimated market value at harvest, to be determined by PAVC. • Advance notice to be issued in time to harvest the standing crop.	• Same as above
B.7 Loss of Community Properties	•	•	•
• Community/ Managing Committee of the affected Community properties constructed on Private/ Wakfo or Government land including access to graveyards and immersion points	• Compensation Top-up on DC's CUL to reach the Replacement Cost or Replacement Cost in case of non-payment by DC. • Structure Transfer Grant (STG) • House Construction Grant (HCG). •	• Project Authority and consultant will consult the Community including Managing Committee to finalize relocation site of the new community structure • Community structure will be better or at last similar to the previous one if it is constructed by the project. • If the structure is constructed by the managing committee, the project will ensure monitoring during construction. • In case on mosque, the affected one cannot be demolished until new one is constructed	• BIWTA to inform PAPs of RAP policies, assist in updating records, pay Top-up, STG, HCG, and monitor and report progress on RAP implementation. • BIWTA will determine Replacement Cost of structures with assistance from the projects' Property Assessment and Valuation Committee and the INGO
C. OTHER RESETTLEMENT BENEFITS	•	•	•
C.1: Loss of Business Income from Displaced Commercial Premises	•	•	•
• Business operators in the affected permanent premises (title-holders and non-title holders; whether owning or renting premises) • Owner of the rented-out premises situated on private and public lands	• Compensation for loss of business/ trading income. • Cash assistance for 30 (thirty) days for temporarily relocation business • Cash assistance for 60 (sixty) days net income for Permanently relocated	• Compensation for loss of permanent loss of business income for large-scale[9] business premises based on average daily net income but not over 1000 (one thousand) per day for 45 (forty five) days as determined by PAVC. • Compensation for loss of permanent loss of	• DC may determine compensation for loss of business income based on onsite verification jointly with BIWTA or only consider business structures. • BIWTA will determine average net

[9] Business premises operating large business such as industry, wholesale depot, etc. and having Income Tax certificate

	business • Compensation for loss of rental income from rented-out premises on the right of way.	business income for small and medium business premises based on average daily net income but not over BDT 500 (five hundred) per day for 60 (sixty) days as determined by PAVC. • Partially and temporarily affected business owners will receive compensation for the number of days needed to repair and/or reopen the businesses not exceeding 30 (thirty) days @ daily net income but not over BDT 500 (five hundred)/day. • Three months' rent to owner of the rented out premises on private land, as determined by PAVC.	daily income from affected businesses with assistance from the projects' Property Assessment and Valuation Committee and the IA and based on findings will determine compensation for loss of business/rental income. • BIWTA to inform PAPs of RAP policies assists in updating records, pay Top-up or market price, and monitor and report progress on RAP implementation.
C 2: Temporary Loss of Income (Wage Labors in affected shops)	•	•	•
• Adult persons employed continuously for at least six months in businesses displaced from private and public lands.	• Grant to cover temporary loss of income (GTL) from wage employment	• Length of employment to be counted backward from the cut-off date. • GTL will be equivalent to 30 days wage at the rate of daily wage at current market price determined by PAVC.	• BIWTA will determine average daily wage rate in the project area with assistance from the projects' Property Assessment and Valuation Committee and the IA and based on findings will determine compensation for loss of wage.
• Women and other Vulnerable persons	• Additional allowance of 30% over and above the entitlements • Women will be actively considered and will get employment opportunities in created by project and as specified in RPF.	• RPF guidelines for women and other vulnerables	• BIWTA Environment and Social Cell

5.6 Dredged Material Disposal Plan

Criteria for selection of site for dredged material deposition in Meghna river for 130 km. The remaining 770 the dredged materials will be disposed in the river. Approximate volume of dredged materials in the Meghna River is 5.8 million m3 annually. Composition of the dredged material is dominated by sand follwed by silt and clay The following table provides options for disposal of dredged material. On-,land disposal of the dredged material will be last option provided there is no additional adverse impacts on the adjacent land and on the community's livelihood. The contaminated dredge material will be disposed off in the river.

Dredged material disposal plan for non-contaminated dredged material is given below:

Table 12: Locations of options for disposal

Location of Dredging	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting (m)	Northing (m)	Proposed Location	Easting (m)	Northing (m)	Proposed Location				
Algi Bazar, Raipura				597449	653482	Algi Bazar, Raipura			Uttar Araisidha	
Hashempur Moulovi bazar				594420	651977	Hashempur Moulovi bazar				
Noorpur Bazar				587293	650907	Noorpur Bazar				
Char Madua Bazar				588582	643238	Char Madhua			Char Madhua	
Barikandi				586599	640644	Barikandi				
Delarpur Bazar				577879	641578	Delarpur Bazar				
Hazipur Bazar				575680	644652	Hazipur Bazar				
Sreemoddi Bazar				578184	621109	Purba Uzan Char South				

Location of Dredging	Table 12: Locations of options for disposal									
	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting (m)	Northing (m)	Proposed Location	Easting (m)	Northing (m)	Proposed Location				
Uttar Homna				575286	617252	Uttar Homna				
Dhanukunda Bazar				553077	616517	Dhanukunda Bazar				
Tarabo Bazar-2				550977	623029	Demra				
Ekhlaspur				560847	580770	Kachikata Bazar			Eklaspur	
Rajrajeswar				562819	576649	Rajrajeswar				
Kallyanpur				568137	572895	Kallyanpur				
Kallyanpur				565336	567631	Puran Bazar, Chandpur				
Eidgah Bazar				560010	563081	Eidgah Bazar				
Char Fatejonpur Bazar				557755	559466	Char Fatejonpur Bazar				
Akhanar Hat				544348	544621	Akhanar				

Location of Dredging	Table 12: Locations of options for disposal									
	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting (m)	Northing (m)	Proposed Location	Easting (m)	Northing (m)	Proposed Location				
						Hat				
Nazirpur				537119	538240	Nazirpur				
Hijla				553122	537217	Hijla				
Koter Hat				559798	523076	Koter Hat				
Zia Bazar				554629	511315	Zia Bazar				
Jangalia				550847	511709	Jangalia				
Mokrampotab Bazar				543028	514797	Mokrampotab Bazar				
Barisal				538761	510046	Barisal				
Shaheber Bazar				584411	517266	West Kadir Panditer Hat				
Selim Bazar				594599	492033	Selim Bazar				
Chandnandi				612697	486702	Chandnandi				
Nalchira				617769	473548	Nalchira				
Alokbali									Alokbali	

<table>
<tr><th rowspan="4">Location of Dredging</th><th colspan="10">Table 12: Locations of options for disposal</th></tr>
<tr><th colspan="6">Option 1</th><th>Option 2</th><th>Option 3*</th><th colspan="2">Option 4*</th></tr>
<tr><th colspan="3">In the river (Coordinates in BTM)</th><th colspan="3">Scour hole (Coordinates in BTM)</th><th rowspan="2">Existing stake yard of the sand traders (to be identified)</th><th rowspan="2">Government Land/Char land (encumbrance-free)</th><th rowspan="2">Lease land from the private</th><th rowspan="2">Community</th></tr>
<tr><th>Easting (m)</th><th>Northing (m)</th><th>Proposed Location</th><th>Easting (m)</th><th>Northing (m)</th><th>Proposed Location</th></tr>
<tr><td>Paschim Saifullakandi</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Paschim Saifullakandi</td><td></td></tr>
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<tr><td>Meghna Estuary -3</td><td>653946</td><td>457537</td><td>Meghna Estuary - 3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

5.6.1 Criteria for selection of land for disposal/ storage:

I. The area would be close to the river (within 2 km beyond the river bank)
II. Close to the dredging location (3 km includes the river bank)
III. Encumbrance-free land
IV. No adverse impact on income and livelihood of individual or community
V. Non-agricultural land
VI. No beels/ marshy /reed land
VII. Contaminated sediment (a permanent disposal site is required)
   a. No beels/reed areas
   b. Government owned land (encumbrance free)
   c. Private land (non-agricultural)

Details of the safeguard measures of the contaminated sediment disposal is included in the Environment Management Plan (EMP).

5.6.2 Principles for lease agreement

The Project Management Unit of the Bangladesh Inland Water Transport Authority (BIWTA) will arrange land for disposal of the dredged materials following GoB law i.e. Acquisition and Requisition of Immovable Property Ordinance 1982 (Ordinance No. 2) and subsequent amendment until 1994. The land will be requisitioned through the concerned Deputy Commissioners of the project districts. The PMU will pay the required amount to DC office as per law as required for renting/leasing for the particular land for the sand deposition. DC office will annually assess the rent for the land and claim fund from the PMU to disburse to the lessees. A lease agreement would be signed between the PMU and the land owners according to the broad principles as under:

1. DC will identify the actual owners of the proposed land taking into account of the record of rights to the property
2. Rent would be paid through the DC office on yearly basis at the beginning of the year
3. Land will be used for project purposes only (sand deposition)
4. Land will be restored to original condition and returned to the land owners after agreed lease period.
5. The lease agreement will be based on requisition of land.

5.7 Community Engagement

BIWTA will ensure the engagement of target communities through continued consultations for planning and full community management of implementation and monitoring of sub-project activities. Consultations will be held at regular intervals with target communities, GS/ GP/UP members, Women, etc. In general, the following consultations will be carried out during the project cycle.

- Socio-economic survey for preparing the baseline of the PAPs and vulnerable families

- Estimation of land requirement; possibilities of willing sale
- Motivation of titleholders to facilitate the willing sale
- Implementation of the IEC/ Communication plan for awareness creation about project activities
- Identifying livelihood support programs
- In order to keep the momentum of engagement, activity specific consultations and a quarterly overall consultation will be held with all community groups.

5.7.1 Stakeholder Participation

BIWTA recognizes the fact that affected communities are primary and key stakeholders of the project. Hence, the BIWTA would ensure that these stakeholders are consulted on issues and they participate in all the sub-project activities including planning and implementation. The BIWTA would address the legitimate concerns of community members and provide opportunities and avenues for consultation and their participation. In order to provide a sense of ownership and ensure sustainability, the community members would be a part of the decision making process. The project has a commitment for community participation in each of the sub-projects taken up.

5.8 Special Attention to Women and Other Vulnerable Groups

The vulnerable groups include Women Headed Households, Destitutes, Below Poverty Line families, Old Aged, Differently Abled, Chronically Ill and Orphans. It is envisaged that in the course of conducting Social Assessment and preparing and implementing Social Management Plans and Resettlement Action Plans, interests of these vulnerable groups would be adequately addressed and protected.

5.8.1 Vulnerable Groups

Like in other projects, as per available experience, in these sub-projects as well, women are likely to experience differential socio-economic setbacks due to their disadvantaged positioning within socio-economic structures and processes. This is likely to be manifested most in the adverse conditions to their participation and engagement. In order to mitigate such impacts, BIWTA during verification and socio-economic survey shall collect information on the following:

- Number of women headed households and Small Ethnic Communities households and other vulnerable persons
- Socio-demographic characteristics of affected women and Small Ethnic Communities and other vulnerable groups
- Health status including number of children per woman
- Women's role in household economy by collecting information on usual activity; occupation; etc.
- Time Disposition
- Decision making power among women

As women are often the worst victims of transition between poverty and alleviation, they have to be integrated in the project as full-fledged participants taking part in all the stages of the project starting from planning through implementation and on to the post-project stages. This is the only way to make sure that the process of restoring living standards an exercise in equitable distribution of resources and benefits in a gender sensitive manner.

5.8.2 Actions to be taken

The BIWTA and its representative offices has to perform following tasks:

- Ensure participation of vulnerable groups in project activities
- Ensuring project benefits to vulnerable persons
- Carrying out other responsibilities towards vulnerable groups

Participation and engagement of women and other vulnerable groups can be ensured specifically in the following ways:

- During the project initiation, conduct a survey and identify Women and Other Vulnerable Groups in the village. Document their details, socio-economic status, poverty, vulnerability, etc. during this survey.
- Ensure that the women and other vulnerable groups are consulted and invited to participate in group-based activities, to gain access and control over the resources.
- Ensure that women and other vulnerable groups are actually taking part in issuance of identify cards, opening accounts in the bank, receiving assistance amounts through cheques in their name, etc. This will further widen the perspective of participation by the women and other vulnerable groups in the project implementation. While registering properties make sure they are registered in both the spouses names.
- Provide separate trainings to women and other vulnerable groups for upgrading the skill in the alternative livelihoods and assist throughout till the beneficiaries start up with production and business.
- Initiate women's Self-Help Group linking with special development schemes of the Government. Also form special SHGs for other vulnerable groups where possible and required.
- Encourage women and other vulnerable groups to evaluate the project outputs from their point of view and their useful suggestions should be noted for taking necessary actions for further modifications in the project creating better and congenial situation for increasing participation from women and other vulnerable groups.
- Wherever possible, women and other vulnerable groups involvement in construction activities should be encouraged in order to help them have access to benefits of project activities.

All these done in a participatory manner might bring sustainable results in positive outcomes including income improvement of women and other vulnerable groups.

5.8.2.1 Other Actions

The following actions would result in women and other vulnerable groups' participation and their engagement.

- Cases of assistance to vulnerable groups/ persons should be handled with care and concern considering their inhibited nature of interaction.
- All assistances would be paid in a joint account in the name of both the spouses; except in the case of women headed households and women wage earners.
- BIWTA representatives shall prepare a list of able bodied and willing women and other vulnerable persons for constructional activities and utilize their services.
- At present there are not many women among the project staff. It should be noted that this project primarily interacts and deals with women at village level, but the number of women staff at cluster, district and regional level is far below that of men. Hence, at least half (subject to a minimum of one third) of the project staff and all other involved agencies (including consulting agencies) staff should be woman. When qualified/ skilled women are not available, women with lesser qualifications/ skills may be employed and trained. They may be encouraged and facilitated to obtain the necessary qualifications and/or skills during the employment. Women personnel may be replaced during the period of project contract, only with women persons of equivalent qualifications and experience.
- Same wage rate for men and women must be ensured.
- Small ethnic communities' population identified and they should be given first preference in selection for any project benefit, viz., infrastructure, demonstration projects, tube wells, livelihoods, etc.
- The petty contracts arising out of the sub-project should be considered for entrusting to SHGs on community contract basis.
- While selecting community members for training at least half of them should be women and vulnerable persons.

5.9 Grievance Redress Mechanism (GRM)

5.9.1 Objective of the GRM

The Project will establish a project level Grievance Redress Mechanism (GRM) which will be implemented by Project Implementation Unit (PIU) at BIWTA with an aim to respond to queries or clarifications about the project, resolve problems with implementation and addressing complaints and grievances. The GRM will focus on corrective actions that can be implemented quickly and at a relatively low cost to resolve identified implementation concerns before they escalate to the point of harm or conflict. GRM will serve as a channel for early warning, helping to target supervision to where it is most needed and identify systemic issues.

The GRM will directly focus on and seek to resolve complaints (and requests for information or clarification) that pertain to outputs, activities and processes undertaken by the Project, i.e., those which (i) are described in the Project Implementation Manual; (ii) are funded through the Project (including counterpart funds); and (iii) are carried out by staff or consultants of the organization, or by their partners and sub-contractors, directly or indirectly supporting the project. It is envisaged that such cases would fall under (but are not limited to) the following categories:

- request for information, comment or suggestion, e.g., request for clarification as to the delay in reimbursing expenses of participants in a given training event;
- violation of rights or non-performance of obligations, e.g., complaint by consultant or firm whose contract is suspended as a result of presumed poor performance or non-delivery of agreed-upon outputs;
- grievances or offenses involving a violation of law, e.g., allegations of corruption; and
- complaints against project staff, members of project committees, consultants, and sub-contractors involved in project implementation

GRM will be implemented in two phases: 1) Phase 1 to support safeguards implementation, 2) Phase two of GRM will cover all components and overall project implementation. A formal grievance redress process for phase two will be outlined in the project's operational manual and a protocol will be set up and distributed to project staff and implementers. The project level protocol will build on existing GRM system developed by BITWA and experience of the initial GRM protocol which supports implementation of the safeguards explained below. The GRM will be IT based supported by toll free helpline.

It is envisage that the Project Implementing Unit (PIU) will have a dedicated person who can oversee the preparation of the guidelines and rollout of the project GRM. The Secretary of BITWA will be responsible for overseeing the overall GRM.

5.9.2 Scope of GRM

In the first phase the project will focus on establishing protocol and procedures for GRM related to safeguards as required per Bank policies. Bank-financed projects that trigger the OP 4.12 on Involuntary Resettlement require projects to establish a GRM in order to collect grievances related to the resettlement process which applies to this project. The scope of such GRM is relatively narrow, as it only solicits complaints from project beneficiaries that are affected by project activities and covered by dedicated Resettlement Action Plans (RAPs) thus the project protocol will be extended and expanded later to cover all project related grievances throughout project cycle.

In phase two, the project-level GRM will not only aim to address social but also environmental, financial management, procurement and other issues and will build on grievance system practices set up to meet requirements of OP 4.12. It will also build on existing informal and traditional structures of grievance redress—such as village committees and local user groups involved in delivery of the project and may be a cost-effective and a more accessible approach to grievance redress. However, its impartiality would need to be carefully examined before relying on traditional systems. Given that poor and marginalized communities often face the most obstacles in accessing and using GRMs, throughout the design process special attention must be given to integrating design features that make GRMs participatory and socially inclusive.

5.9.3 Phase One - GRM under Safeguard Issues

In the first phase of the GRM, the proposed GRM will build on existing BIWTA GRM system and will be supported to setting up of Toll Free number to register complaints for which the back of system will need to be developed to ensure that the following steps are followed:

A. List of front line staff, district and PIU with clear roles and responsibilities and the contact details. This is required to forward the complaint to the concerned official responsible for the task that may generate complaint and will be responsible for resolving too.
B. Outsource only the management of the system "receiving, registering, forwarding and closing the grievance".
C. Grievance will be addressed by the concerned person responsible for the task.
D. During this phase the GRM would cover all grievances apart from the resettlement related issues.

Given below is the suggested work-flow:

- Receive Complaint through the toll free number.
- Register Case no by issuing a complaint number to the complainant; Date and channel of receipt; Name of complainant; Gender, Father or husband, Complete address,
- Nature of compliant – list of options (loss of land/property or entitlements),
- Forward the compliant to the concerned person immediately via SMS.
- Within five days complain examined and resolved and reported on line.
- If not resolved within five days, SMS alert is sent out by the system to senior management.
- Complaint investigated and resolved within seven days from the date of receiving the complaint.
- Confirmation received from complainant on grievance redress and ticket number closed.
- Monthly reports to be generated from the system that provides feedback to improve the process of implementation of RPF.

Option for the complainant to move to the court is available under the existing laws

5.9.4 Phase Two – Establishment of Implementation Arrangements for Setting up Project Level GRM

This phase will start along with the start of civil works/ contracts. Experience from the phase one of GRM implemented to support social and environment safeguards will be used to extend the protocol and inform the design of project wide GRM. The project PIU will need to identify groups of users that are likely to use the GRM and assess the resources—human, financial, and technological—that are available (and required) for the GRM to function effectively while establishing the protocol to support all project components and implementation. PIU will need to develop standard operating procedures and flowcharts to detail how the grievance redress process will unfold within the project's operating structures and how it will be monitored and reported on. The overall process will be overseen by BIWTA Chairman. More specifically;

- Assign a dedicated GRM officer at the PIU (e.g. drafting operating procedures, guidelines and manual, and stand-alone information for GRM staff and users); and assign grievance redress responsibilities and train staff at the local level to handle grievances
- Raise awareness of the availability of the GRM through project-related events and by posting information about the GRM in public locations / project sites(e.g. via project boards)
- The communications strategy should aim to reach out to poor and marginalized groups and communication materials should be translated into local language
- Accept grievances through a variety of locally-appropriate channels (e.g., in-person, phone - set up toll free number, email);
- Register all grievances (e.g., ensure that all complaints lodged through local authorities are logged and tracked, and that data on resolutions is made public)
- Follow a clear and transparent procedure of complaint investigation (e.g., field visits, inspection of contractors and/or local project implementation teams, discussion with relevant service providers, etc.)
- Take a remedial action within a specified amount of days
- Monitor and evaluate grievance-related data

5.9.5 Legal Options to Aggrieved Parties

The aggrieved parties will have two kinds of options for addressing their grievances. One is the grievance redress mechanism incorporate in this framework as above. The other is the general legal environment consisting of court of law to address their grievances. These options will be disclosed to the communities during the public consultation process.

5.9.6 Grievance Redress Service of The World Bank

In addition to seeking to resolve their grievances through the GRM established at the government level, "communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project such as this operation may also submit complaints to the Grievance Redress Service (GRS) established by the World

Bank. The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may also submit their complaint to the WB's independent Inspection Panel, after having brought the complaint to the World Bank's attention through its GRS. Information on how to submit complaints to the World Bank's Grievance Redress Service is available at http://www.worldbank.org/GRS. Information on how to submit complaints to the World Bank Inspection Panel is available at www.inspectionpanel.org.

5.10 Institutional Arrangements and Capacity Enhancement

BIWTA will arrange for RPF/ RAP/ ARAP implementation and monitoring mechanism. The Project Implementation Unit (PIU) will have a Environmental and Social Cell in the PIU. These arrangements are given in Figure 3. At overall project level all RPF/ RAP/ ARAP oversight will be ensured by BIWTA. A Joint Director of BIWTA will head the Environmental and Social Cell of BIWTA. Two Deputy Directors, one each in charge for Environment and Social aspects of the project. The Deputy Director Social will be assisted by a Senior Land Acquisition and Resettlement Specialist and two other consultants each in charge for Community Engagement and Gender. The ESIA consultants will conduct ESIAs for sub-projects and prepare RAPs. The Supervision Consultants and Contractors will have Environmental and Social Specialists to supervise and implement RAP/ARAP provisions. NGOs will be commissioned for implementation of RAPs/ ARAPs. M&E Consultants will do the quarterly monitoring and mid-term and end-term impact evaluation and assessments. The arrangements for overseeing RPF compliance and RAP/ ARAP implementation are given in Table 13.

The following are the functions of Senior Land Acquisition and Resettlement Specialist and Social Team:

- Ensuring overall implementation of the RFP/ RAP/ ARAP in the project.
- Coordinating on a day-to-day basis with the implementing agencies for implementation of the RFP/ RAP/ ARAP.
- Advising and assisting the BIWTA and implementing agencies during the appraisal of the sub-projects to be taken up.
- Acting as an early warning system for the BIWTA with regard to the actions to be taken as per the RFP/ RAP/ ARAP.
- Preparing regular quarterly reports on the social compliance for the BIWTA for its own use or for transmission to The World Bank
- Ensuring that recommendations from supervision and monitoring are integrated into the project and the RFP/ RAP/ ARAP is updated periodically as necessary.
- Conducting social supervision of sub-projects on a quarterly/ half yearly basis.
- Taking all those actions which are necessary for effective implementation of the RFP/ RAP/ ARAP.
- Training and orientation of the PMU and implementing agencies' teams on the requirement, application and implementation of the RFP/ RAP/ ARAP.

- Reviewing the monitoring and evaluation reports submitted by the M&E Consultants to check compliance with the RFP/ RAP/ ARAP, as applicable to the sub-component/activity.
- Regularly visit project sites to review compliance with RFP/ RAP/ ARAP.
- Provide guidance and inputs to the BAPEPS and implementing agency teams on social management aspects.
- Ensure that GRM is functioning and act as a single point of contact for resolving queries related to social issues.

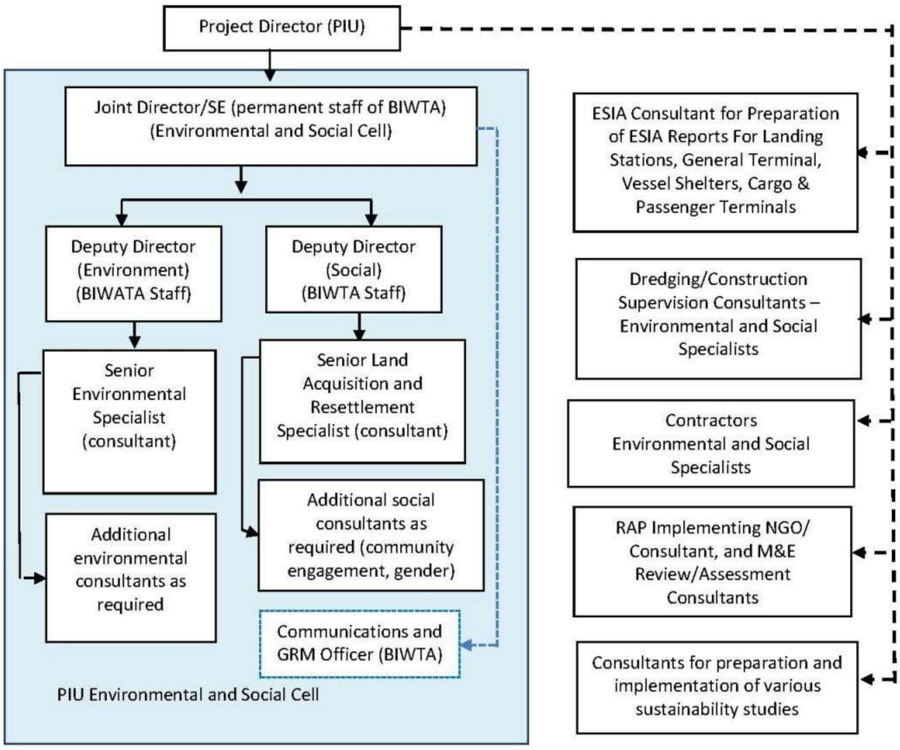


Figure 3: Institutional Structure for Environmental and Social Management of the Project

Table 13: Institutional Arrangements and Functions for RPF Compliance

Level	Organisation	Functions
Project	BIWTA Environment and Social Cell	➤ Orientation and training to Field Units on RPF/ RAP/ ARAP and providing oversight on the SIA process and its outputs. ➤ Assisting in fulfilling requirements for all Category sub-projects ➤ Review of monitoring reports submitted by the M&E Consultants on RAP/ ARAP implementation. ➤ Regularly visiting sub-project sites to review RPF compliance during sub-project planning and implementation. ➤ Providing guidance and inputs to the Field Units on social management aspects. ➤ Managing Monitoring Evaluation of RPF/ RAP/ ARAP implementation. ➤ Preparing Quarterly Compliance Reports and sharing them with The World Bank. ➤ All the actions related to ensure compliance with RPF.
Field	NGO	➤ Managing RPF/ RAP/ ARAP implementation and monitoring ➤ Collecting data for monitoring. ➤ Providing social assistance to communities. ➤ Coordination with the other agencies for RPF compliance. ➤ Monthly reporting on RPF compliance to BIWTA. ➤ All the actions related to ensure compliance with RPF as directed by BIWTA. ➤ Compliance screening and Categorization of all sub-Projects and support in preparation of RAPs/ ARAPs.

5.10.1 Monitoring, Evaluation and Assessment

An M&E Consultants will be commissioned to conduct quarterly monitoring and evaluation and report to BIWTA. The quarterly monitoring and evaluation will be done by these consultants. They will visit about an appropriate percentage of all category sub-projects, as decided by BIWTA. They will prepare appropriate formats for monitoring. BIWTA will send quarterly Monitoring Reports on RPF compliance to The World Bank. The M&E Consultants will conduct mid-term and end-term evaluation of RAPF/ RAP/ ARPA implementation. There is a need to internalize the Social Safeguards Management processes at all levels, as these cannot be treated as stand-alone and parallel functions any more. This internalization of social processes helps in better implementing the safeguards provisions, provided the capacity of implanting supervising agencies is adequately built in Safeguards Management.

5.10.2 Social Monitoring Indicators

The monitoring indicators are presented in table 14. While these are general, indicators can be added based on the sub-projects.

Table 14: Social Monitoring Indicators

Monitoring Indicators	Frequency	Agency
• Payment of compensation and entitlements before replacement • Time taken for land acquisition • Number of grievances registered and resolved • Number of court cases • Income patterns • Land holding status • Income from land • Changes in occupations • Housing status (area, floor, walls, roof, etc.) • Ownership of household assets • Length of rural roads (connectivity to nearest launch ghats) • Journey time • No. of training programs conducted • No. of personnel trained • Trainees' understanding of the training content • Achievement of learning objectives • Adherence to contract conditions and standards (housing, sanitation, crèches, use of local labour, equal wages to men and women, avoidance of child labour, etc.) • Absence of inconvenience and nuisance during implementation • Adherence to RPF/ RAP/ ARAP provisions/ guidelines during sub-project preparation and implementation	• Quarterly by Independent Consultants • Annually by PIU	• PIU guiding the collection of information on indicators • M&E Consultants • Implementing NGO

5.10.3 Capacity Enhancement

In order to enhance the capacity of BIWTA in social safeguards implementation several measures are proposed. These include a). orientations on RPF/ RAP/ ARAP and its components, b) national and international trainings on Social Assessment, Social Management and RAP Implementation. A detailed Capacity Enhancement Needs Assessment (CENA) need to be taken up for this purpose. The training programs will need to be designed as per the recommendations of this CENA. However, lump sum budget is provided for these initiatives.

5.11 RPF Budget

The total administrative budget for RPF implementation and social management activities under this project has been worked out as US$. 2.2 Million. The cost of implementing the proposed mitigation measures under respective Resettlement Action Plans (RAPs/ ARAPs), staff costs are not included in this costing. The detailed breakup of the administrative budget is presented in the table below.

Table 15: Administrative budget for RPF activities

S No.	Activity	Amount in US$
1	Social Safeguards Capacity Enhancement Needs Assessment	50,000
2	Orientations and workshops on RPF/ RAP/ ARAP	50,000
3	Safeguards Training – National and International	150,000
4	Consultants for Monitoring and Evaluation and Mid-term and End-term Impact Evaluation and Assessment at US$. 75,000 per year for 6 years	600,000
5	Preparation of specific social related community awareness materials (lumpsum) for communication campaign	100,000
6	NGO for RAP/ ARAP implementation assistance at US$ 50,000 per year for 6 years	300,000
7	Outsourced Staff Costs 10 persons * 7 years * US$10,000	700,000
8	NGO Costs Lump sum	450,000
9	Land requirement – Purchase LS Provision	150,000
10	Land requirement – Leased Land LS Provision	150,000
11	R&R Assistance LS Provision	1,000,000
12	Sub Total	3,400,000
13	Contingencies @ about 10%	400,000
14	**Total**	**3,800,000** **US$ 3.8 Million**

6. Annexures

6.1 Annexure 1: Social Screening Data Sheet

Part a: General Information

1. Location of the sub-project	
• Name of Sub-Project	
• Name of the Division	
• District	
• Block	
• Location	
2. Implementing Agency Details (sub-project level)	
• Name of the Department/Agency	
• Name of the designated contact person	
• Designation	
• Contact Number	
• E-mail Id	

Part b: Social Impacts Information

1. Land Requirement for the sub-project:

Details	Unit	Quantity	Classification/ Category	Present Usage and Users
Government Land	Acres			
Private Land	Acres			
Title Holders	Number			
Non-Titleholders – Encroachers	Number			
Non-Titleholders – Persons without title to the land (Squatters)	Number			
Various users of Govt. Land under various tenures	Number			
People losing livelihoods/ access due to loss of Govt. Lands project	Number			

2. Agricultural Land affected due to sub-project:

Details	Unit	Quantity
Total Affected	Number	
Title Holders	Number	
Non-Titleholders – Encroachers	Number	
Non-Titleholders – Persons without title to the land (Squatters)	Number	
BPL Families losing Agricultural Land	Number	

3. Dwellings affected due to sub-project:

Details	Unit	Quantity
Total Affected	Number	
Title Holders	Number	
Non-Titleholders – Encroachers	Number	
Non-Titleholders – Persons without title to the land (Squatters)	Number	
BPL Families losing Dwellings	Number	

4. Commercial properties affected due to sub-project:

Details	Unit	Quantity
Total Affected	Number	
Title Holders	Number	
Non-Titleholders – Encroachers	Number	
Non-Titleholders – Persons without title to the land (Squatters)	Number	
BPL Families losing Commercial Properties	Number	

5. Common Property Resources Affected: (Please give each type by number)

Type	Unit	Quantity
	Number	
	Number	
	Number	
	Number	
	Number	

S No	Items	Results
1.	Total no of HH affected due to proposed project activity (Single or multiple impacts)	
2.	Total no of vulnerable HH affected due to proposed project activity (Single or multiple impacts)	
3.	Total number of Community Property Resources affected	

Part c : Result/Outcome of Social Screening Exercise		
1.	No SA Required	
2.	SA Required	

Part d: Transect Walk Map

While filling in this data sheet, the implementing agency should hold a consultation with the local community through the Gram Parishad/ Ward in order to determine and sort out issues of land availability (including forest land), moderate any adverse social and environmental impacts and elicit necessary community participation in the programme. For this purpose the implementing agency should organise an informal 'Transect Walk' and prepare a map (Not To

Scale) of this and attach the same to this data sheet. The following points should be borne in mind while preparing this map.

- The Transect walk shall be undertaken by the Officer filling in this data sheet, accompanied by the member of Parishad/ Ward and other community members after adequate advance publicity.
- During the Transect Walk, issues relating to land requirements and its impact on landowners, encroachers, Persons without title to the land, etc. need to be discussed with members of the local community present. Collect all land related revenue records, maps and gazettes for supporting the claims and attach to this report. To this check list attach a typical cross section of the structure at its widest and note the land required.
- Environmental impact on vegetation, land, soil and water etc. shall be identified and noted for resolution.
- During the walk, due opportunity shall be given to interested persons to put forward their points of view.
- At the end of the walk and after recording the issues that arose during the walk, the action taken/ proposed to resolve the issues be noted. This shall be recorded by the official of the Parishad and countersigned by the members of Parishad/ Ward. A copy of this document shall be attached to the data sheet.
- During or after (as convenient) the Transect Walk, a map (Not To Scale) with the location of buildings, the features around the site, ownership of land need to be prepared. Identify all structures, viz., places of worship, schools, hospitals and other common property resources, forest land, etc. and locate on this Transect Walk Map.
- To this map attach some photographs showing and highlighting the most critical places.

6.2 ANNEX 2: Terms of Reference for Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) of River Terminals, Landing Stations and Vessel Shelters under Bangladesh Regional Inland Water Transport Project 1 (Dhaka-Chittagong-Ashuganj Corridor)

A. Background

The Bangladesh Inland Water Transport Authority (BIWTA) is planning to develop 'Bangladesh Regional Inland Water Transport Project 1 (Dhaka-Chittagong Corridor Project)', which involves investments in development of Inland Water Transport (IWT) routes and infrastructure between Dhaka – Chittagong IWT Corridor, including branches to Ashuganj, Narayanganj and Barisal. The World Bank is currently considering the project for financing. Key components of this proposed project include:

- **Component 1: Improved Inland Waterway Navigation:** This component includes inland Waterway Maintenance through long-term performance-based contracts for: (i) dredging/river maintenance and provision of visual Aids to Navigation Class 1 route between Dhaka and Chittagong Corridor, including Class 1, 2 and 3 branches to Ashuganj, Narayanganj and Barisal; (ii) construction and maintenance of six vessel storm shelters along the aforementioned routes; and (iii) maintenance dredging of the main river ferry crossing routes (Chandpur and Shariatpur; Lakshmipor and Bhola; and Beduria and Laharhat). This component shall include work to maintain advertised depths and mark channel routes through provision of long-term (7-years) performance-based contracts for maintenance dredging and provision of visual aids to navigation including light buoys (lateral marks, cardinal marks, isolated danger and other marks), radar beacons (for navigation during rain and fog), leading lines and other aids to assist day and night navigation.

- **Component 2: Improved Services at Priority Inland Waterway Terminals and Landing Ghats/Stations:** This sub-component includes works to improve six common user cargo and passenger terminals with last mile connectivity access infrastructure, as well as fourteen river landings and one general terminal on the Dhaka-Chittagong route and connecting routes. The passenger terminals included are: a new terminal at Shasanghat near Dhaka and a new terminal at Chandpur, and rehabilitation/ upgradation of two existing terminals at Narayanganj and Barisal. The cargo terminals included in the project are: a new terminal at Pangaon near Dhaka and rehabilitation/ upgradation of existing Ashuganj cargo terminal.

BIWTA has carried out an Environmental and Social Impact Assessment (ESIA) for the Component 1 and an Environmental Management Framework (EMF) and Resettlement Policy Framework (RPF) for the project. **The present TOR has been prepared for the detailed ESIA and Resettlement Action Plan (RAP) studies for the works under Component 2 (6 Passenger Terminals and 14 landing stations) and Component 1 (6 vessel shelters).**

B. Project Overview

Locations of the proposed sites for the terminals, landing stations and vessel shelters are given in Figure 1. Description of existing and proposed facilities at the terminal sites, landing stations and vessels shelters are given in Table 1, Table 2 and Table 3, respectively.

Table 1 in Annex 1: Details of existing and proposed facilities at the six terminal sties

Passenger Terminal	Existing Facilities	Proposed Facilities
Sashanghat Passenger Terminal Located 2.5 km downstream of the Sadharghat terminal at Dhaka on the Buriganga River	Greenfield site. There are no existing facilities.	The proposed facilities to be developed include: A Six storied terminal building, with a total floor are of approximately 20,000 square meters; A quay wall (bank protection) of approximately 250 m length Three terminal pontoons of approximately 200m length and five steel gangways A parking yard of approximately 2,000 square meters new landside pedestrian and vehicle access roadways pedestrian and vehicle turn-outs, drop-off, collection and waiting facilities
Chandpur Passenger Terminal. Located on Lower Meghna River	Established in 1995. Existing facilities include a walkway (167 m^2), steel jetty – 2 nos, steel spud – 6 nos., pontoon – 4 nos., passenger waiting shed (74 m^2) and parking yard (8010 m^2)	The proposed facilities include: Land development (21,669 m^3), 3-storied terminal Building (4061 m^2), Bank protection (253 m), Boundary wall (231 m), RCC Ramp- 3 nos, Steel gangway – 3 nos, Spud and spud ring -22 nos. Terminal pontoon -4Nos, steel jetty (267.65m^2). Widening of 265 m of access road

Passenger Terminal	Existing Facilities	Proposed Facilities
Barisal Passenger Terminal Located on Kirtonkhola River (Lower Meghna Tributary)	Established in 1964. Existing facilities include: two storied terminal building, passenger waiting space, 6nos. of pontoons, 4 nos. of gangway, cargo shed, transit shed, parking yard and access road.	The proposed facilities include: Extension of existing terminal building (346 m^2), construction of 4 storied multipurpose building for port facilities (5600 m^2), RCC Ramp 2 nos., Steel Gangway 2 nos., and bank Protection works
Narayanganj Passenger Terminal Located on Sitalakya River	Established in 1972. Existing facilities include a single storied building, 4 pontoons, 3 gangways, an RCC jetty and an administrative office. Existing facilities also include cargo handling facilities with 4 pontoons.	The proposed facilities include extension of existing terminal building, RCC ramps and 2 steel gangways.
Pangaon Cargo Terminal Located next to existing Pangaon Container terminal on Buriganga River, near Dhaka	Greenfield site. No existing facilities.	The proposed facilities include: Two berths, constructed on RCC piles with a suspended deck – total length 190m; An apron area of approximately 2,750 square meters A open storage area of 2,220 square meters; A transit Shed of 1,500 square meters; Vehicle parking areas of 500 square meters; and A new port road of 400m length together with a gate house.
Ashuganj Cargo Terminal Located on Upper Meghan River	Established in 2004 primarily for use by. Existing facilities include: office (150 m^2), RCC Jetty (425 m^2), steel jetty (90 m^2), pontoons – 2nos., gangway, warehouse (225 m^2), parking area (1000 m^2)	Proposed facilities include: office building, RCC Jetty (425 m^2), steel jetty – (2x45m), pontoon- 2nos., gangway – 2nos., bank protection, warehouse (225 m^2), and parking area (2000 m^2)

Table 2 in Annex 1: Details of existing and proposed facilities at the landing stations

Landing Station/ Launch Ghat	Existing Facilities	Proposed Facilities
Bhairab Bazar	Established in 2004. Daily about 300 to 400 passengers use this launch ghat. Existing facilities include two pontoons and one gangway.	The proposed facilities include two pontoons and one gangway.
Alubazar	This is a ferry terminal established in 2001. Daily traffic include 3 launches, 4 ferries and 15 local boats. Daly weight of goods transported is 20 t. Existing facilities include: shore connection seri -1, pontoon -1, steel jetty, ferry ghat with pontoon.	Estimated 0.18 ha of addition land acquisition required for proposed facilities, which include: Shore connection seri-4 Steel jetty -45m² Steel spud – 4nos Approach Road -372m² Passenger waiting sheed-75m² Parking yard – 1860m² Toilet complex – 42m² Bank protection -200m²
Horina	This is a ferry terminal established in 2001. Daily traffic includes 2 launches and 4 ferries. Approximate daily weight of goods transported is 15 t. Existing facilities include a ferry ghat with a pontoon	Estimated 0.093 ha of addition land acquisition required for proposed facilities, which include: Shore connection seri-4 Steel jetty -45.00m² Steel spud – 4nos Approach Road -372m² Bank protection -200m²
Hijla	The average daily traffic at this launch ghat is 150 passengers and 10 boats. Approximate daily weight of goods transported is 3t. Existing facilities include a shore connection seri and a pontoon	Estimated 0.12 ha of addition land acquisition required for proposed facilities, which include: Passenger waiting shed:125 m² Parking yard : 2500 m² Toilet complex: 75 m² Access road: 1000 m² Deep tube-well: 01 No
Ilisha (Bhola)	The average daily traffic at this launch ghat is 251 passengers and 12 vessels. Approximate daily weight of goods transported is 19t. Existing facilities include 2 shore connection seris and a pontoon	Estimated 0.30 ha of addition land acquisition required for proposed facilities, which include: Passenger waiting shed:125 m² Parking yard : 2000 m² Toilet complex: 75 m² Access road: 2000 m² Deep tube-well: 01 No

Landing Station/ Launch Ghat	Existing Facilities	Proposed Facilities
Moju Chowdhury	A ferry ghat established in 2008. Daily traffic is 2 ferries, 2 sea trucks and a launch. Approximate daily weight of goods transported is 20t. Existing facilities include a shore connection seris, a pontoon, and a passenger waiting shed (55 m^2)	Area required for proposed facilities is 0.5 ha but land acquisition is not required. The proposed facilities include: Shore connection seri-4 Steel jetty -45 m^2 Steel spud – 4nos Approach road Passenger shed Parking yard Bank protection
Laharhat	The average daily traffic at this launch ghat is 277 passengers and 13 vessels. Approximate daily weight of goods transported is 21 t. Existing facilities include: Passenger waiting shed : 125 m^2 Parking yard : 3375.00 m^2 Toilet complex: 75.00 m^2 Access road: 2000.00 m^2 Deep tube-well: 01 No Shore connection sheri-01 Pontoons- 01	Area required for proposed facilities is 0.28 ha but land acquisition is not required. The proposed facilities include: Passenger waiting shed: 125 m^2 Parking yard : 1500 m^2 Toilet complex: 75 m^2 Access road: 2000 m^2 Shore connection sheri-01 Pontoons- 01
Beduria	The average daily traffic at this launch ghat is 81 passengers and 13 vessels. Approximate daily weight of goods transported is 6 t. Existing facilities include a shore connection seri and a pontoon	Area required for proposed facilities is 0.047 ha but land acquisition is not required. The proposed facilities include: Passenger waiting shed:125 m^2 Parking yard : 2000 m^2 Toilet complex: 75 m^2 Access road: 2000 m^2 Deep tube-well: 01 No
Daulatkha	The average daily traffic at this launch ghat is 1000 passengers and 4 vessels. Approximate daily weight of goods transported is 730 t. Existing facilities include a 22 m jetty and 1 pontoon	Area required for proposed facilities is 0.12 ha but land acquisition is not required. The proposed facilities include: Passenger waiting shed:125 m^2 Parking yard : 2000.00 m^2 Toilet complex: 75.00 m^2 Access road: 2000.00 m^2 Deep tube-well: 01

Landing Station/ Launch Ghat	Existing Facilities	Proposed Facilities
Tojumuddin	The average daily traffic at this launch ghat is 307 passengers and 4 vessels. Approximate daily weight of goods transported is 23 t. Existing facilities include 2 shore connection seris and a pontoon	Area required for proposed facilities is 0.12 ha but land acquisition is not required. The proposed facilities include: Passenger waiting shed:125 m^2 Parking yard : 2000.00 m^2 Toilet complex: 75.00 m^2 Access road: 2000.00 m^2 Deep tube-well: 01 No Pontoons- 01
Monpura	The average daily traffic at this launch ghat is 207 passengers and 2 vessels. Approximate daily weight of goods transported is 9.5 t. Existing facilities include: Pontoons-1 Sheri - 02 Transit shed RCC Jetty 625.00 M	Area required for proposed facilities is 0.12 ha but land acquisition is not required. The proposed facilities include: Passenger waiting shed:125 m^2 Parking yard : 2000.00 m^2 Toilet complex: 75.00 m^2 Access road: 2000.00 m^2 Deep tube-well: 01 No Shore connection
Chairman Ghat (Char Bata)	The average daily traffic at this launch ghat is 620 passengers 2 launches, 6 local boats and 12 speed boats. Approximate daily weight of goods transported is 18 t. Existing facilities include: Steel Jetty (12m) 1Nos Spud 2 Nos Pontoon 1Nos Waiting Shed 45 m^2	0.5 ha of addition land acquisition required for proposed facilities, which include: Passenger Terminal 120 m^2 Parking Yard 550 m^2 Deep tube well -1nos Approach Road 450 m^2 Bank Protection 290 m^2
Sandwip RCC Jetty	The average daily traffic at this RCC Jetty is 200 passengers 2 steamer, 10 local boats and 30 speed boats. Approximate daily weight of goods transported is 30 t. Existing facilities include: RCC Jetty 750m Waiting shed 60 m^2 Parking yard 200 m^2	Area required for proposed facilities is 1 ha but land acquisition is not required. The proposed facilities include: CC Jetty 30m Harbour Basin Passenger Terminal 125 m^2 Parking Yard 550 m^2 Deep tube well 1nos Approach Road 450 m^2

Landing Station/ Launch Ghat	Existing Facilities	Proposed Facilities
		Bank Protection 2000 m^2
Boddarhat Launch ghat	The average daily traffic at this RCC Jetty is 150 passengers 2 launch and 10 local boats. Approximate daily weight of goods transported is 30 t. Existing facilities include: RCC Jetty 750m Waiting shed 60 m^2 Parking yard 200 m^2	0.4 ha of addition land acquisition required for proposed facilities, which include: Shore connection seri-4 Steel jetty -185.00m^2 Steel spud – 4nos Approach Road -150m^2 Passenger waiting sheed-100m^2 Parking yard – 4048m^2 Toilet complex – 42m^2 Bank protection -200m^2
Tomuruddin	The average daily traffic at this launch ghat is 600 passengers 2 launches, a sea truck and 6 local boats. Approximate daily weight of goods transported is 18 t. Existing facilities include: Steel Jetty (28m) 1Nos Spud 2 Nos Pontoon 1Nos	0.5 ha of addition land acquisition required for proposed facilities, which include: Passenger Terminal 120 m^2 Parking Yard 550 m^2 Deep tube well 1nos Approach Road 450 m^2

Table 3 in Annex 1: Details of existing and proposed facilities at vessel shelters

Vessel Shelter	Existing Facilities	Proposed Facilities
Shatnal Amirabad Chadpur Mehendiganj Sandwip (Sarikait) Nolchira	All the proposed locations are greenfield sites, except in Chandpur where an existing Madrasa Ghat terminal can be modified as vessel shelters	About 4 ha of land acquisition is required for proposed facilities, which include for each site: Dredging for navigation and basin Bank protection Berthing facilities (spud, ramp, gangway, pantoon) Mooring facilities Break water system approach road Attendant room Water supply

C. ESIA and RAP Studies

The proposed study is being commissioned to assess environmental and social consequences of the proposed developments including their pre-construction, construction, and operation and maintenance phases, and to ensure that land acquisition and involuntary resettlement required for the project are carried out in line with the World Bank's Operational Policies as well as compliance with applicable national regulations on environment and social aspects. The proposed study is aimed at screening and assessing the proposed developments against adverse environmental and social impacts and recommending, where necessary, appropriate mitigation and enhancement measures, and course of action for implementation. The study will also provide recommendations on gender and disability sensitive design, including aspects of terminal design and management that reduce specific barriers that women and physically disabled face in using the facilities. These include but are not limited to issues of safety, lighting, drinking water facilities, separate toilets and waiting areas.
The ESIA and RAP will need to follow the framework provided in the EMF and RPF prepared for the Bangladesh Regional Inland Water Transport Project 1 (see last paragraph of section A); comply with the World Bank safeguards requirements given in different operational policies (a list of applicable policies are provided at end of this document). The ESIA will also comply with the national environmental requirements defined through Bangladesh Environmental Conservation Act, 1995 and subsequent regulations and guidelines. For purposes of these TOR, it is assumed that two separate ESIA reports (one for terminals and other one covering both landing stations and vessel shelters) will be prepared; however, during the scoping stage the consultant shall verify whether the Bangladesh Department of Environment will require a stand-alone ESIA for each terminal, and if so, shall prepare separate reports for each of terminals.

The ESIA will take into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, physical cultural resources and gender aspects and for physically disabled people for terminal design); climate change and its implications, and also induced impacts as well as the cumulative impacts of other development projects in the area. The ESIA will consider natural and social aspects in an integrated way. It will also take into account the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements.

D. Specific Tasks for the Consultant - ESIA

To complete the ESIA study or studies, the consultant will:

1. Review the Project details

Review the proposed developments and their geographic, ecological, social, and temporal context, including any offsite investments that may be required. Work closely with BIWTA and its design consultants to identify the need for any additional land requirements for proposed developments, including associated facilities or other directly related investments. Review the ESIA for Component 1 and EMF and RPF studies for investments in Component 2 (documents are available on BIWTA website). Define 'project influence area' on the basis of the project scope and extent. Review the shapes of river channels within the influence area and how they change over time.

2. Review of the Legislative and Regulatory Framework

Review the policy, legal, and administrative framework within which the ESIA is carried out. Review the national environmental requirements. Identify relevant international environmental agreements to which the country is a party. Review the country's resettlement and rehabilitation policies. Also review the WB OPs and their triggering status for the Project. Also state the policy requirements as applicable to the proposed investments, and actions taken/planned in response to each OP triggered.

Review existing systems on grievance management and citizen's feedback within BIWTA, and suggest measures for strengthening to ensure access to community and timely response during both construction and operation phases of the proposed subprojects.

3. Scoping

Scoping is the first step of the ESIA and is essentially the process of identifying the significant issues relating to the proposed action and of determining the scope of the issues to be addressed in the ESIA. The key tasks include: i) carry out reconnaissance field visits; ii) carry out stakeholder mapping, hold initial stakeholder consultations, and develop a stakeholder participation plan for the completion of the studies; iii) identify the key aspects to be studied during the detailed ESIA, iv) finalize ESIA ToRs in consultation with the stakeholders for approval of DOE if required; v) prepare work plan for the subsequent ESIA tasks; and vi) prepare the Scoping Statement compiling the process and outcome of the scoping tasks described above. Review the definition of project influence area and revise if necessary. Facilitate, on behalf of BIWTA, the obtaining of DOE's approval of the final TORs for ESIA, if required.

4. Project Planning and Analysis of Alternatives

Provide input to the BIWTA and its design consultants for inclusion of waste collection and treatment facilities (ship related waste management), land use planning, climate change adaptation and resilience, last mile connectivity, female and physically disabled friendly facilities(such as separate toilets, waiting areas and ticket counters, inspection areas, adequate lighting and safety features, etc.), relocation of public facilities (for example, the local boat crossing point at Pangaon to be relocated), and access roads to public facilities (e.g. access to graveyard/burial and ashes immersion sites will be restricted at both Pangaon and Shasanghat) to be incorporated in the project planning and design. In addition to these, study integrating the resettlement aspects into the design process, for e.g. provision for building of shops and facilities (that affected people can be given priority to occupy) in the terminal designs.

Systematically compare feasible alternatives to the proposed project location, design, and operation - including the "without project" situation - in terms of their potential environmental and social impacts; and state the basis for selecting the particular project design.

5. Detailed Baselines Studies and Analysis

Review relevant physical, biological, and socioeconomic conditions of the study area, including any changes anticipated before the project commences. Also identify current and proposed development activities within the project area but not directly connected to the project. Also analyze the trends in the key environmental and social parameters of the area. Data should be relevant to decisions about project location, design, operation, or mitigatory measures.

Review the primary and secondary data collected during the preparation stage of the Bangladesh Regional Inland Water Transport Project 1 by the IWM ESIA team, and presented in EMF and RPF reports, and collect additional data if required on the following aspects:

Physical Environment. The data on physical environment should cover, inter alia:

- physiography,
- climate,
- geology and seismology,
- soils,
- hydrology and river dynamics, including annual and seasonal peak discharges, recurrence intervals and flood levels for various peak discharges (including at minimum for 5, 10, and 100-year flood events as well as historic maximum discharge), annual and seasonal low-flow discharges and recurrence intervals including historic minimum discharge, etc.
- groundwater,
- vulnerability of area to flooding and storm surges,

- river morphology, including erosion and sedimentation / sediment deposition patterns, currents and bathymetry
- soil quality,
- river bed sediment quality, in areas where dredging may be required and/or construction activities may disturb sediments, such as piling works (including the presence of contaminants, pollutants or heavy metals such as PCBs, POPs, hydrocarbons, and heavy metals such as arsenic, cadmium, mercury, etc.).
- water quality, in particular including major ions, TSS, TDS, DO, BOD, NO3, pH, etc.,
- ambient air quality and noise

Characterize the baseline status for each parameter, and discuss trends underway independent of the project which could change baseline conditions over the life of the project, including trends in land use changes and climate change.

Biological Environment. The data on biological environment should cover, inter alia:

- natural habitats and ecosystems;
- flora - trees, grasses, others;
- fauna - mammals, birds including migratory birds, reptiles, amphibians, insects, fish and red listed species;
- biodiversity including carrying capacity;
- protected and non-protected areas including hunting, poaching, illegal fishing;
- wetlands;
- fish;
- benthic flora and fauna; and
- others as identified by the consultant.

The trends underway independent of the project which could change baseline conditions over the life of the project, including trends in land use changes and climate change, should also be covered.

Socio-Economic Baseline. The socioeconomic baseline should identify and characterize all affected households as well as general socioeconomic aspects of the area of influence of each project investment location. This shall include using mobile application to geo-tag all affected households with Photographs of household members and the asset(s) affected, prepare maps of affected households and communities, and describe their present socioeconomic conditions, mobility, livelihoods, gender and vulnerability based on household surveys of all directly and indirectly affected households, and consultations with communities and key stakeholders. The data will also cover:

- population and demography;
- use of land, river and natural resources in the project area including for agriculture, fishing, livestock, grazing;
- other economic activities e.g. sand quarrying/extraction, trade, services;

- existing river traffic (both commercial and recreational) and navigation routes, etc; existing traffic patterns on access routes;
- social infrastructure and services including education, health, communications, others;
- economic activities;
- identification of direct and indirect beneficiaries;
- access and security;
- community organizations;
- vulnerable groups and poverty situation;
- gender aspects;
- Physically disabled;
- recreation areas;
- cultural heritage and cultural property;
- objects of special interest, e.g. cultural practices, graveyards and monuments; and
- others as identified by the consultant.

6. Stakeholder Consultations

The consultants need to identify all the stakeholders; both direct and indirect, and carry out a detailed stakeholder analysis and identify key stakeholders at each site. Continued consultations are required during the project preparation with the affected communities and relevant stakeholders. In addition, at least two major consultation meetings are to be held at the project sites (the first one during the initial stages of ESIA study and the second one after preparation of draft ESIA report) with the affected communities and businesses as well as other relevant stakeholders including boat owner associations, commuters, auto-rickshaw unions, women, institutional stakeholders and local nongovernmental organizations, etc. Consultation methodologies should also include Focus Group Discussions (FGD) and key informant interviews, which shall be briefly documented using mobile application and geo-tagged, to complement larger consultation events and ensure social inclusion of the consultation process. FGD should include in particular different user groups of the future terminals, including specific FDGs with women only, as well as with stakeholders with physical disabilities. All consultations shall be fully documented, including with photolog, and included in an annex to the final ESIA report. Documentation should include dates and locations of consultation events, stakeholder groups consulted, information shared and issues raised, and how feedback received will be taken into account in the analysis and design of the project.

7. Environmental Impact Assessment

Predict and assess the project's likely positive and negative impacts, in quantitative terms to the extent possible, associated with Project siting, design, construction, and operation. This analysis will require in depth interpretation, particularly on impacts related with instream construction activities such as piling, bank protection works and dredging (on aquatic ecology and river erosion); disposal of dredge spoils; management of solid and liquid waste (from ships and cargo activities); water and sanitation; air and noise quality; site remediation and disposal of contaminated soils– especially for Shasanghat where the site is currently being used for metal scrap business, ship breaking and fabrication facilities; occupational health and safety issues; on-land traffic impacts, emergency management; and traffic safety issues associated with terminal development and ongoing use. Predict the impacts and mitigation measures due to construction of breakwaters, RCC piles and sheet piles. Analyze the morphology of river channels within the influence area and how they change over time due to construction of proposed facilities and the increased traffic movement.

Explore opportunities for environmental enhancement. Identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specify topics that do not require further attention.

8. Social Impact Assessment

Assess the impacts of land acquisition (if any) and land use change (even if it is government land) on the livelihoods of the affected people and their socioeconomic conditions through detailed census surveys, and identify the options for resettlement of affected people and restoration of their livelihoods through focused consultation with affected groups. Assess the impact of proposed developments on the access to public facilities, community health and safety, gender and employment.

The social research and census surveys should cover the squatters living in the proposed development areas owned by BIWTA (for e.g. in Pangaon area about 50 squatters; both residential and commercial and others on public land; in Shashanghat area about 50 businesses dealing with scrap from shipbreaking and fabrication; in Barisal area about 60 shops). There are common property resources to be considered during the assessment at both sites. A robust socio-economic baseline of all these affected people will form the backbone of this assessment. The assessment should not limit the surveys to the impacts cited here, but list all the direct and indirect impacts due to the proposed project. All socio-economic survey should be carried out using mobile device for real time data collection.

The social impact assessment will cover the directly affected people and affected communities to formulate development strategies in order to assist in determining project impacts on the social, economic, cultural, and livelihood activities of affected communities. This will establish a social baseline against which changes resulting from the intervention can be measured in the future. A socio-economic survey of the area to analyse the demographic, socio-economic cultural and other social relations and stakeholders needs to be conducted. Local tenure and property rights arrangements, which may include usufruct or customary rights to the land or other resources taken for the project including common property resources needs to be assessed.

9. Cumulative and Induced Impacts

Consider and assess the cumulative impacts of other development projects in the area (on-going and planned). In particular, review the projects and facilities associated with IWT and consider and assess any potential interaction of impacts of those projects with those of proposed facilities.

10. Environmental Management Plan (EMP)

Prepare EMP complete with mitigation plan, compliance monitoring plan, effects monitoring plan, institutional arrangements, training needs, documentation and communication protocol, grievance redressal mechanism, cost of implementing EMP, and mechanism to integrate EMP with the Project (e.g., through design changes, contractual clauses, etc.). Prepare environmental code of practices (ECoPs) with standard mitigation measures and best management practices to address the impacts associated with both during construction and operation phases of the proposed facilities. Describe in details who will (a) implement the environmental mitigation activities; (b) carry out environmental monitoring; (c) supervise environmental mitigation and monitoring; (d) design, implement and apply the environmental management information system (EMIS); and (e) prepare monthly/ quarterly progress reports on environmental management. Include measures for emergency response to accidental events (such as entry of raw sewage or toxic wastes into the river, collision of boats, flooding of facilities, etc.). Provide an itemized budget for implementing the EMP, as well as descriptions of minimum qualifications for key personnel responsible for its implementation. Prepare a detailed plan, including schedule and necessary budget, to monitor the implementation of mitigating measures and the impacts of the project during construction and operation (e.g., emissions thresholds and ambient levels of pollutants where these may be detrimental to human health, soil erosion, etc.). Provide guidance for reporting and enforcement and conducting environmental audits.

The EMP should be divided into two sections: one encompassing the requirements of the civil works contractors (in a format that can be annexed easily to the bid packages), and one for all other aspects of environmental management during construction and operational phases.

11. Resettlement Action Plan (RAP)

A stand-alone Resettlement Action Plan shall also be prepared, in accordance with World Bank OP 4.12 on Involuntary Resettlement, as well as applicable Bangladeshi land acquisition, resettlement and rehabilitation laws, regulations and guidelines.

Aside from the RAP (described below), the social management plan should be delivered as a stand-alone section of the ESIA and should include, among other aspects: (i) Social mitigation and enhancement measures for the proposed investments, ii) Grievance redressal mechanism, iii) Monitoring protocol, and iv) Strategies and plans for a) Community consultation and engagement, b) Women engagement, c) Small, ethnic and vulnerable communities development, d) Communication plan and e) Capacity building.

In preparation of the RAP and any other social management plan, the tasks to be performed are as below:

- To photograph the affected/ displaced family with the affected assets and number each asset; to videograh the entire affected area including the affected land and assets.
- To conduct census survey of all PAPs residing/ using the corridor of impact to collect an inventory of types and extent of losses of each affected household, family composition and details on age and sex of all the members of the household, income and expenditure levels and occupational patterns, vulnerability status, legal ownership status (private, traditional and customary ownership, lease), asset ownership status and skills possessed. Prepare a fact sheet and attach the photograph of each project-affected person/family.
- Assess in detail all the adverse impacts and categorise each type of losses specific to the project area.
- To conduct focus group discussions on the preliminary designs options such on location, accessibility, facilities, safety and others and integrate the outputs in the technical design with that of the mitigation measures proposed.
- To carry out public consultations with different project affected social groups about their options and rights pertaining to resettlement and with other stakeholders like NGOs, District Administration, etc., and provide a plan for continuous public consultation during implementation.
- Identification of key formal and informal institutions operating at village, up-zilla and regional levels and assessment of their role in community decision making processes as these affect project activities.
- To carry out market survey and focus group discussion with different social groups including women and vulnerables to prepare socially, technically and economically feasible income generations schemes including skill upgradation plans.
- To determine the legal framework of private land, customary and traditional laws governing land tenure, usufruct rights, leasehold and land acquisition, or transfer plans for the total project including for tree plantation, if any, according to the revenue records (including acquisition for temporary purposes).

- Based on draft detailed designs conduct field verification and consultation to identify locations for further minimization of social impacts if any, and integrate with final designs.
- To establish the legal status of the affected people and carry out joint verification with the revenue department and implementing agency, of the project affected area to pre- pare land acquisition plans and provide specific details on the gaps between physical ownership and revenue records; identify land allotted to affected people by government departments and other agencies, if any.
- Modify and update database of project affected persons on a user friendly platform.
- To finalize estimate of land required for resettlement and for economic rehabilitation.
- To identify the land and prepare a plan for relocation in consultation with the project displaced people with different social groups including women and local administration.
- To prepare a plan that ensures the host population will not be adversely impacted and plan for consultation on the impact on resources and infrastructure with increase in population of the host areas.
- Based on project RPF policy provide an appropriate action plan for additional support for the vulnerable, and other action plans if necessary.
- To determine the impact on community assets/ cultural property and prepare a management plan for relocation and restoration in consultation.
- To develop terms of reference for NGOs, external evaluation consultants, and for any other study identified for impact evaluation.
- To assess institutional capacity and propose the institutional arrangement for implementation of RAP, addressing grievances, and ensuring gender equity, and identify the roles and responsibilities of each agency.
- To identify various formal and informal institutions that may provide support for the implementation of RAP.
- To develop a training program on R&R, based on the assessment of the capacity of the implementing agency.
- To develop monitoring indicators and formats for physical and financial progress, process monitoring and impact evaluation and indicators to for other stakeholders and finalize the same.
- To prepare an implementation schedule synchronized with time frame of civil works, and ensure that no civil works will begin until people are fully compensated and adequately rehabilitated.
- Conduct risk assessment for proposed mitigation measures.
- To develop detailed budget based on the based on the outcomes of study.
- Develop a mobile based web based interactive application for monitoring, grievance redressal and feedback, which can be used by the community including PAPs, during preparation and implementation.

E. Deliverables

The deliverables to be submitted are:

- Inception report, including results of scoping, final proposed TOR for ESIA, and work plan
- Executive Summary (a summary of the ESIA report), written in a form that is understandable and accessible to a layman audience, in both English and Bengali
- Draft and final ESIA Reports, including Environmental and Social Management Plans (e.g. for social plans: relocation of ghats, enhancement of ghat and terminal facilities, etc.)
- Draft and final Resettlement Action Plan, with adequate measures for compensation, relocation, livelihoods restoration, grievance redresses and budgetary provisions, in both English and Bengali

F. Time Schedule

The assignment is expected to be completed within 10 months. The inception report should be submitted within 4 weeks. The draft ESIA and RAP reports along with management plans should be submitted at the end of the 6th month.

G. Study Team

The proposed core team for the ESIA study is given below. The man months shown are initial estimates only for core skill areas, and may not be inclusive of all required skills and team members necessary to complete the studies. The consultant is responsible to make a determination on the required staffing to complete the assignment, and is free to employ whatever resources are required.

S.No.	Key Specialists	Man Months
1	Environmental Specialist and Team Leader – International experience with experience on ESIAs for ports or terminals	10 months
2	Environmental Engineer - National with expertise on management and remediation of contaminated soils and sediments, preferably with relation to port or terminal development.	4 months
3	Ecologist – National with experience on river ecology, and preferably prior knowledge of the ecology of the relevant rivers under study.	5 months
4	Social Development and Social Research Specialist – International experience with experience in SIA and preparation of RAPs	10 months
5	Community Engagement Expert – National with experience in engaging communities in preparation of RAPs; preferably female 2 persons	6 months for each person
6	Gender Expert – National with experience in gender mainstreaming in preparation of RAPs; preferably female	4 months

H. Applicable OPs

Operational Policies (OP) / Bank Procedures (BP) that are applicable to the proposed ESIA study are:

OP / BP 4.01	Environmental Assessment
OP / BP 4.04	Natural Habitats
OP 4.11	Physical Cultural Resources
OP / BP 4.12	Involuntary Resettlement
OP / BP 7.50	Projects on International Waterways
BP 17.50	Disclosure of Operational Information

The consultants will also make use of and follow applicable thresholds and standards outlined in the WBG Environmental, Health, and Safety (EHS) Guidelines, including both General EHS Guidelines as well as EHS Guidelines for Ports, Harbors and Terminals (available for download at http://www.ifc.org/wps/wcm/connect/9e558c00488556ebbaf4fa6a6515bb18/Final%2B-%2BPorts%252C%2BHarbors%2Band%2BTerminals.pdf?MOD=AJPERES&id=1323152828015).

I Proposed/Indicative Structure of ESIA Report

The ESIA report will be in two parts; 1) EIA and EMP and 2) SIA and RAP.

The suggested and indicative contents of the EIA and EMP report is given below:

Executive Summary: Concisely discusses significant findings and recommended actions.

1. Introduction

- 1.1 Overview
- 1.2 Background of the project
- 1.3 Objective of ESIA
- 1.4 Approach to work
- 1.5 Area/Corridor of Impact
- 1.6 Composition study team

2. Legal and administrative framework

- 2.1 GoB requirements (legislation; guidelines and rules; policies; international treaties signed by Bangladesh; national and provincial authorities; environmental procedures), their applicability, and compliance status for the Project.
- 2.2 World Bank requirements (operational Policies and safeguard requirements; and WBG Environmental Health guidelines) and their triggering and compliance status for the Project.

3. Project description
- 3.1 Need and purpose of project
- 3.2 Project location
- 3.3 Salient features
- 3.4 Description of project components
- 3.5 Construction activities
- 3.6 Construction machinery, materials and other supplies (including estimated numbers/quantities)
- 3.7 Waste generation and disposal (including estimated quantities)
- 3.8 Manpower requirements
- 3.8 Operation and maintenance (supplies; waste generation and management; manpower requirements; others).

4. Baseline description/analysis
- 4.1 Study area
- 4.2 Physical environment
- 4.3 Biological environment

5. Project alternatives
- 5.1 Without project alternative
- 5.2 Site Options
- 5.3 Design Options
- 5.6 Other temporary and permanent facilities

6. Climate Change
- 6.1 Climate Change
- 6.2 Risk of flooding

7. Public Consultation and Information Disclosure
- 7.1 Scoping sessions
- 7.2 Focused group discussions
- 7.3 Public consultations
- 7.4 Information disclosure

8. Potential environmental impacts and their mitigations
- 8.1 Impact assessment, prediction, and characterization method.
- 8.2 Impacts during construction phase
- 8.3 Impacts during operational phase
- 7.4 Impacts during decommissioning phase.

9. Cumulative and Induced Impacts
- 9.1 Cumulative impacts of on-going and planned projects in the area and on Indus River
- 9.2 Induced impacts of the Project.

10. Environmental management plan (EMP)
- 10.1 Types of impacts and their mitigations
- 10.2 Mitigation measures
- 10.3 Environmental Code of Practices
- 10.4 Monitoring Plan
- 10.6 Communication and documentation

10.7 Cost of EMP
10.8 Integration with Project (contract clauses, others)
10.9 Grievance redressal.
10.10. Institutional strengthening

REFERENCES

ANNEXES

- Flora and fauna list
- Documentation on Public consultations
- Environmental code of practices, etc.

The suggested and indicative contents of the SIA and RAP report is given below:

Executive Summary: Concisely discusses significant social findings and recommended mitigation measures and actions.

1. Introduction

1.1 Overview
1.2 Background of the project
1.3 Objective of SIA and key tasks
1.4 Approach and methdology
1.5 Area/Corridor of Impact
1.6 Composition study team

2. Legal and administrative framework

2.1 GoB requirements (legislation; guidelines and rules; policies; international treaties signed by Bangladesh; national and provincial authorities; social procedures), their applicability, and compliance status for the Project.
2.2 World Bank requirements (operational Policies and safeguard requirements; and WBG Environmental Health guidelines) and their triggering and compliance status for the Project.

3. Project description

3.1 Need and purpose of project
3.2 Project location
3.3 Salient features
3.4 Description of project components
3.5 Construction activities
3.6 Construction machinery, materials and other supplies (including estimated numbers/quantities)
3.7 Waste generation and disposal (including estimated quantities)
3.8 Manpower requirements
3.8 Operation and maintenance (supplies; waste generation and management; manpower requirements; others).

4. Baseline description/analysis
- 4.1 Study area
- 4.2 Demographic Profile
- 4.3 Socio-economic profile
- 4.4 Socio-economic analysis based on primary data
- 4.4 Cultural aspects (cultural heritage; archaeology; and other objects of special interest, e.g. graveyards, monuments).

5. Stakeholder Analysis
- 5.1 Stakeholders at different levels
- 5.2 Stakeholder expectations
- 5.3 Overall issues emerged during consultations

6. Public Consultation and Information Disclosure
- 6.1 Stakeholder consultations
- 6.2 Focused group discussions
- 6.3 Public consultations
- 6.4 Information disclosure

7. Potential social impacts and their mitigations
- 7.1 Impacts
- 7.2 Risks and Assumptions
- 7.3 Issues of significance
- 7.4 Resettlement and compensation
- 7.5 Impacts and their mitigations during construction phase
- 7.6 Impacts and their mitigations during operational phase.

Annexure

I. Resettlement Action Plan (RAP) as an annexure

1. Introduction
1. Brief Introduction of the sub-project
2. Description of Component(s) that cause land acquisition/alienation and resettlement
3. Overall Estimates of Land Acquisition and R&R

2. Measures to Minimize Resettlement
1. Description of Efforts Made for Minimizing Displacement
2. Description of the Results of these Efforts
3. Description of Mechanisms to Minimize Displacement and Loss of Livelihood/Income during Implementation

3. Census and Socio-Economic Surveys
1. Provide the results of the census and socio-economic surveys
2. Identify all categories of impacts and the extent of impact on each affected

4. Consultation and involvement of PAPs
1. Describe various Stakeholders
2. Summarize process of consultation on the results of socio-economic surveys

3. Describe the need and mechanisms to conduct updates to socio-economic surveys
4. Describe how this process of consultation would be continued through implementation and monitoring
5. Describe the plan for disseminating information to Project Affected Persons

5. Entitlement Framework

1. Provide a definition of PAFs and PAPs together with their categorization based on impacts
2. Describe R&R entitlements for each category of impact
3. Describe method of valuation used for affected land, structures and other assets
4. Using Entitlement Matrix, present a table of all PAFs/PAPs and their losses/ impacts and entitlements

6. Relocation (if applicable)

1. Does the Project need community relocation sites? If yes, have they been inspected and accepted by PAPs?
2. Have the Project Affected Persons agreed to the strategy for housing replacement? Will new housing be constructed/allocated? If PAPs are to construct houses, explain if compensation entitlement for housing is sufficient to help them construct houses.
3. List of proposed sites along with number of affected families to be relocated
4. Describe respective mechanisms for (i) procuring/acquiring/alienating ; (ii) developing and (iii) allotting resettlement sites
5. Provide detailed description of arrangements for development of resettlement sites including provision of social infrastructure
6. Describe the feasibility studies conducted to determine the suitability of the development of sites

7. Income Restoration

1. Are the compensation entitlements sufficient to restore income streams for each category of impact? If not, what additional economic rehabilitation measures are necessary?
2. Briefly spell out the restoration strategies for each category of impacts, and describe institutional, financial and technical arrangements/aspects involved
3. Describe the process of consultation with PAPs to finalize strategies for income restoration
4. How do strategies for restoration vary with the area/locality of impact
5. If income restoration involves change in livelihoods or other economic activities allow substantial amount of time for capacity building, accessing institutional funds/credits/markets, preparation and implementation. Work out the rate of returns for each of the economic activities opted by the entitled person.
6. How are the risks of impoverishment proposed to be addressed?
7. Explain the main institutional and other risks for effective implementation of plans for restoration of livelihood

8. Describe the process for monitoring the effectiveness of income restoration activities

8. Institutional Arrangements

1. Describe institution(s) responsible for: (a) delivery of each item/activity in the entitlement policy; (b) implementation of resettlement and rehabilitation programs and (c) coordination of all other activities as described in the Rehabilitation Action Plan
2. State how coordination issues will be addressed in cases where resettlement and rehabilitation are spread over a number of institutional/departmental jurisdictions
3. Indicate the agency that will coordinate all implementing agencies - do they have the necessary mandate and the resources
4. Describe the external (non-Project) institutions/departments involved in the process of resettlement and restoration of income such as land development, land allocation, credit, training for capacity building and the mechanisms in place to ensure adequate cooperation and performance of these institutions/departments
5. Describe the results of the institutional capacity assessment and give the institutional development plans including staffing schedule and training requirements
6. Discuss institutional capacity for, and commitment to, resettlement and rehabilitation

9. Monitoring and Evaluation

1. Describe the internal monitoring process
2. Define key monitoring indicators for resettlement, rehabilitation and participation and provide a list of these indicators which would be used for internal monitoring
3. Describe institutional (including financial) arrangement
4. Describe frequency of reporting and contents of reports
5. Describe the process for integrating feedback from internal monitoring into implementation
6. Describe financial arrangements for external monitoring including process for awarding and maintenance of contracts for the entire duration of R&R
7. Describe the methodology for external monitoring
8. Describe frequency of external reporting and its contents

10. Redress of Grievances

1. Describe the structure and process of grievances mechanisms at various levels including step-by-step process for registering and addressing grievances and provide specific details regarding registering complaints, discussing them with PAPs, response time, communication modes etc.
2. Describe the mechanism for appeal

3. Describe the provision, if any, to enable PAPs to approach civil courts in case these provisions fail

11. Implementation Schedule

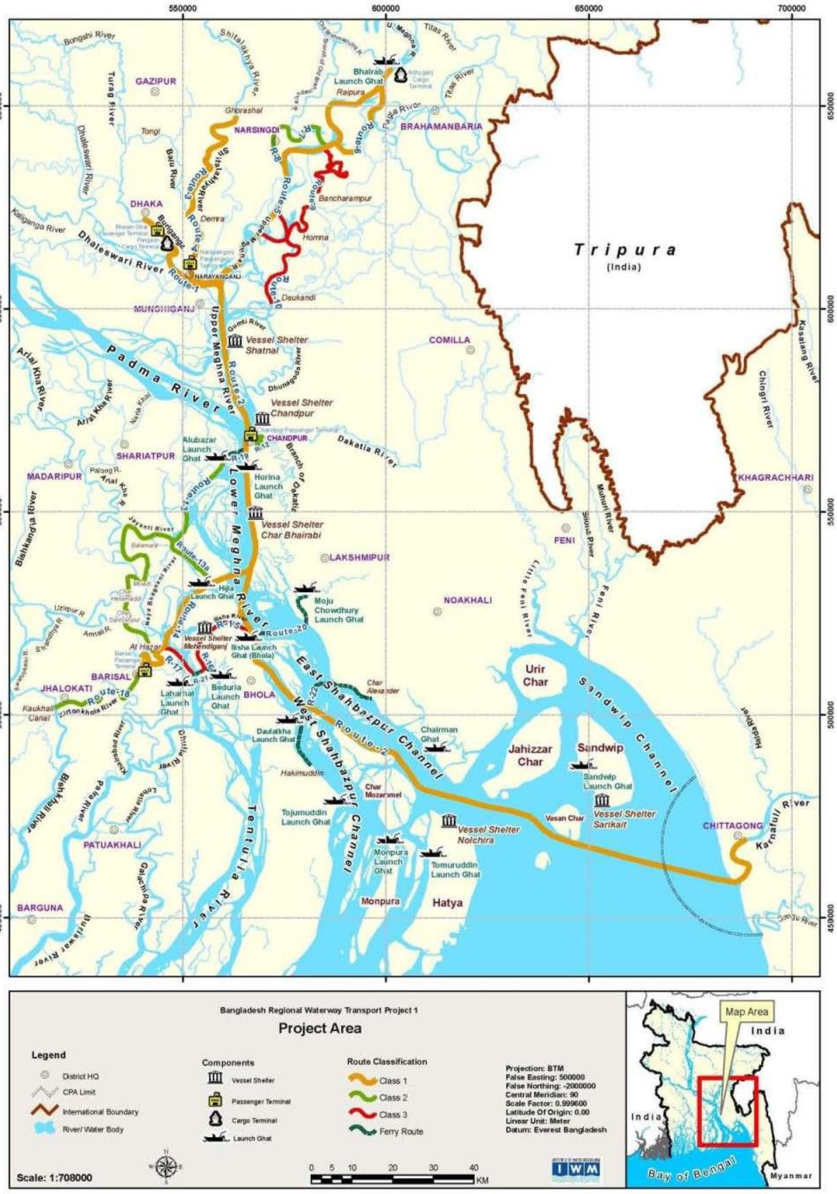
1. List the chronological steps in implementation of R&R Action Plan including identification of agencies responsible for each activity along with a brief explanation of each activity
2. A month-wise implementation schedule (Gantt chart) of activities to be taken as part of R&R Action Plan
3. Description of the linkage between R&R implementation and initiation of civil works for each of the Project component

12. Costs and Budgets

1. Clear statement of financial responsibility and authority
2. List the sources of funds for R&R and describe the flow of funds
3. Indicate if costs of R&R are included in the overall Project costs
4. Identify R&R costs, if any, to be funded by the WB
5. Provide a cost-wise, item-wise budget estimate for the entire R&R costs including administrative expenses, monitoring and evaluation and contingencies
6. Describe the specific mechanisms to adjust cost estimates by *inflation* factor
7. Describe provisions to account for different types of contingencies

II Documentation on Public consultations

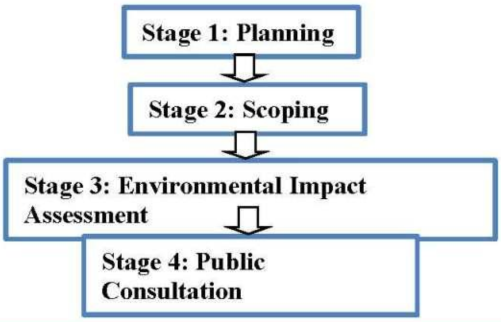
Figure 1 in Annex 1: Locations of the proposed terminal, landing stations and vessel shelter sites



ANNEX 2: Scope of Work for ESIA studies for Improvement of Terminals and Landing Stations

1.1. Environmental Assessment Process

The environmental assessment will be conducted using major stages as shown in the following diagram.



Stage 1: Planning

Soon after the commencement of planning and design process, based on desk study, reconnaissance survey and experience of earlier projects, detailed methodology and schedule should be prepared for the effective and timely execution of the Environmental Assessment.

Desk Study: To collect the secondary information and checking out the methodology for carrying out the EA study and fixing of responsibilities of the EA team members for preparing a complete, addressing all issues, Environmental Management Plan.

Reconnaissance survey: To collect the first hand information about the project area and develop a perspective of the entire team and revise the methodology and work program.

Experience from Earlier Project:

Focus on the main issues: It is important that the EA does not try to cover too many topics in too much detail. Effective scoping can save both time and money by focusing the EA studies on the key issues.

EA requires the formation of a multidisciplinary team and the leadership of a strong EA coordinator. The range of effects considered in the EA requires the skills of technical experts to be employed on an assessment team, led by a Team Leader. It is important to involve the right people (e.g., scientists, engineers, policymakers, government representatives, representatives of public interest groups and the local community) and agencies (e.g., the developer, the aid agency, regulatory authorities and politicians) in the EA process. Selection will be made through consultation at different stages.

Make maximum use of existing information before engaging expensive field studies.

Determination of Project influence Area. Based on reconnaissance survey and desk study and modeling, project influence area will be finalized.

Present clear and appropriate options for mitigation of impacts and for sound environmental management. Mitigation is an integral part of impacts assessment.

Application of appropriate mitigation can eliminate or reduce negative impacts, and improve the net overall environmental performance of a project. Hence public consent, practical viability will be considered in proposing the mitigation measures.
Post-EIA audits and monitoring programs are essential to ensuring that EA commitments are carried out and that future EA improve. An effective monitoring plan will be proposed in consultation with the client and the World Bank. Proper budgeting will be ensured for smooth functioning of monitoring plan proposed.

Stage 2: Scoping

Scoping will identifies which of the activities has a potential to interact with the environment. Scoping will be conducted early in the EA process so that a focus on the priority issues (i.e. those that have the greatest potential to affect the natural and/or environment) can be established for the rest of the EA process. Necessary consultation with stakeholders will be made after scoping to incorporate any unattended issues. Key elements/ inputs to the scoping exercise will be as follows:

- Gathering and reviewing existing environmental data like atmosphere, climate, topography, congestion area, alternative requirement, land use pattern, hydrology and drainage pattern, major River and waterways, religious, cultural and archaeological sites and sensitive areas.
- Identifying project stakeholders; including PAPs, Government and non-government agencies (utilities), Bangladesh Water Development Board, Department of Fisheries, Agricultural Department, Department of Environment (DOE) etc.
- Assemble and review relevant legislative requirements, environmental standards and guidelines (national and international) associated with the proposed development as well as the World Bank's operational policies and standards.
- Gathering existing information sources and local knowledge;
- Informing stakeholders of the project and its objectives and get input on the EA;
- Identifying the key environmental concerns (community and scientific) related to a project and the relative importance of issues;
- Defining/preparing the EA work program, including a plan for public and stakeholder involvement;
- Carrying out monitoring of natural environment including air, water, soil, noise etc.
- Defining the range of project alternatives to be considered.
- Obtaining agreement/consensus on the methods and techniques to be used in EA studies and document preparation;
- Determining/freezing the spatial and temporal boundaries for the EA studies.

The following issues will be addressed through scoping, but will not be limited to.

- To improve the quality of EA information by focusing scientific efforts and EA analysis on truly significant issues;
- To ensure environmental concerns identified and incorporated early in the project planning process, at the same time as cost and design factors are considered;
- Reducing the likelihood of overlooking important environmental issues;

- Thinning the chance of prolonged delays and conflicts later in the EA process by engaging stakeholders in a constructive participatory process early in the EA process.

The scooping report will be submitted to DOE in a form of IEE for approval.

Stage 3: Environmental Impact Assessment

After conducting IEE, the EIA should be conducted, as per TOR for EIA suggested in IEE study and approved by DOE. The process of EIA study is briefly described below.

Analysis of the Project Design and Components: All the components of the DCA IWT PROJECT and design specifications will be analyzed to get insight of the project interventions. This will guide detail environmental baseline survey and particular investigations.

Data collection on Environmental and social baseline: Environmental and social baseline condition of the proposed subprojects has already been collected through several field visits, surveys and intensive consultation with local people. Intensive consultation with the stakeholders should be carried out for updating the baseline condition to obtain their perceptions on the proposed interventions and the possible impacts.

Major Field investigations: At this stage, detailed field survey (social and environmental) will be carried out to obtain information on the possible impact of the interventions on the environmental parameter.

Assessment of Environmental and social Impacts: The impacts of the proposed subprojects on the environmental and social components will be identified through consultation with experts and local community. The impacts will be analyzed and graded qualitatively (e.g. high, medium, low) in order to identify the major impacts. The future-without-project condition will be generated through trend analysis using information collected. The future-with-project condition will be predicted using professional judgment of the multi-disciplinary team members based on information collected. Difference between the two (with and without project) conditions will be taken as impact of the proposed interventions. The impact of the priority reach will also be monitored. Moreover, cumulative impacts of the project inside or outside the project area will be analyzed. Possible mitigation measures for alternatives of the project will be identified in this stage. For true impacts prediction following questionnaire will be attempted to answer:

- How will a particular project activity give rise to an impact?
- How likely is it that an impact will occur?
- What will be the consequence of each impact?
- What will be the spatial and temporal extent of each impact?

Analysis of Alternatives: The various criterial to be considered in evaluating various alternatives are given below

- Technical Aspects: Robustness, constructability, geology, maintenance requirements, history of performance, etc.
- Financial Aspects: Construction cost and maintenance cost

- Environmental Aspects: project footprints, material requirements, impact on river flows and channels, impact on flood plains and erosion, impact on chars, impact on aquatic and terrestrial habitats, impact on river banks, safety, etc.
- Social Aspects: Land acquisition, Resettlement, Impacts on navigation, Impacts on char people, socioeconomic impacts, etc.

Evaluation of impacts: Impact assessed on different parameters will be evaluated for both positive (+) and negative (-) impacts considering magnitude, immediacy, reversibility and sustainability.

Preparation of environmental management plan: The EMP will be prepared suggesting mitigation measures for minimizing the effect of the negative impacts, compensation measures for the negative impacts which cannot be mitigated, enhancement measures for increasing the benefits of the positive impacts, emergency plan for taking care of natural hazards and accidental events. An environmental monitoring plan will also be suggested in the EMP. Each component of the EMP will be divided into pre-construction, during construction, post construction and operation and maintenance phases. Responsibilities of the institutions in the implementation of the EMP will be suggested to ensure efficient utilization of all the parties involved. The EMP should also include institutional capacity assessment and capacity building plan.

EIA Report Preparation: All the findings would be presented in the EIA reports.

Stage 4: Public Consultation

"Public consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. All Category 'A' projects or activities shall undertake public consultation. The key points of public consultation are given below:

Stakeholder Consultation at all Stages of Project

- Identification of primary and secondary stakeholders.
  - Primary stakeholders include people having direct impact.
  - Secondary stakeholders include village representatives, women's group, voluntary organizations NGOs, field level officers and staff, other government officials.
- Structured Consultation at the subproject sties, district and divisional levels

Consultation at Village Level

- Along with preliminary inventory and survey information dissemination will be done along the bank and the affected villages included in the project influence area canvassing about the project. Date and venue for detailed consultation will be fixed.
- Pictorial method (Pamphlet) will be adopted to explain proposed improvements and possible environmental impact in the concerned villages.
- Public consensus would try to be arrived for and mitigation proposed.
- Public suggestion and graveness will be addressed at appropriate level.

Consultation at Upazila and District Level

- Consultation with officers of Agricultural Department, Forest Department, Soil Department, Fisheries Department, Department of Public Health Engineering (DPHE), etc.
- Consultation with the elected representatives and other stakeholders.

Consultation at Divisional level

- Consultation with senior department officers, like DOE office, District Commissioner Offices, Settlement offices etc. and mechanism of regulatory clearance, utility shifting, land acquisition etc.

After completion of the public consultation, the design consultant shall address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the client to the concerned regulatory authority for appraisal.

6.3 Annexure 3: Format for Preparation of Resettlement Action Plan

As per the impacts of the sub-projects, i.e., if the number of PAPs exceeds 20, then a comprehensive Social Impact Assessment needs to be conducted and a Resettlement Action Plan (RAP) needs to be prepared, following the guidelines given in this RPF.

1. Introduction

4. Brief Introduction of the sub-project
5. Description of Component(s) that cause land acquisition/alienation and resettlement
6. Overall Estimates of Land Acquisition and R&R

2. Measures to Minimize Resettlement

4. Description of Efforts Made for Minimizing Displacement
5. Description of the Results of these Efforts
6. Description of Mechanisms to Minimize Displacement and Loss of Livelihood/Income during Implementation

3. Census and Socio-Economic Surveys

3. Provide the results of the census and socio-economic surveys
4. Identify all categories of impacts and the extent of impact on each affected

4. Consultation and involvement of PAPs

6. Describe various Stakeholders
7. Summarize process of consultation on the results of socio-economic surveys
8. Describe the need and mechanisms to conduct updates to socio-economic surveys
9. Describe how this process of consultation would be continued through implementation and monitoring
10. Describe the plan for disseminating information to Project Affected Persons

5. Entitlement Framework

5. Provide a definition of PAFs and PAPs together with their categorization based on impacts
6. Describe R&R entitlements for each category of impact
7. Describe method of valuation used for affected land, structures and other assets
8. Using Entitlement Matrix, present a table of all PAFs/PAPs and their losses/ impacts and entitlements

6. Relocation (if applicable)

7. Does the Project need community relocation sites? If yes, have they been inspected and accepted by PAPs?

8. Have the Project Affected Persons agreed to the strategy for housing replacement? Will new housing be constructed/allocated? If PAPs are to construct houses, explain if compensation entitlement for housing is sufficient to help them construct houses.
9. List of proposed sites along with number of affected families to be relocated
10. Describe respective mechanisms for (i) procuring/acquiring/alienating ; (ii) developing and (iii) allotting resettlement sites
11. Provide detailed description of arrangements for development of resettlement sites including provision of social infrastructure
12. Describe the feasibility studies conducted to determine the suitability of the development of sites.

7. Income Restoration

9. Are the compensation entitlements sufficient to restore income streams for each category of impact? If not, what additional economic rehabilitation measures are necessary?
10. Briefly spell out the restoration strategies for each category of impacts, and describe institutional, financial and technical arrangements/aspects involved
11. Describe the process of consultation with PAPs to finalize strategies for income restoration
12. How do strategies for restoration vary with the area/locality of impact
13. If income restoration involves change in livelihoods or other economic activities allow substantial amount of time for capacity building, accessing institutional funds/credits/markets, preparation and implementation. Work out the rate of returns for each of the economic activities opted by the entitled person.
14. How are the risks of impoverishment proposed to be addressed?
15. Explain the main institutional and other risks for effective implementation of plans for restoration of livelihood
16. Describe the process for monitoring the effectiveness of income restoration activities

8. Institutional Arrangements

7. Describe institution(s) responsible for: (a) delivery of each item/activity in the entitlement policy; (b) implementation of resettlement and rehabilitation programs and (c) coordination of all other activities as described in the Rehabilitation Action Plan
8. State how coordination issues will be addressed in cases where resettlement and rehabilitation are spread over a number of institutional/departmental jurisdictions
9. Indicate the agency that will coordinate all implementing agencies – do they have the necessary mandate and the resources
10. Describe the external (non-Project) institutions/departments involved in the process of resettlement and restoration of income such as land development, land allocation, credit, training for capacity building and the mechanisms in place to ensure adequate cooperation and performance of these institutions/departments
11. Describe the results of the institutional capacity assessment and give the institutional development plans including staffing schedule and training requirements
12. Discuss institutional capacity for, and commitment to, resettlement and rehabilitation

9. Monitoring and Evaluation

8. Describe the internal monitoring process
9. Define key monitoring indicators for resettlement, rehabilitation and participation and provide a list of these indicators which would be used for internal monitoring
10. Describe institutional (including financial) arrangement
11. Describe frequency of reporting and contents of reports
12. Describe the process for integrating feedback from internal monitoring into implementation
13. Describe financial arrangements for external monitoring including process for awarding and maintenance of contracts for the entire duration of R&R
14. Describe the methodology for external monitoring
8. Describe frequency of external reporting and its contents

10. Redress of Grievances

4. Describe the structure and process of grievances mechanisms at various levels including step-by-step process for registering and addressing grievances and provide specific details regarding registering complaints, discussing them with PAPs, response time, communication modes etc.
5. Describe the mechanism for appeal
6. Describe the provision, if any, to enable PAPs to approach civil courts in case these provisions fail.

11. Implementation Schedule

4. List the chronological steps in implementation of R&R Action Plan including identification of agencies responsible for each activity along with a brief explanation of each activity
5. A month-wise implementation schedule (Gantt chart) of activities to be taken as part of R&R Action Plan
6. Description of the linkage between R&R implementation and initiation of civil works for each of the Project component

12. Costs and Budgets

8. Clear statement of financial responsibility and authority
9. List the sources of funds for R&R and describe the flow of funds
10. Indicate if costs of R&R are included in the overall Project costs
11. Identify R&R costs, if any, to be funded by the WB
12. Provide a cost-wise, item-wise budget estimate for the entire R&R costs including administrative expenses, monitoring and evaluation and contingencies
13. Describe the specific mechanisms to adjust cost estimates by *inflation* factor
14. Describe provisions to account for different types of contingencies

6.4 Annexure 4: Format for Preparation of Abbreviated Resettlement Action Plan

When the impacts are limited, i.e., if the number of PAPs are less than 20, then an Abbreviated Resettlement Action Plan (ARAP) needs to be prepared, following the guidelines given in this RPF.

1. Introduction

1. Brief Introduction of the sub-project
2. Description of Component(s) that cause land acquisition/alienation and resettlement
3. Overall Estimates of Land Acquisition and R&R

2. Census and Socio-Economic Surveys

1. Provide the results of the census and socio-economic surveys
2. Identify all categories of impacts and the extent of impact on each affected

3. Consultation and involvement of PAPs

1. Describe various Stakeholders
2. Summarize process of consultation on the results of socio-economic surveys
3. Describe the plan for disseminating information to Project Affected Persons

4. Entitlement Framework

1. Describe R&R entitlements for each category of impact
2. Describe method of valuation used for affected land, structures and other assets
3. Using Entitlement Matrix, present a table of all PAFs/PAPs and their losses/ impacts and entitlements

5. Income Restoration

1. Are the compensation entitlements sufficient to restore income streams for each category of impact. If not, what additional economic rehabilitation measures are necessary.
2. Briefly spell out the restoration strategies for each category of impacts, and describe institutional, financial and technical arrangements/aspects involved
3. Describe the process of consultation with PAPs to finalize strategies for income restoration
4. If income restoration involves change in livelihoods or other economic activities allow substantial amount of time for capacity building, accessing institutional funds/credits/markets, preparation and implementation. Work out the rate of returns for each of the economic activities opted by the entitled person.
5. How are the risks of impoverishment proposed to be addressed?

6. Institutional Arrangements

1. Describe institution(s) responsible for: (a) delivery of each item/activity in the entitlement policy; (b) implementation of resettlement and rehabilitation programs and (c) coordination of all other activities as described in the Rehabilitation Action Plan

7. Monitoring and Evaluation

1. Describe the internal monitoring process

8. Redress of Grievances

1. Describe the structure and process of grievances mechanisms at various levels including step-by-step process for registering and addressing grievances and provide specific details regarding registering complaints, discussing them with PAPs, response time, communication modes etc.
2. Describe the mechanism for appeal
3. Describe the provision, if any, to enable PAPs to approach civil courts in case these provisions fail.

9. Implementation Schedule

1. List the chronological steps in implementation of R&R Action Plan including identification of agencies responsible for each activity along with a brief explanation of each activity.

10. Costs and Budgets

1. Clear statement of financial responsibility and authority
2. List the sources of funds for R&R and describe the flow of funds
3. Indicate if costs of R&R are included in the overall Project costs
4. Identify R&R costs, if any, to be funded by the WB
5. Describe the specific mechanisms to adjust cost estimates by *inflation* factor
6. Describe provisions to account for different types of contingencies

Annex H: Communication Strategy and Action Plan

Dhaka-Chittagong Inland Water Transport Corridor Project:

Communications Strategy and Action Plan

Background

Despite being a riverine country with some 700 rivers, streams and canals covering a total length of about 24,000 km, the river route has been declining in Bangladesh for lack of adequate water and its proper management. About 6,000 km of river route are navigable during the monsoon for different size vessels, but it shrinks to about 3,900 km in the dry period. While the larger rivers are up to 50m depth in places and the lower Meghna is generally 10-25m depth, navigation is hindered by very shallow depths on bars, especially in the delta area, at the confluences of the major rivers and their tributaries, river bends and mouths.

Once the country's transportation highly depended on river routes, but it is shifted to roads and railways in recent decades. But carrying goods in waterways is cheaper than roads or railway. Considering the potential of waterways in transportation, the government has given more emphasis on the inland water transportation to minimise pressure on roads and railways.

Among the country's all river routes, Dhaka-Chittagong corridor is the main trafficked route for inland water transport (as also for roads and railways) and carries about 80 percent of all Inland Water Transport (IWT) traffic. Realising the importance of this corridor and the need to fully utilise all transport modes to reduce demand on roads, the Bangladesh government has prioritised the improved development and maintenance of the Class-I routes and linked Class-II and -III routes along this corridor. The main trunk route is about 300km, of which it is initially estimated that about 40km currently require dredging and channelisation to maintain the advertised depth for the existing traffic. Another 110-130km of linked routes is part of this corridor, of which about 33-50 km requires constant maintenance.

As part of its priority, the government has taken the Dhaka-Chittagong Inland Water Transport Corridor Project with financial support from the Work Bank. Bangladesh Inland Water Transport Authority (BIWTA) under the Shipping Ministry will implement the project.

Communication activities can contribute to awareness, uptake and adoption of BIWTA's work into the government policies and management plans at all tiers of government to sharing information with the stakeholders concerned and the people living in local communities to improve their livelihoods.

This document deals with BIWTA communication events and activities at local and national scale for the project: 'Dhaka-Chittagong Inland Water Transport Corridor Project'. To ensure that communication activities are aligned with this strategy the BIWTA communication team, project managers and the relevant stakeholders when required to discuss upcoming activities and issues and progress to date.

Overall Programme/Project Objectives

The proposed World Bank project aims to establish and maintain i) Dhaka-Munshigonj-Gajaria-Chandpur-Chittagong River Route, Munshiganj-Demra-Ghorashal route, and connecting routes to Barisal and Ashuganj; ii) six vessel shelters to be located along the aforementioned river routes; and iii) ferry crossing routes between: Chandpur and Shariatpur; Lakshmipor and Bhola; and Beduria and Laharhat. To implement the project, BIWTA must acquire land for spoils disposal where applicable, and manage the onshore dredge spoils deposits, including facilitating use of spoils for construction activities, land-filling, and other end-uses as appropriate and based on demand.

The objective of the project is:

To increase the capacity, reliability and safety of inland water transport along the Dhaka-Chittagong corridor.

To ensure more private sector involvement in inland water transport sector.

To increase number of country boats and vessels as inland transport.

To provide an opportunity to improve the institutional capacity for environmental management, social management, and safety in overall IWT sector.

To popularise IWT sector in carrying goods to minimise pressure on road and rail communications.

Communications Objectives

The overall Communication Strategy is intended to be a dynamic document and be updated to reflect the continually evolving nature of work and to take advantage of new events and evolving project plans.

The objectives of this communication strategy are:

• To outline appropriate communication activities to ensure enhanced capacity and skill of both government agencies and private sector to sustainably manage the country’s inland water sector

• To assist in building capacity of communities, community-based organisations and local government agencies through various programmes

• To build awareness among a wide but defined group of audiences and user groups about the importance of inland water sector

• To influence policymakers, civil society and development practitioners for dissemination of project achievements using media, publication of policy briefs and the publishing of book

• To sensitise private sector and aid agencies to invest more in the country’s inland water transport sector

Target Audience

The purpose of this project is to effectively operate Dhaka-Chittagong Inland Water Transport Corridor by establishing water structures and dredging the river channels to popularise water transportation in the country with a view to cut pressure on road and rail communications.

It is recognised that to achieve this outcome, a broad range of potential audience groups are required to be targeted, each with differing communication activities and approaches. However to be effective each target audience needs to have a different communication strategy and approach.

The following priority audience groups have been identified for communication activities:

Stakeholders/Audiences	
INTERNAL	EXTRNAL
The Ministry of Shipping - BIWTA - Bangladesh Inland Water Transport Corporation (BIWTC)	**Aid Agencies and Donors** - World Bank
Project staff - Dhaka office - Local staff	**Local Government** - UpazilaParishad - Union Parishad
Government agencies - Bangladesh Water Development Board (BWDB) - Department of Agricultural Extension (DAE) - Department of Fisheries (DoF) -Department of Environment (DoE) - Land Ministry - Ministry of Commerce - Ministry of Industries - Department of Fisheries - Department of Hydrology - ChittagongPort Authority (CPA) - MonglaPort Authority (MPA) - LandPort Authority	**Local communities** - Women - Community leaders - Fishermen - Farmers - School teachers - Opinion leaders - Community-based organisations
	NGOs/Research organisations - Bangladesh Center for Advance Studies (BCAS) - Bangladesh Environmental Lawyers

	Association (BELA) - BRAC - Center for Sustainable Development Center for Natural Resource Studies - Coastal Area Resource Development and Management Association - Centre for Coastal Environmental Conservation - Center for Environmental and Geographic Information System (CEGIS) - Development of Biotechnology and Environmental Conservation Centre - Environment and Social Development Organisation - Wildteam - Forum of Environmental Journalists of Bangladesh
	Media - Print media (newspapers) - Broadcast Media (Television and Radio) - Online
	Development practitioners - Institute of Governance Studies (IGS) - BRACUniversity

	Private sector - Bangladesh Cargo Vessel Owners' Association - Bangladesh Launch Owners' Association - Bangladesh Inland Waterways Passenger Carrier Association - Dhaka Chamber of Commerce and Industry (DCC) - Federation of Bangladesh Chambers of Commerce and Industries (FBCCI)

Channels

The table below outlines the key stakeholders/audiences and the channels used to disseminate communication messages:

Internal Stakeholders	
Stakeholder/Audience	**Communication channel**
Shipping Ministry	Publications - Project summary - Documentary video/dvd - Project brochure Promotional materials - Stickers Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies **Media articles**
Government agencies	Meetings - Meeting with Policymakers and Government officials - Community and local level Publications - Advocacy publication - Policy briefs - Project summary - Documentary video/dvd - Project brochure Promotional materials - Stickers Workshop Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies Media articles
Project Staff	Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies Publications - Advocacy publication - Policy briefs - Project summary - Documentary video/dvd - Project brochure

	- Training manual Promotional materials - Stickers Workshop

External Stakeholders	
Stakeholder/Audience	**Communication channel**
Aid Agencies and Donors	Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies Media articles Reports - Project report (monthly, quarterly and annually) Publications - Advocacy publication - Policy briefs - Project summary - Documentary video/dvd - Project brochure Promotional materials - Stickers Workshop
Local Government	Promotional materials -Stickers -Publications - Advocacy publication - Policy briefs - Project summary - Documentary video/dvd - Project brochure National workshop Local Media articles
Local Communities	Meetings - Local and community level meetings - Exposure visits - Field worker visits - Presentation sessions

	Promotional materials - Stickers - Billboards Local media - Newspapers - Online Publications - Project summary - Documentary video - Policy briefs - Training manual - Project brochure - Advocacy publication Workshop
NGOs/Research organisations/Development practitioners	Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies Media articles Reports - Project Report (monthly, quarterly and annually) - Baseline Report - Training Assessment Report Publications - Advocacy publication - Policy briefs - Project summary - Documentary video/dvd - Project brochure Meetings - Validation meeting - Meeting with stakeholder representatives - Meeting with policymakers Workshop
Private Sector	Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies Media articles Publications - Advocacy publication

	- Policy briefs - Project summary - Documentary video/dvd - Project brochure Meetings - Meeting with stakeholder representatives - Meeting with policymakers Workshop
Media	Media release Ministry, BIWTC and BIWTA websites - Web stories - Photos - Case studies Workshop Publications - Advocacy publication - Policy briefs - Project summary - Documentary video/dvd - Project brochure Promotional materials - Stickers Exposure visits (dependant on budget)

Communication objectives per audience

COMMUNICATION OBJECTIVE	AUDIENCE
To outline appropriate communication activities to strengthen capacity and skill of both government agencies and private sector to sustainably manage the country's inland water transport sector	The Shipping Ministry, the government agencies, private sector and local community
To assist in building capacity of communities, community-based organisations and local government agencies through various programmes to manage water resources	The Shipping Ministry, the government agencies, aid agencies, NGOs, research organisations and local community

To build awareness among a wide but defined group of audiences and user groups about the importance of inland water sector	The Shipping Ministry, the government agencies, aid agencies, NGOs, research organisations and local community and media as well
To influence policymakers, civil society and development practitioners for dissemination of project achievements using local media, publication of policy briefs and the publishing of book	The Shipping Ministry, the government agencies, aid agencies, NGOs and media
To sensitise private sector and donor agencies to invest more in inland water transport sector	Private sector, the Shipping Ministry, government agencies, aid donors and media

Key Messages

The key messages to be delivered through this project are:

1. BIWTA is working to revive the country's inland water transport sector by ensuring sustainable management of water resources in Bangladesh.

2. Inland water transportation is the most environmentally friendly and low-cost transport modes in the world.

3. Dhaka-Chittagong Inland Water Transport Corridor project will help increase inland water traffic in the country and will minimise transport pressure on road and rail communications.

4. Dhaka-Chittagong Inland Water Transport Corridor project will contribute to the increase of volume of trade and commerce. Thus, it will help enhance the country's socioeconomic development.

5. Once the project is implemented, local community as well as private sector will be benefited from it.

Communications Mix

The Communications Strategy and Action Plan for Dhaka-Chittagong Inland Water Transport Corridor Project will use different tools to reach the message to different sections of audiences during a year period.

The list of communications tools is given bellow:

External Communications Mix

- **Press**
  Press release
  Radio
  Opinion editorial
  Features
  Features advisories

- **TV**
- – News and features
- – Long-format programmes and online television options

- **Advertising**
- – Print
- – Radio
- – Television

- **Print**
- – Brochures
- – Posters
- – Letters
- – Leaflets
- – Scientific reports
- – Etc.

- **Public Relations**
- – Event
- – Endorsements
- – Telephone calls
- – conferences
- – Etc.

Internal Communications Mix

- Conference calls
- Face-to-face meetings
- Etc.

Budget

(Budget to be fixed in consultation with the project officials)

The amount of money available now
The amount of money available in the future

Action Plan

This communication action will cover over the next 12 months of the project. During this period, two local workshops will be held in Barisal and Chandpur involving local stakeholders and community leaders to inform local people about the project. Besides, some 20 focus group discussions (FGDs) will be held with local community at different locations. During the FGDs, leaflets, stickers and posters will be distributed among the local people to sensitise them.

What: Two local workshops

Why: To inform local people

Where: Barisal and Chandpur

When: (To be fixed)

Who: (Chief Guest Name)

How: Involving community leaders and local authorities

Target Audience: Local government representatives and community leaders

Key Message(s): (To be fixed)

Media Strategy: (To be fixed)

Tools and Materials: (To be fixed)

This table is a living document, to be updated on a continual basis – by the project team at BIWTA

EVENTS							
When	Activities	Target Audience	Message	Communications Materials	Channel	Persons responsible	Cost
Communications Plan							
Ongoing, ideally created during the project planning stage and reviewed quarterly	Create individual project communication plan that allow for broad planning of event, workshops, media releases	- BIWTA - Government agencies - Donor agencies	Overview of the communications activities for the project	Overall communications strategy		- Communications Officer - Project Staff	Staff time
Meetings							
Date:	Validation Meeting	- BIWTA - Government agencies - Donor agencies	Validate communications strategy	-Communications plan - Presentation - Project summary	Meeting	- Project Staff - Communications Officer	- Staff time - Venue - Transport costs - Accommodation costs - Food costs

Dates	Meeting with MSP (Multi-stakeholder platform) Representatives	- BIWTA - Government agencies - Donor agencies MSP	- Introduce project - Project Update - Issues/ Challenges - Way forward - Knowledge Sharing	- Project summary - Presentation	Meeting	Project staff	- Transport - Food - Accommodation
Workshops							
Date: Venue: Chandpur	Local Workshop	- Policymakers - Partners - Local community - Local authorities - Project Staff - NGOs - Media	Project information, Project achievement, risks faced and future direction	- Press release - Invite media - Banner		- Communication Officer - Project Staff	Workshop cost, consultant fee and staff time, media

Date Venue: Chandpur	Local Workshop	- Policymakers - Partners - Local community - Local authorities - Project Staff - NGOs - Media	Project information, Project achievement, risks faced and future direction	Press release Invite media Banner		- Communication Officer - Project Staff	Work shop cost , consultant fee and staff time, media
Date Venue: Chandpur	Local Workshop	- Policymakers - Partners - Local community - Local authorities	Project information, Project achievement, risks faced and future direction	Press release Invite media Banner		- Communication Officer - Project Staff	Work shop cost , consultant fee and staff time, media

		- Project Staff - NGOs - Media					
Date: Venue: Barisal	Local Workshop	Policymakers - Local community - Local authorities - Project Staff - NGOs - Media	Project information, Project achievement, risks faced and future direction	- Press release - Invite media - Banner		- Communication Officer - Project Staff	Workshop cost, consultant fee and staff time, media
Focus Group Discussions (FGDs)							
Dates: Venues:	20 FGDs	- Local community - Local authorities - Project Staff - NGOs - Media	Campaign on IWT project	- Press release - Invite media - Banner		Communication Officer - Project Staff	Consultant fee and staff time, and media
Reports							
- Monthly - Quarterly	Project Report - Monthly	- Donor - Shipping	- Progress report	Pre-designed format supplied	Report format	Project Staff	Staff time

- Annually	- Quarterly - Annually	Ministry - BIWTA - BIWTC -Govt agencies	- Financial report	by Donor			

Evaluating Success

How will we measure the success of our communications? It is important to assess the communication strategy/project so that any changes, if necessary, can be made when engaging in a similar strategy/project in the future.

Communications objective	Verifiable Indicator	Means of Verification	Timing
• To outline appropriate communication activities to strengthen capacity and skill of both government agencies and private sector to sustainably manage the country's inland water sector • To assist in building capacity of communities, community-based organisations and local government agencies through various programmes to manage water resources • To build awareness among a wide but defined group of audiences and user groups about the importance of inland water sector • To influence	- Presence of project's stories in media and on the BIWTA website. - Changes in the community's attitude to IWT sector	Media monitoring – collecting online and newspaper articles Log of disseminated materials	Collection on daily/weekly basis. Dissemination to IWT Corridor project staff and Communication Coordinator on monthly basis. As disseminated.

policymakers, civil society and development practitioners for dissemination of project achievements using media, publication of policy briefs and the publishing of book • To sensitise private sector and aid agencies to invest more in the country’s inland water transport sector			

Annex I: Stakeholders Consultation Record

National Stakeholder Consultation on Inception and Scoping Report

Public Consultations Record (National)

Overview of the consultation event

A public consultation event was held on October 14th, 2015 at the CIRDAP International Conference Center (CICC) in Dhaka on the Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project. The purpose of the event was: (a) to share preliminary information about the proposed project, and (b) to share and seek feedback on the proposed scope and methodology of the environmental and social safeguards studies, as per the Government of Bangladesh and World Bank requirements and standards.

Bangladesh Inland Water Transport Authority (BIWTA), responsible agency of the project, and Institute of Water Modeling (IWM), consultant for the Environmental and Social Impact Assessment study, publicized the event through sending invitations to the attendees by means of invitation cards, emails and phone calls during October 2-6, 2015. The list of attendees is presented in Table 1.

Table 1 : List of attendees in the National Stakeholder Consultation Workshop held on 14 October 2015 at CIRDAP International Conference Center (CICC), Dhaka.

Ministry of Shipping

Sl.	Name	Position	Organization	Phone number	Email
1.	Mr. Shajahan Khan, MP	Honourable Minister, Ministry of Shipping			
2.	Mr. Shafique Alam Mehdi	Secretary, Ministry of Shipping		01711527722	
3.	Mr. Abu Jafar Md. Farid Uddin Chowdhury	Deputy Chief		01815442203	
4.	Ms. Sirat Mahmuda	Senior Asst. Chief		01717514152	
5.	Mr. Mohammad Anamul Haque Bhuiyan	Project Procurement Consultant PMU		01715790844	
6.	Mr, Md. Jahangir Alam Khan	PRO		01711425364	
7.	Dr. BKD Raja	Environment Specialist			
8.	Venkata Nukala	Socio-Development Specialist			

Bangladesh Inland Water Transport Authority

Sl.	Name	Position	Organization	Phone number	Email
1.	Mr. Md. Moniruzzaman	Chairman (in-charge)			
2.	Mr. Mohammed Mofizul Haque	Member (Engineering)		01718547528	
3.	Mr. Md. Mahbub Alam	Director, Hydrography Department		01711397277	
4.	Mr. Mahmud Hasan Salim	Director (Planning), Planning Department		01911914636	
5.	Mr. Md. Abdul Hai	Director, Conservancy & Pilotage Department		01711111184	
6.	Mr. Majibur Rahman Sarker	Chief Engineer, Engineering Department		01726060433	
7.	Mr. Md. Siddiqur Rahman,	Director, Audit Department		01713076564	
8.	Mr. Gopal Chandra Saha	Director, Finance Department		01712256768	
9.	Mr. Abdul Awal	Director, Account Department		01713453211	
10.	Mr. Mahabubul Alam	Director, Port Department		01713007084	
11.	Mr. Mazibur Rahman	Joint Director (Planning). Planning Department		01912164998	
12.	Mr. Zaved Anwar	Joint Director (Planning), Planning Department			
13.	Mr. Md. Mohiuddin Chowdhury	Deputy Director (Planning) Planning Department			
14.	Mr. Liaquat Akbar	Assistant Director (Planning) Planning Department		01686773771	
15.	Mr. Atahar Ali Sardar	Addl. Chief Engineer (Marine) Dredging Department		01712602922	
16.	Mr. Rokibul Islam Talukder	Addl. Chief Engineer (Dhaka Zone) Engineering Department			
17.	Mr. Md. Mohidul Islam	Addl. Chief Engineer (Barisal Zone) Engineering Department		01911914636	
18.	Mr. Shajadur Rahman	Superintending Engineer (Dhaka Circle), Engineering Department		01917845639	
19.	Mr. Saidur Rahman	Superintending Engineer (Dredging) Dredging Department		01913048786	
20.	Mr. Md. Saifur Rahman	Joint Director (Survey) Hydrography Department		01552472062	
21.	Mr. Md. Alfaz Uddin	Deputy Director (Survey) Hydrography Department		01913733916	
22.	Mr. Monjurul Haque	Deputy Director (Survey) Hydrography Department		01722179479	
23.	Mr. Mostafizur Rahman	Assistant Director (Survey) Hydrography Department		01717796169	
24.	Mr. Babul Akhter	Assistant Director (Survey) Hydrography Department		01913109139	

25.	Mr. Sabur Khan	Deputy Assistant Director (Survey) Hydrography Department		01712844309	
26.	Mr. Mortaza Kabir Ahmed	Additonal Director, Hydrography Department			
27.	Mr. Md. Nesar Uddin Khan	Additional Chief Engineer MME Department,		01720123455	
28.	Mr. Mohammad Tariqul Hasan	Executive Engineer, Dredging Department		01745770033	
29.	Md. Mosarrof Hossain	Deputy Assistant Director			
30.	Md. Enayet Hossain	Joint chief			
31.	Md. Mizanur Rahman	Joint Director			
32.	Md. Motaher Hossain	Assistant Director			
33.	Md. Iqbal Alam	System Analyst			
34.	Burhanuddin Ahmed				
35.	Md. Obaidur Rahman	Assistant Director			
36.	Md. Sharfuddin	Deputy Assistant Director			

Bangladesh Inland Water Transport Corporation

Sl.	Name	Position	Organization	Phone number	Email
1)	Mr. NSM Shahadat Ali	GM (Commerce), BIWTC, Dhaka			
2)	Ms. Jesmin Ara Begum	Chief Planning, BIWTC, Dhaka		01199007062	

Bangladesh Water Development Board

Sl.	Name	Position	Organization	Phone number	Email
1)	Niger Sultana	Deputy Chief			
2)	Dr. Shamol Chandra Das	Executive Director			
3)	Abul Kalam Azad	Chief Engineer			
4)	Mr. Md. Maqbul Hussain	Director, Planning-2. Anser Building (7th Floor)	BWDB	01715208986	
5)	Mr. Saleh Ahmed	Executive Engineer, Office of Chief Planning	BWDB	01711198577	
6)	Mr. Muhammed Mahboob-Ul-Kabir	Director, Central Procurement Cell,	BWDB		
7)	Mr. Belal Uddin Biswas	Deputy Chief, Forest & Environment, Office of the Chief Planning,	BWDB	01711264593	

Mongla Port Authority

Sl.	Name	Position	Organization	Phone number	Email
	Rear Admiral Riazuddin Ahmed, BSP, NDU, AFWC, PSC, BN	Chairman Mongla Port Authority	MPA	01706363591	
	Md. Bazlur Rahman	Deputy Chief Engineer (H) Mongla Port Authority	MPA		

	Md. Motiur Rahman	Assistant Engineer Civil and Hydraulics Department		01948901970	
	Md. Golam Kader	ATM,	MPA		

Department of Environment

Sl.	Name	Position	Organization	Phone number	Email
	Dr. Sultan Ahmed	Director (Natural Resource Management)		01552328617	
	A K M Rafiqul Islam	Deputy Director/CC (Research & Monitoring)		01711446249	

Department of Agricultural Extension (DAE)

Sl.	Name	Position	Organization	Phone number	Email
	Tahmina Begum	Deputy Director Water Management (WM), Department of Agricultural Extension,		01716481517	

International Union for Conservation of Nature

Sl.	Name	Position	Organization	Phone number	Email
	Dr. Ishtaq Uddin Ahmed	Country Representative International Union for Conservation of Nature (IUCN)		01712085944	

Bangladesh University of Engineering and Technology

Sl.	Name	Position	Organization	Phone number	Email
1)	Professor Dr. Md. Mashud Karim	Head, Dept. of Naval Architecture and Marine Engineering (NAME)		01715313384	

World Fish

Sl.	Name	Position	Organization	Phone number	Email
	Dr. M. Yousuf Ali	Focal Manager, World Fish			
	Mahtab Khan Bhadhon	Junior Provisionary Fishery Officer			

Delta Plan

Sl.	Name	Position	Organization	Phone number	Email
1	Mollah Ruhul Alom				

Directorate General of Forces Intelligence

Sl.	Name	Position	Organization	Phone number	Email
1	Md. Shahjahan				

2	Md. Faizur				

Private Sector

Sl.	Name	Position	Organization	Phone number	Email
	Mr. SP Mahabuddin Ahmed Bir Bikrom.	President Bangladesh Inland Water Transport (Passenger Carriers) Association		9871432	
	Tuhin Dutta	MD, DSS			
	Mr. Md. Shah Alam	President Bangladesh Launch Labour Federation			
	Mr. Chowdhury Ashiqul Alam	Secretary Bangladesh Launch Labour Federation			
	Momin Islam	President Bangladesh Oil Tankers Owner's Association			
	A.M.M. Shahadat Hossain	Director, Logistics, Shipping & Port M/S A.K.Khan& Co Ltd. (Former Chairman, Chittagong Port Authority)			
	Habibul Alam, Bir Pratik	Chairman, Bangladesh Oil Tankers Owners' Association			
	Sharif Md. Afzal Hossain	Managing Director, S.S.Rahman Shipping Lines Ltd.			
	Mahbub Ahmed	Managing Director, Ship Owners Rights			
	Md.Sharif	Knowledge Management Consultants			
	Shoumo Khondoker	CARRINUM			
	Shah Abdul Latif	WMSM			
	Tanjim Mashrur	CARRINUM			
	Ms. Anannya	CARRINUM			
	Mr. Ariful Haque	CARRINUM			

Institute of Water Modelling

Sl.	Name	Position	Organization	Phone number	Email
	Prof. Dr. M. Monowar Hossain	Executive Director, Institute of Water Modelling		01716415528	
	Mr. Abu Saleh Khan	Deputy Executive Director (opn),		01819238085	
	Zahirul Haque Khan	Director, CPE, IWM		01819432538	
	Md. Ashraf Ali Khan	Manager, HRD		01714 395624	
	M.H. Anupam Mahmud	Program Associate, HRD		01841-930041	
	M. Samiun Nabi	Manager, Business Development		01711489961	
	Mr. Ruhul Amin	BD officer, IWM		01841930036	
	Rubayat Alam	Senior Specialist		01841930017	
	Shume Akhter	Associate Specialist		01841930023	
	Md. Abdus Salam Sikder	Sr. River and Coastal Morphologist			

	Md. Moshiur Rahman	Associate Specialist		01847189319	
	Sheikh Nahiduzzaman	Junior Specialist		01914758134	
	Md. Raqubul Hasib	Junior Engineer		01823798921	
	Farhan Md. Zahir	Junior Engineer		01798144187	
	Md. Ziaur Rahman	Associate Specialist		01715814390	
	Md. Mohaimenul Islam	Manager (Admin)			
	Md. Mainul Islam	Secretary, CPE		01911906602	
	Md. Samsuddin	Environmental Specialist			
	Dr. Sheikh Muhammad Abdur Rashid	River Ecologist, IWM			
	Mr. Khairul Matin,	Socio-Development Specialist, KMC		01741127731	
	Mehedi Hasan Emon	Environmental Specialist		01811446974	
	Syed Monowar Hossain	Navigation Specialist			
	Dipen Shaha	Junior Engineer			
	Md. Golam Rasul	Agronomist			
	Zahirul Islam	Agronomist			
	Morsheda Begum	Junior Engineer			

World Bank

Sl.	Name	Position	Organization	Phone number	Email
1	Venkata Nukala	Environmental Specialist			
2	BKD Raja	Socio-Development Specialist			
3	Leanne Farrell				
4	Elaile Jiang				
5	Md. Akhtar zaman				
6	Iqbal Ahmed				
7	Dick Konijn				
8	Jiry de Waal				
9	Deepak Man Singh Shrestha				
10	Diep Nguyen-Van Houtte				

Bangladesh Land Port Authority

Sl.	Name	Position	Organization	Phone number	Email
1	Md. Hasan Ali	Executive Engineer			
2	Md. Rezaul Karim	Estate Officer			

Media

Sl.	Name	Position	Organization	Phone number	Email
1	Amadul Haque	Reporter, BTV			
2	Kazi Zabel	Daily Jagantar (News Paper)			
3	Kamal Ahemd	Bangladesh Radio			
4	Mr. Sohag	Daily New Nation			

The event was attended by senior government officials of the Shipping Ministry and representatives from other bodies like BIWTA and BIWTC and DoE, Development Partners, NGOs, Research Organizations, Private Sector, Print Media (including The Daily Star and Prothom Alo etc.) and electronic media (including BTV, RTV, channel 9, Channel 24 etc.)

Shipping Minister Shajahan Khan, MP, addressed the workshop as the chief quest while Secretary of Ministry of Shipping Shafique Alam Mehdi spoke on the occasion as special guest. BIWTA acting chairman M Moniruzzaman presided over the workshop.

Honourable Shipping Minister Shajahan Khan said Bangladesh is a riverine country with some 700 rivers, streams and canals with a total length of about 24,000 km.

“About 6,000 km are navigable during the monsoon for different size vessels, shrinking to about 3,900 km in the dry period, which is not acceptable. To restore our navigation routes, our government has taken initiatives which are being implemented by BIWTA,” he added.

The Shipping Minister said the Government has identified 65 main river navigation routes that are essential to passenger and freight transport within Bangladesh. “Of these, 12 have been clearly identified as high priority.”

The Dhaka-Chittagong corridor is the main trafficked route for inland water transport and carries approximately 80 percent all Inland Water Transport traffic, Shajahan Khan said, this is why this route has been given highest priority.

“This route is very significant as goods of inter country and transit trade under Protocol on IWT between Bangladesh and India are transported by these routes. Growth of international sea borne trade will largely depend on this Dhaka-Chittagong Corridor,” he said.

The Shipping Minister said that the projection of IWT Container Traffic is 8.52 million TEU in 2035, which is very promising and this also demands the improvement of navigability of Dhaka-Chittagong river route.

“I am happy to know that IWM is carrying out comprehensive EIA and SIA studies of the project. I believe that the institute will perform their activities with detailed analysis with risks and impacts on environment and risks to the aquatic, estuarine and marine environment, terrestrial environment, socio-economic impacts on populations in relation with the investments and activities in project area,” he said.

Shajahan Khan thanked the World Bank to come forward for such an important project and expressed his sincere thanks and gratitude to all participants, electronic and print media and the organizers.

Speaking as special guest, Shipping Secretary Shafique Alam Mehdi said the routes are the most important passenger corridor with almost 200,000 passengers travel by these waterways daily on average. “Even with the expansion of road network majority of the passengers prefer waterways for travelling to and from Barisal Division, Chandpur District and adjacent areas of Laxmipur and Noakhali Districts.”

Similarly, he said, in terms of freight movement, the routes under study play a vital role in the overall transport sector. These routes connect the main consumption and distribution area of the country, including Dhaka-Narayanganj area, with maritime ports and other major consolidation places of goods.

The Shipping Secretary said the movement of break-bulk cargo and POL depends on these routes. This natural advantage has inspired investors to establish industrial units along these routes or on average within a distance of 10km from the routes.

“Goods of inter-country trade between Bangladesh and India are being transported by these routes under the provisions of the Protocol on Inland Water Transit and Trade (PIWTT). Goods from one place to other place of India are also being transported through these routes under the provisions of PIWTT,” he said.

Secretary Shafique Alam Mehdi informed the workshop that the Ministry of Shipping has engaged one independent Environmental Safeguard Specialist and one Social Safeguard Specialist to oversee and provide guidance on the EIA/SIA and SMF studies. “They will interface with and guide the IWM study team on an ongoing basis to make sure that the resulting studies are fully compliant with applicable environmental and social safeguard policies of the World Bank,” he added.

BIWTA acting chairman M Moniruzzaman said the proposed project might result in significant environmental impacts, if the project activities are not properly planned, designed, executed, and maintained in the perspective of physical, biological and social environment. “Further to that, the project will provide an opportunity to improve the institutional capacity for environmental management, social management, and safety in overall IWT sector.”

He said the Dhaka-Chittagong corridor is the main trafficked route for inland water transport and carries approximately 75 to 80 percent all Inland water transport traffic. “This is why this corridor has been given much importance nationally and internationally. BIWTA has playing its role and providing necessary supports for success of the study as implementing agency,” Moniruzzaman added.

IWM Executive Director Prof Dr M Monowar Hossain made a power-point presentation on overview of the study “Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project”.

The workshop was carried out in English language and it was recorded and filmed. The length of event was three hours and 30 minutes. Project brief and its map were distributed among the participants. After the inaugural session of the workshop, five power-point presentations on environmental and social assessment of the study were presented during technical session followed by an open discussion.

Dr. Sultan Ahmed, director (Natural Resource Management) of Department of Environment, chaired the technical session while five power-point presentations were made:

A) Presentation on overview of Bangladesh Trade and Transport Facilitation Project by Venkata Nukala, Environmental Consultant of Ministry of Shipping

B) Presentation on the scope of environmental and social assessment of the study and proposed methodology for carrying out the study by Md. Zahirul Haque Khan, Team Leader and Director CPE Division, IWM

C) Presentation on Physical Environment of the Project and Key Issues by Mr. Mehedi Hasan Emon, Environmental Specialist, IWM

D) Presentation on Ecological Environment of the Project and Key Issues by Mr. Dr. Sheikh Muhammad Abdur Rashid, River Ecologist, IWM

E) Presentation on Socio-cultural Environment of the Project and Key Issues by Mr. Khairul Matin, Socio-Development Specialist, IWM.

Mahmud Hasan Salim, Project Director and director (Planning) of Bangladesh Inland Water Transport Authority (BIWTA), gave welcome address at the event.

Summary of comments, questions, and feedback received

The table below summarizes the key issues raised (including those not relevant to the proposed project) by stakeholders, and responses from BIWTA and IWM.

Stakeholder category #1 CENTRAL GOVERNMENT AGENCY OFFICIALS		
Stakeholder comment	BIWTA and IWM response	Remarks/Additional actions / agreed follow-up
BIWTA director Abdul Hye recommended for upgrading Kanchpur and Sultana Kamal bridges as these are creating barrier against plying of big-seize containers on the river route.	BIWTA responded that it will put forward the recommendation to the authorities concerned.	
DoE director Sultan Ahmed asked project officials to submit EIA of the project to the DoE to get environmental clearance.	Project authorities responded that they will submit EIA of the project to DoE within stipulated timeframe.	
Md. Saidur Rahman, Superintend Engineer, BIWTA, Dredging department said that Char nurul islam is a part of the project and the area is very much unpredictable, siltation rate is very high, water velocity is very high during tide, river bed always changes, so that area should be taken into consideration during study and he asked What type of dredger will be used in the project.	Project authorities responded that they will take char nurul islam's characteristics into consideration. Cutter suction dredger and hopper dredger (for estuarine) will be used for the project.	
Md. Alfazuddin, Deputy Director (Survey), BIWTA emphasized on Bank protection/river control plan and he asked whether the project will be extended up to mongla port in pussur river	Project authorities responded that the project doesn't consider route up to mongla.	
AKM Rafiqul Islam, Deputy Director, DOE said Identifying ecologically critically areas(ECA) within project area should be done, wet land and water bodies should not be	Project authorities agreed with his views and assured that the report will be uploaded in the website in due time.	

filled up by spoils and he asked for a disclosure of the ESIA at website for comments and suggestions.		
Md. Saiful Islam, Joint Director, BIWTA said that origin of most of the rivers are in upstream in India. So to sustain the project the issue of water flow between two countries should be settled in priority basis.	BIWTA and IWM said that Bangladesh is hopeful of getting adequate water from upstream countries as per agreements to maintain water flow of Dhaka-Chittagong Inland Water Transport Corridor.	
Tahmina Begum, Deputy Director, DAE Extension asked to consider Cost benefit ratio	Project authorities said that it will be considered.	
Shajadur Rahman, Superintend Engineer, BIWTA said that a good co relation needs to be assessed for river-bay/estuary in terms of aquatic life during dredging interventions.	Project authorities said that likely impacts of dredging will be assessed and in accordance with that ECA will be formulated with monitoring program.	
Dr. Shamal Chandra Das, Executive Engineer, BWDB wanted to know the criteria of selecting project influence area which is one km either side of the river bank. And In case of tributaries and distributaries- what will be the influence.	Project authorities informed that for tributary and distributary 1 km influence area has also been considered.	
Stakeholder category #2 Media		
Stakeholder comment	BIWTA and IWM response	Remarks / Additional actions / agreed follow-up
Morshedul Islam of Daily Nayadigantha said that regional cooperation will be a key to ensure water flow of the Dhaka-Chittagong water way as Bangladesh depends on water of trans-boundary rivers.	BIWTA and IWM said that Bangladesh is hopeful of getting adequate water from upstream countries as per agreements to maintain water flow of Dhaka-Chittagong Inland Water Transport Corridor.	
Stakeholder category #3 Academics		
Stakeholder comment	BIWTA and IWM response	Remarks / Additional actions / agreed follow-up
Dr. Md. Mashud Karim, Professor, BUET said that a comparative study of the route should be done with rail and roadways.	Project authorities informed that the study will be carried out.	

Stakeholder category #3 Private Sector		
Stakeholder comment	BIWTA and IWM response	Remarks / Additional actions / agreed follow-up
A former chairman of Chittagong Port Authority suggested upgrading Shitalakhya River route to Class-1 from existing Class-2.	BIWTA responded that they will sincerely consider the suggestion	
Chowdhury Ashiqul Alam, Secretary General , Bangladesh noujan sramik federation asked for Tidal management policy and said that river should be free from man-made obstacle in national and international river.	Project authorities agreed with his views.	

Event closing

The event closed at 13:20 pm and stakeholders were thanked for their attendance and participation. They were also informed about the following current plans for future consultation and engagement opportunities related to the projects, where to find ongoing information about the projects' planning and development, and how to get in touch with BIWTA with any further questions, concerns or suggestions.

Participants were furthermore informed that this summary would be made publicly available (both in English and Bengali) at January, 2016 within 90 days of the event.

Annex 1: detailed list of consultation participants

Ministry of Shipping

Attendance Sheet

National Stakeholder Consultation Workshop

"Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project"

Date: 14 October 2015; **Venue: CIRDAP International Conference Center (CICC), Dhaka**

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	V. Nhksoda				[signature]

BIWTA

Attendance Sheet

National Stakeholder Consultation Workshop

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	Md. Mohidul Isl	BIWTA	01711269706		২৮/১০/১৫

Government Agencies

Attendance Sheet

National Stakeholder Consultation Workshop

"Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project"

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BWDB

Attendance Sheet

National Stakeholder Consultation Workshop

"Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project"

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World Bank

Attendance Sheet

National Stakeholder Consultation Workshop

"Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project"

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Private Stakeholders

Attendance Sheet

National Stakeholder Consultation Workshop

"Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project"

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Research Organizations

Attendance Sheet

National Stakeholder Consultation Workshop

"Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project"

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IWM

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Reporter, BTV

INSTITUTE OF WATER MODELLING
IWM

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Annex 2: Photo log of event

Welcome Address by Mr. Mahmud Hasan Salim, Project Director

Speech by Special Guest Mr. Shafique Alam Mehdi, Secretary, Ministry of Shipping

Speech by Chief Guest Mr. Shajahan Khan, Hon'ble Minister, Ministry of Shipping

	
Speech by Chairperson Commodore Mohammad Mozammel Haque, Chairman, Bangladesh Inland Water Transport Authority (BIWTA)	Presentation on the scope of environmental and social assessment of the study and proposed methodology for carrying out the study by Md. Zahirul Haque Khan, Team Leader and Director CPE division, IWM
	
Presentation on Physical Environment of the Project and Key Issues by Mr. Mehedi Hasan Emon, Environmental Specialist, IWM	Audiences giving their feedback about the project

	
Open Discussion	Qustion & Answer Session
	
Qustion & Answer Session	Prof. Dr. M. Monowar Hossain, Executive Director, Institute of Water Modelling (IWM) answering the queries put by the stakeholders

		
Mr. Mahmud Hasan Salim, Project Director answering the queries put by the stakeholders		Dr. Sultan Ahmed,Director (Natural Resource Management), Department of Environment along with other speakers in the technical session

Regional Stakeholder Consultation on Inception and Scoping Report

Public Consultations Record (Regional)

Overview of the consultation event

A public consultation event was held on November 17th, 2015 at RJ Tower Hotel & Resort (2nd floor), Sariat Nagar, Ashuganj, B. Baria on the Environmental and Social Impact Assessment study of Dhaka-Chittagong Inland Water Transport Corridor Project. The purpose of the event was: (a) to share information about the proposed project, and (b) to share and seek feedback on the proposed scope and methodology of the environmental and social safeguards studies and mitigation measures for measure environmental and social impacts ,(c) involve the stakeholders in the project planning process, as per the Government of Bangladesh and World Bank requirements and standards.

Bangladesh Inland Water Transport Authority (BIWTA), responsible agency of the project, and Institute of Water Modeling (IWM), consultant for the Environmental and Social Impact Assessment study, publicized the event through sending invitations to the attendees by means of invitation cards, emails and phone calls and advertising through two national newspapers during November 10-16, 2015. The list of attendees is presented in Table 1.

Table 1: List of attendees in the National Stakeholder Consultation Workshop held on 17 November 2015 at RJ Tower Hotel & Resort (2nd floor), Sariat Nagar, Ashuganj, B. Baria.

Bangladesh Inland Water Transport Authority

Sl.	Name	Position	Organization	Phone number	Email
1	Mr. Md. Mohiuddin Chowdhury	Deputy Director (Planning) Planning Department			
2	Mr. Saiful Islam	Joint Director, Marine Safety & Traffic Management Department		01819673257	
3	Mr. Shah Alam	Traffic Officer		01717747906	
4	Mr. Mainuddin	Traffic Officer			

Upazilla Administration

Sl.	Name	Position	Organization	Phone number
1	Ferdousi Akter	Assistant Commissioner (Land), Ashuganj Upazilla	District Administration	01705411244
2	Abu Asif Ahmed	Upazilla Chirman, Ashuganj Upazilla Parishad	Community Representative	
3	Mr. Ayub Khan	Chairman, 2 No. Char Chartala Union Parishad, Ashuganj	Community Representative	
4	Rehena Begum	Vice Chairman, Ashuganj Upazilla Parishad	Community Representative	01703325452

5	Ferdousi Zahan	7,8,9 Word Union Parishad Member, Ashuganj	Community Representative	
6	Nazmul Haque Rana	UP Secretary, 2 No. Char Chartala Union Union Parishad, Ashuganj	Community Representative	01747005635
7	Selina Akter Fatema	UP Member Char Chartala Union Parishad, Ashuganj		

Department of Livestock

Sl.	Name	Position	Organization	Phone number	Email
	Mr. Nasir Uddin	Upazilla Livestock Officer, Ashuganj Upazilla	Livestock		

From NGO

1. Hazi Md. Mizanur Rahman, Chairperson, Sushashoner Jonno Nagorik, Ashuganj Upazilla

Local Businessman

1. Mohammad faruque, Owner, R J Tower, Ashuganj, B. Baria
2. Abul Kalam Azad, Shokal-Shondha Shopping Mall, Ashuganj, B. Baria
3. Mr. Shahjedda Shaju, Owner, M/S Malek Group

Local Stakeholders and Influenced People

1. Md. Zahirul haq, Ferrighat Lease Owner, Ashuganj
2. Md. Kader Ali Sarker, Representative, Ashuganj Boatman Association
3. Ishrak Sarder, Representative, Ferri Ghat Labour Association, Ashuganj
4. Md. Mostafizur Rahman, Bhairab Bazer
5. Md. Kanchan Miah, Ashuganj
6. Md. Saiful, Ashuganj
7. Md. Abdul Ali, Ashuganj
8. Shobuj, Ashuganj
9. Salek, Ashuganj

10. Ripon, Ashuganj

11. Md. Nannu, Ashuganj

12. Md. Sohel, Ashuganj

13. Md. Hossain Ali, Ashuganj

14. Md. Shahin, Ashuganj

15. Abdur Razzak, Ashuganj

16. Neyeb Ali, Ashuganj

17. Hazi Md. Jamal Uddin, Ashuganj

18. Md. Nasir Miah, Ashuganj

19. Siddik, Ashuganj

20. Abu Bokor, Ashuganj

21. Shourov, Ashuganj

22. Alamgir, Ashuganj

23. Noor Sayed Rubel, Ashuganj

24. Awal, Ashuganj

25. Parvez Alam, Ashuganj

26. Md. Ismail Sumon, Ashuganj

27. AKM Md. Asir Uddin, Ashuganj

28. Md. Babul, Ashu Ganj

29. Md. Bakul, Ashujanj

30. Hazi Md. Zamal Uddin, Ashuganj

31. Aronno Kabir, Ashuganj

32. Jurain Al Abdullah, Ashuganj

33. Md. Abu Siddik, Ashuganj

34. Md. Dulal, Ashuganj

35. Kawsar, Ashuganj
36. Shakil Mahmud, Ashuganj
37. Zahir Miah, Ashuganj
38. Hasne Maymuna, Ashuganj
39. Shefali, Ashuganj
40. Sayra Khatun, Ashuganj
41. Shakil, Ashuganj
42. Rajon, Ashuganj
43. Sorful, Ashuganj
44. Mr. Nazum Uddin, Ashuganj
45. Mr. Billal Hossain, Ashuganj Launch Ghat
46. Mr. Shofiqul Islam, Ashuganj Launch Ghat
47. Mr. Riazul Islam, Ashuganj Launch Ghat
48. Mr. Ramzan Ali, Ashuganj Launch Ghat
49. Md. Hero Hossain, Ashuganj Launch Ghat
50. Mrs. Shahera Khatun, Tarua Union, Ashuganj
51. Mrs. Shefali, Begum, Tarua Union, Ashuganj
52. Mr. Jamal Hossain, Char Chartala, Ashuganj
53. Md. Moinuddin, Ashuganj Ferri Ghat, Ashuganj
54. Md. Faruque, Ashuganj
55. Masud Ahmed, Ashuganj
56. Tanvir Hasan, Char Chartala Union Parishad, Ashuganj
57. Ramjanul Islam, Char Chartala Union Parishad, Ashuganj
58. Mrs. Masuda Begum, Char Chartala Union Parishad, Ashuganj
59. Taslim Ahemd, Char Chartala Union Parishad, Ashuganj

60. Mrs. Helena Begum, Char Chartala Union Parishad, Ashuganj

61. Moju Miah, Ashuganj, Aronno Kabir, Journalist, Ashuganj

62. Ishak Shumon, Journalist, Daily Manabjamin, Ashuganj

63. Azizul haque, Ashuganj

64. Sumon Shaha, Ashuganj

65. Rasel Munshi, Char Chartala Union Parishad, Ashuganj

66. Md. Abu Siddique, Char Chartala Union Parishad, Ashuganj

67. Shontos Shutrodhar, Ashuganj

Many other govt. officials and local persons are also invited by invitation card and over telephone.

Institute of Water Modelling

Sl.	Name	Position	Organization	Phone number	Email
	Zahirul Haque Khan	Director, CPE, IWM		01819432538	
	Mr. Syed Monowar Hussain	Navigation Specialist			
	Farhan Md. Zahir	Junior Engineer		01798144187	
	Md. Mainul Islam	Secretary, CPE		01911906602	
	Mr. Khairul Matin,	Socio-Development Specialist, KMC		01741127731	

The event was attended by public representatives, Upazilla Chairman, Vice-chairman, Chairman of Union Parishad, local woman leader, official of land ministry, Launch owner association, ferry ghat leasee, sand businessmen, journalists, livestock officials, NGOs, local people and representatives from other bodies like BIWTA and BIWTC, Private Sector, Print Media and electronic media (ATN etc.)

Upazilla Chairman, Mr. Abu Asif Ahmed, addressed the workshop as the chief guest while Chairman of Union Parishad, Mr. Ayub Khan spoke on the occasion as special guest. Former BIWTA Secretary Syed Monowar Hossain presided over the workshop. At the onset of the session, Syed Monoar Hossain former BIWTA Secretary and chairman of the session welcomed all. Then he invited to present overview of the project and other findings to the audience by power point presentation. Two power point presentations were made.

A) Presentation on the baseline environmental conditions, Project Interventions and dredging locations by Zahirul Haque Khan, Team Leader

E) Presentation on Socio-cultural Environment of the Project and Key Issues by Mr. Khairul Matin, Socio-Development Specialist, IWM.

After presentation session, the participants gave their feedback, raised many suggestions and comments about the project.

Honorable Upazilla Chairman, Mr. Abu Asif Ahmed said Bangladesh is a riverine country and daily 2-3 million people travel using the navigational route. He expressed his opinion that Ashuganj, one of the largest inland ports of the country requires further development to meet the increasing transport demand. He further added that navigability of inland water route should be developed by dredging and port and terminal facilities should be developed as well. At the cost of inconvenience that will cause to some people by this project, benefit of maximum may be yielded. So, the Upazilla Parishad and people of Ashuganj would extend all out cooperation for implementation of this project. He cautioned that the list of the affected persons should be prepared carefully and an appropriate resettlement program should be worked out. He also suggested that the dredged materials can be used effectively. There is a proposed road Nabinagar-Ashuganj-Dhaka which reduces the distance 25 km between Ashuganje to Dhaka. The dredged materials can be used to construct the proposed road. Dredged materials can also be used to develop Ashrayon Prokolpo and to raise the government Khashland. Traditional local dredger shouldn't be used and proper procedure and rules and regulations must be followed during dredging. Ashuganj is very important considering the connectivity between Dhaka to Delhi through navigational route. He particularly mentioned that special care should be taken in respect of boatmen and landing station of boat should be earmarked and be developed.

Speaking as honorable guest, Assistant Commissioner (land), Ferdoisi Akhter said the Ashuganje launch ghat will be used widely in future and considering this the development work should be sustainable. For a sustainable project ESIA is indispensible. Work plan should be taken according to public opinion based on social survey output. Participation of local people in all stages must be ensured. Print and electronic media should focus the importance of Ashuganj launch route properly. The Upazilla administration will extend assistance and cooperation to conduct ESIA. She assured that appropriate compensation package will be awarded to the persons to be affected by the project.

Rehana Maqbul, Vice Chairperson (woman), Upazilla Parshad, Ashuganj, said that the project must uphold the rights and privilege of the women. She mentioned that with many other projects this is one of the important projects that would enhance livelihood of people. She hoped that the project will provide sufficient provision to create employment opportunity for women.

Ayub Khan, Chairman, Union Parishad No. 2, Chartala, Ashuganj said that the importance of Ashuganj Port is characterized by national and sub-regional traffic. It is the gateway of the vast Haor area where food grains and other agricultural commodities are produced and transported to elsewhere in the country through Ashuganj. On the other hand, Ashuganj is the nodal point for transportation between neighboring seven sisters and mainland of India. Project for development of Ashuganj Port and inland routes will certainly facilitate the economy. We welcome the project what is conducive to vision 2021. Land what will require for implementation of the project may affect some people but appropriate compensation package may remove grievances substantially. Discharge of dredged spoils will not be a problem if it is managed properly integrating local community need for land development for the purpose of constructing community facilities like bazaars, rural roads, educational and other social institutions.

Hazi Mijanur Rahman, president, Shuzon (a social welfare institute), said that the Ashuganj launch ghat will be recognized as an international river port in future. He added that in the past depth of Upper Meghna river was more and the water depth was about 17 m. But now the navigational depth has been decreasing day by day. Dredging should be conducted to have at least 4 m depth. As a result water reserve will be increased and fish availability will be increased. Due to implementation of this project, 17 Upazilla will be benefited. The government of India will provide loan for development work as they will use this navigational route for their transport. He also mentioned a vessel shelter is required here. He suggested to make market every 2 to 5 mile interval along the Nabinagar-Ashuganj-Dhaka road. He also strongly mentioned that the agricultural land must be protected and shouldn't be damaged by dredged materials.

Mr. Mostafizur Rahman, representative of Launch owner association, said that this navigational route will become more important if it is connected to Surma-Kushiara river. He also urged that a permanent terminal is required here. Sufficient facilities should be provided for disable people. Dredged materials can be used to develop land for landless people.

Md. Kader Ali, representative from boatman association, said that this Launch and ferry ghat is very old. The boatman must be compensated if any development work effects them.

Transport contractor of Ferry ghat suggested that the ghat should be more spacious. The boat and the Ferry launch at the same ghat. As a result many times the boats are damaged due to the collision with Ferry. He proposed a new Ferry ghat with sufficient facilities and wide space.

Miss Selina Akhter Fatema, representative of woman group informed that boatman and fisherman both are affected due to Ferry and launch movement. So there should be a plan to overcome their sufferings. Sufficient security must be provided for woman in the launch.

Miss. Mashra Begum, urged that women's right must be protected. She also suggested that dredged materials should be used for improvement of the rural road.

Mr. Israq, leader of ghat laborer said that it will be good if the dredging of the river is done. He also complained that there is no facility for accommodation or primary treatment for the laborer. Government also provides no facilities for the welfare of ghat laborer. During flood, navigational depth is decreased. Measures should be taken to minimize this. The dredged materials can be sold to sand business man by open tender. Dyke can be made with dredged materials and later this dyke can be used as road.

Mr. Nasir Uddin, livestock officer said that India is directly related to the navigational route. Environmental impacts will be minimum due to this project. Food security should be considered. A project of grass cultivation can be taken by dredged materials.

Event Closing

The event closed at 13:00 pm and stakeholders were thanked for their attendance and participation. They were also informed about the following current plans for future consultation and engagement opportunities related to the project, where to find ongoing information about the project's planning and development, and how to get in touch with BIWTA with any further questions, concerns or suggestions.

Participants were furthermore informed that this summary would be made publicly available (both in English and Bengali) at January, 2016 within 90 days of the event.

Annex 1: detailed list of consultation participants.

Bangladesh Inland Water Transport Authority

Consultation Attendance for

Environmental and Social Impact Assessment Studies for Designated River Routes, Vessels Shelters and Ferry Crossings

Time: 10.00 AM   Union/Ward: Char Chartola   Date: 17.11.2015

Venue: R J Tower, Ashuganj   Thana: Ashuganj

Sl No.	Name	Father's Name	Address	Mobile No.
1.	MD. MOSTAFIZUR RAHMAN	ABDUL HASIM MIAH	BHAIRAB BAZAR	01711-683297
2.	MD. KANCHAN MIAH	JINAT ALI MIAH	DO -	01711-684685
3	MD. BABUL	M.D. RUPMID	ASHUGANJ	01711-466463
4	[illegible]	[illegible]	[illegible]	01703325452
5.	[illegible]	[illegible]	[illegible]	01747005635
6.	[illegible]	[illegible]	[illegible]	
7.	[illegible]	[illegible]		
8.	[illegible]	[illegible]	[illegible]	01749020513
9.	[illegible]	[illegible]		
10.	[illegible]	[illegible]		
11.	[illegible]	[illegible]		
12.	[illegible]	[illegible]	[illegible]	01753618672
13.	[illegible]	[illegible]	[illegible]	01758210221
14.	[illegible]	[illegible]		
15.	[illegible]	[illegible]		01709397536
16.	[illegible]	[illegible]	[illegible]	
17.	[illegible]	[illegible]		
18	[illegible]	[illegible]	[illegible]	[illegible]
19	md. Nani Miah	[illegible]		01718-940394
20	Rafuddin NABS	Ru. NABS		01713501254
21	[illegible]			01711497587

Bangladesh Inland Water Transport Authority

Consultation Attendance for

Environmental and Social Impact Assessment Studies for Designated River Routes, Vessels Shelters and Ferry Crossings

Time: 10.00am **Union/Ward:** Char charTola **Date:** 17.11.15

Venue: R J Tower, Ashuganj **Thana:** Ashuganj

Sl No.	Name	Father's Name	Address	Mobile No.
২২	ইমারক সরদার	সাবের উদ্দিন	আশুগঞ্জ	01724593826
২৩	মো: নাজিম উদ্দিন	মো: হাফিজ মিয়া	"	01737243142
২৪	মো: বিল্লাল হোসেন	ওয়াহেদ বিশ্বাস	আশুগঞ্জ লঞ্চ ঘাট	01744559039
২৫	আমিরুল ইসলাম	ইউনুস	"	01750470900
২৬	রিয়াজুল ইসলাম	আব্দুল সামাদ	"	01959772791
২৭	মো: রমজান আলী	মো: কুদ্দুস ব্যাপারী	"	01785665210
২৮	মো: হিরা হোসেন	মো: রহম শেখ	"	01858698088
২৯	মো: মাইনুদ্দিন	মো: আবু তাহের	"	0181325650
৩০	সাহেরা খাতুন	মৃত ওয়াহেদ মিয়া	তারুয়া ইউনিয়ন	01792659880
৩১	শেফালী বেগম	মো: মালু মিয়া	"	01723227483
৩২	হাজী (মাং মিজানুর রহমান)	মোহাম্মদ আলী মিয়া	[illegible] আশুগঞ্জ	01711-647785
৩৩	মো: জহিরুল হক	মৃত অলিউর রহমান	(ফেরী ঘাট, আশুগঞ্জ ব্রাহ্মণবাড়িয়া)	01711666511
৩৪	আবুল কালাম আজাদ	হাজী আবু তাহের	[illegible]	01819508452
৩৫	জামাল হোসেন	আবু তৈয়ব	চর চারতলা	01711325791
৩৬	আবু বক্কর	নূর মিয়া	চর চারতলা	01712002203
৩৭	মুহাম্মদ মাইনুদ্দিন	আলমগীর আকন্দ	আশুগঞ্জ ফেরী ঘাট	01820705028
৩৮	মো: হিরো হোসেন	মো: রহম শেখ		01783-102749
৩৯	সৌরভ	[illegible]		01967322982
৪০	[illegible]	[illegible]		01711455051
৪১	Md. Faruque	H.A. Jalil	Ashuganj	01711534734
৪২	MASUD AHMED	RAMIZ UDDIN AHMED	Ashuganj.	01715771515

Bangladesh Inland Water Transport Authority

Consultation Attendance for

Environmental and Social Impact Assessment Studies for Designated River Routes, Vessels Shelters and Ferry Crossings

Time: 10.00 am **Union/Ward:** Char char Tola **Date:** 17.11.15
Venue: R J Tower, Ashugonj **Thana:** Ashugonj

Sl No.	Name	Father's Name	Address	Mobile No.
৮৩	Tanvir Hasan	Maharam Ali	Char Chartala	01929415012
৮৪	Ramzanul Islam	Faizur Rahman	Charchartala	01711-062117
৮৫	Nur Syed Rubel	Shahajahan	Charcharta	01739111090
৮৬	Ferdousi Akter	Md. Fazlul Haque	Ashuganj	01705411244
৮৭	BADAR ALI			
৮৮	Awal			
৮৯	[illegible]			
৯০	PARVEZ ALAM CHOW.	MUBARAK ALI CHOW.	ASHUGANJ	01761828205
৯১	Md. Shah Alam.	Abul Khair	BIWTA, Ashuganj	01717-747906.
৯২	MD. Ishak Sumon	Ful Mia	Ashuganj	01711-961739
৯৩	Azizul Hoque	Helim mia	Ashuganj.	01722297994
৯৪	DR. Mohammad Aziz uddin	Late Mohammad Sabar Ali	UAO, Ashuganj.	01716312214
৯৫	[illegible]	[illegible]	[illegible]	01918192927
৯৬	[illegible]	[illegible]	[illegible]	01759116??
৯৭	Selina Akhter Fatema	Maharam Ali	Chorchartala UP member	01718-660769
৯৮	Toslim Ahmed.	Abdul Jafar miah	Char Char Tala, Ashuganj.	01778422506
৯৯	Suman saha	Sento Ranjan saha	আশুগঞ্জ,	01720210611
১০০	Aronno Kabir	Alamgir Kabir	〃	01966828036
১০১	Juzain al abdullah	Mobarak Hossain	〃	01719-141215
১০২	[illegible]	[illegible]	আশুগঞ্জ [illegible]	01718181252
[illegible]				

Bangladesh Inland Water Transport Authority

Consultation Attendance for

Environmental and Social Impact Assessment Studies for Designated River Routes, Vessels Shelters and Ferry Crossings

Time: 10:00 AM **Union/Ward:** Char chartala **Date:** 17.11.2015
Venue: RJ Tower, Ashugonj **Thana:** Ashugonj

Sl No.	Name	Father's Name	Address	Mobile No.
৬৩	সুমন মুন্সী	সামছুল হক মুন্সী	চর-চারতলা	01736859921
৬৪	মোঃ আবু সিদ্দিক	মৃত মোঃ ইছহাক আলী	চর চারতলা	01747364927
৬৫	মোঃ আহমদুল হাসান	মোঃ সামস আলমগীর	〃	01711585786
৬৬	নুরুল	কাদির		01947105887
৬৭	কাউছার	লায়েছ		01829540342
৬৮	সন্তোষ সূত্রধর	ধীরেন্দ্র চন্দ্র সূত্রধর	[illegible]	01726-298577
৬৯	শাকিল মাহমুদ	হাবিবুর রহমান	আশুগঞ্জ	
৭০	[illegible]	হাবিবুর রহমান	[illegible]	01926-[illegible]
৭১	হাসান মামুন	মৃত আব্দুল খালেক		01839929403
৭২	মোঃ [illegible]	Social Development Expert IWM		01839929400
৭৩	মোঃ আমিনুল ইসলাম	Secretary, IWM	IWM	01557735795
৭৪	Zahirul Haque Khan	Team Leader & Director, CPE, IWM	IWM	01841930004
৭৫	Syed Monowar Hussain	Navigation Expert	IWM	
৭৬	Farhan Md. Zahir	Junior Engineer	IWM	01798144187

Annex 2: Photo log of event


গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
নৌ-পরিবহন মন্ত্রণালয়
বাংলাদেশ অভ্যন্তরীণ নৌপরিবহন কর্তৃপক্ষ
River Routes, Vessels Shelters and Ferry Crossing-
মত বিনিময় সভা
Consultant : Institute of Water Modelling
MC) Ltd.
Organized By - Knowledge Management C


জাতন্ত্রী বাংলাদেশ সরকার
নৌ-পরিবহন মন্ত্রণালয়
শ অভ্যন্তরীণ নৌপরিবহন কর্তৃপক্ষ
Routes, Vessels Shelters and Ferry Crossing-
ত বিনিময় সভা

News Paper Notices of Public Consultaion

DHAKA, MONDAY NOVEMBER 16, 2015

www.theindependentbd.com

Notice of Public Consultations

Environmental and Social Impact Assessment of
Dhaka-Chittagong-Ashuganj Regional IWT Corridor Project

The study

Bangladesh Inland Water Transport Authority (BIWTA) is undertaking Environmental and Social Impact Assessment study for the Dhaka-Chittagong-Ashuganj Regional Inland Water Transport Corridor Project under the financial assistance from World Bank. The proposed project components include: (i) maintenance of the Dhaka-Chittagong corridor and the connecting routes to Ashuganj, Narayanganj and Barisal through dredging (ii) maintenance of three priority ferry crossings along these corridors, namely Chandpur - Shariatpur, Lakshmipur - Bhola, and Beduria-Laharhat, and (iii) construction and maintenance of an estimated six vessel shelters along the corridors for use during cyclones.

Public Consultations:

Institute of Water Modeling (IWM) Bangladesh is entrusted to carry out Environmental and Social Impact Assessment for this Project. As part of this study and in accordance with the World Bank Operational Policy 4.01 and Government of Bangladesh Environmental Conservation Rule (1997), public consultations will be conducted at the following locations:

Ashuganj Site:

Date: November 17, 2015 (from 10.00 am to 1.00 pm)

Location: RJ Tower Hotel & Resort (2nd floor), Sariat Nagar, Ashuganj, B. Baria.

Barisal:

Date: November 18, 2015 (from 10.00 am to 12.00 pm)

Location: Laharhat Ferry Ghat,

In these consultation meetings, the public can meet with the study team, discuss the study objectives, environmental and social issues and mitigation measures for major environmental and social impacts and can participate in the project planning process. All the concerned and interested people are invited to attend these meetings. The consultation will also consist of formal invitations to various stakeholders.

Comments:

We are interested in hearing any comments that you may have about the study. With the exception of personal information, all comments will be part of the public record. In addition, there will be a comment sheet available, please drop the completed complete sheet in the box provided at the venue or mail it to the address below:

Mahmud Hasan Salim
Project Director,
Bangladesh Trade and Transport Studies RETF, BIWTA,
Project (BIWTA Component)
Address: BIWTA Bhaban, 141-143 Motijheel C/A, Dhaka 1000
Email: mhasansalim@gmail.com, Tel:01911914636

Zahirul Haque Khan
Team Leader of IWM Study Team
Address: House # 496, Road # 32
New DOHS, Mohakhali, Dhaka 1206
Email: zhk@iwmbd.org, Tel: 01841930004

Figure: Notice of Public Consultation (The Daily Independent, 16 November 2015, Page 8)

দেশের কল্যাণে প্রতিদিন

ভোরের পাতা

নগর সংস্করণ

The Daily Vorer Pata

www.dailyvorerpata.com www.edailyvorerpata.com www.facebook.com/DailyVorerPata www.twitter.com/DailyVorerPata

ঢাকা, ১৬ নভেম্বর ২০১৫ খ্রিস্টাব্দ ● ২ অগ্রহায়ণ ১৪২২ বঙ্গাব্দ ● ৩ সফর ১৪৩৭ হিজরি ● রেজিঃ ডিএ নং-৪০৬, বর্ষ ১১, সংখ্যা ১৩০

২ ○ খবর

IWM

...প্রকল্পের

...ময়

সমীক্ষা ঃ

বাংলাদেশ অভ্যন্তরীন নৌ-পরিবহন কর্তৃপক্ষের অধীনে বিশ্বব্যাংকের আর্থিক সহযোগিতায় ঢাকা-চট্টগ্রাম-আশুগঞ্জ আঞ্চলিক নৌ-সংযোগ পথ উন্মুক্তকরনের জন্য একটি সমীক্ষা পরিচালিত হচ্ছে। প্রস্তাবিত প্রকল্পের অন্যতম কার্যক্রমগুলো হলঃ (১) ড্রেজিং এর মাধ্যমে ঢাকা-চট্টগ্রামের সংযোগ এবং আশুগঞ্জ, নারায়নগঞ্জ এবং বরিশালের সংযোগ পথ চালু রাখা, (২) চাঁদপুর-শরীয়তপুর, লক্ষীপুর-ভোলা এবং বেদুরিয়া-লাহারহাট এই সংযোগ বরাবর তিনটি অগ্রাধিকার ফেরী পারাপারের রক্ষণাবেক্ষণ (৩) ঘূর্ণিঝড়ের সময় ব্যবহারের জন্য উক্ত সংযোগ বরাবর ছয়টি নৌযান পোতাশ্রয় নির্মাণ ও রক্ষণাবেক্ষণ।

মত বিনিময় সভাঃ

প্রকল্পের সামাজিক ও পরিবেশগত প্রভাব সম্পর্কিত সমীক্ষাটি বাস্তবায়নের দায়িত্ব ন্যস্ত করা হয় ইনষ্টিটিউট অফ ওয়াটার মডেলিং (আইডব্লিউএম) এর উপর। এই সমীক্ষার অংশ হিসাবে এবং বিশ্বব্যাংকের পরিবেশগত প্রভাব নিরূপন নীতিমালা ৪.০১ এবং বাংলাদেশ সরকার পরিবেশ সংরক্ষণ আইন (১৯৯৭) এর নির্দেশনা অনুসারে মতবিনিময় সভা নিম্নলিখিত স্থানগুলোতে অনুষ্ঠিত হবে :

আশুগঞ্জ সাইট :

তারিখ ও সময় ঃ ১৭ ই নভেম্বর, ২০১৫ (সকাল ১০:০০ ঘটিকা হতে দুপুর ০১:০০ ঘটিকা পর্যন্ত)
স্থানঃ আর. জে. টাওয়ার হোটেল এন্ড রিসোর্ট, (৩য় তলা),
শরীয়ত নগর, আশুগঞ্জ, বি. বাড়িয়া।

বরিশাল সাইটঃ

তারিখ ও সময়ঃ ১৮ ই নভেম্বর, ২০১৫ (সকাল ১০:০০ ঘটিকা হতে দুপুর ১২.০০ ঘটিকা পর্যন্ত)
স্থানঃ লাহারহাট ফেরীঘাট, বরিশাল।

উক্ত মতবিনিময় সভায় জনগণ সমীক্ষা দলের সাথে সাক্ষাৎ করতে পারেন; প্রকল্পের উদ্দেশ্য, সামাজিক ও পরিবেশগত দিকগুলো এবং প্রধান সামাজিক ও পরিবেশগত প্রভাব প্রশমন ব্যবস্থা আলোচনা করতে এবং সমীক্ষা পরিকল্পনা প্রক্রিয়ায় অংশগ্রহণ করতে পারেন। সংশ্লিষ্ট এবং আগ্রহী ব্যক্তিবর্গ এই সভায় উপস্থিত থাকার জন্য আমন্ত্রিত। এছাড়া আলোচনা সভায় বিভিন্ন শ্রেণীপেশার মানুষদেরকেও আনুষ্ঠানিক আমন্ত্রন করা হবে।

মন্তব্য : উক্ত সমীক্ষা সংক্রান্ত আপনাদের কোন মন্তব্য থাকলে আমরা সেটা শুনতে আগ্রহী। ব্যক্তিগত তথ্য ব্যতিত সকল মন্তব্য পাবলিক রেকর্ডের অংশ হিসেবে বিবেচিত হবে। উপরন্তু, একটি মন্তব্য শীট থাকবে, অনুগ্রহ করে নিম্নলিখিত ঠিকানায় উক্ত মন্তব্য শীটটি প্রেরণ করবেন অথবা মেইল করবেন।

মাহমুদ হাসান সেলিম
প্রকল্প পরিচালক,
বাংলাদেশ বাণিজ্য এবং পরিবহণ গবেষণা আরইটিএফ,
বিআইডব্লিউটিএ, প্রকল্প (বিআইডব্লিউটিএ উপাদান)
ঠিকানা : বিআইডব্লিউটিএ ভবন, ১৪১-১৪৩, মতিঝিল সি/এ,
ঢাকা-১০০০। ই-মেইলঃ mhasansalim@gmail.com,
Tel:01911-914636

জহিরুল হক খান
সমীক্ষা প্রকল্পের টিম লিডার
ঠিকানা : বাড়ী # ৪৯৬, রোড # ৩২
নিউ ডিওএইচএস, মহাখালী, ঢাকা-১২০৬
ই-মেইলঃ zhk@iwmbd.org
Tel : 01841930004

Figure: Notice of Public Consultation (The Daily Vorer Pata, 16 November 2015, Page 2)

National Stakeholder Consultation on Draft Final Report

Public Consultations Record (National)

Overview of the consultation event

A public consultation event was held on March 30th, 2016 at the BRAC Centre in Dhaka on the Environmental and Social Assessment studies for the Proposed Bangladesh Regional Waterway Transport Project. The purpose of the event was: (a) To share findings and recommendations of EMP, EMF & RPF with the stakeholders, (b) to share and seek feedback on the proposed mitigation measures, (c) to involve the stakeholders in the project planning process, as per the Government of Bangladesh and World Bank requirements and standards.

Bangladesh Inland Water Transport Authority (BIWTA), responsible agency of the project, and Institute of Water Modeling (IWM), consultant for the Environmental and Social Assessment study, publicized the event through popular daily newspapers and through sending invitations to the attendees by means of invitation cards, emails and phone calls during March 23-28, 2016. The list of attendees is presented in Table 1.

Table 1: List of attendees in the National Stakeholder Consultation Workshop held on 30 March, 2016 at BRAC Centre, Mohakhali, Dhaka

Ministry of Shipping

Sl.	Name	Designation	Phone number	Email
9.	Zikrur Reza Khanam	Addl. Secretary	01711635252	zikruranwar@gmail.com
10.	Md. Nur UR- Rhaman	Joint Secretary	01789655544	ji.audit.@mos.gov.bd
11.	Md.Anamul Haque Bhuiya		01715790844	bhuiyasqoep@gmail.com
12.	Ms. Sirat Mahmuda	Senior Asst. Chief	01717514152	
13.	Md. Shahidul Islam	Assistant Director (Finance)	01712013856	

Bangladesh Inland Water Transport Authority

Sl.	Name	Designation	Phone number	Email
1.	Mr. Md. Siddiqur Rahman	Director, Audit Department	01713076564	
2.	Md. Saiful Islam	Joint Director	01713076564	
3.	Md. Rafiqul Islam	Addl. Director	01711363510	
4.	Mr. Zaved Anwar	Joint Director (Planning), Planning Department	01713034638	
5.	Mr Md Abu Jafar Howlader	Director, Purchase & Stores Department	01712096780	

6.	Mr Rokibul Islam Talukder	Additional Chief Engineer (Civil), Dredging Department		rislamrukon@gmail.com
7.	Mr. Abdul Awal	Director, Account Department	01713453211	
8	Mr. Gopal Chandra Saha	Director, Finance Department	01712256768	
9.	Md. Mizanur Rahman	Superintending Engineer	01917713554	
10.	Mr. Shajadur Rahman	Superintending Engineer (Dhaka Circle), Engineering Department	01917545639	
11.	Mr.Shafiqul Haque	Director, Ports & Traffic Department	01733583359	
12.	Mr. Md. Abdul Matin	Chief Engineer (Dredging) Dredging Department	01551227977	
13.	Mr. Mohammed Mafizul Haque	Member (Engineering)	01718547528	
14.	Mr. Mahmud Hasan Salim	Director (Planning), Planning Department	01911914636	
15.	Mr. Md. Sadiqul Islam	Deputy Director, Conservancy & Pilotage Department	01555046999	Sadi.iwtaegmail.com
16.	Mr. Md. Monjurul Haque	Deputy Director (Survey) Hydrography Department	01722179479	
17.	Mr. Md. Mahbub Alam	Director, Hydrography Department	01711397277	
18.	Mr. Md. Saifur Rahman	Joint Director (Survey) Hydrography Department	01552472062	
19.	Mr Atahar Ali Sarder	Additional Chief Engineer (Marine), Dredging Department	01712602922	
20.	Mr. Md. Ayub Ali	Superintending Engineer, Dredging Department	01716314580	
21.	Mr. Md. Alfaz Uddin	Deputy Director (Survey) Hydrography Department	01913733916	
22.	Mr. Saidur Rahman	Superintending Engineer (Dredging) Dredging Department	01913048786	

Bangladesh Water Development Board

Sl.	Name	Designation	Phone number	Email
1.	Mr. Belal Uddin Biswas	Deputy Chief, Forest & Environment, Office of the Chief Planning,	01711264593	belalbiswas@yahoo.com
2.	Mr. Abul Kausar	Superintending Engineer, Design Circle-4, BWDB	01712962502	

3.	Umme Salma	Assistant Engineer Design Circle-4, BWDB	01674509058	
4.	Sharmin Jahan Sumi	Assistant Engineer Design Circle-4, BWDB	01917749145	

WARPO

Sl.	Name	Designation	Phone Number	Email
1.	Mr. Md. Sarafat Hossain Khan	Director General	01715038519	
2.	Md. Ekram Ullah	Principal Scientific Officer, Agriculture Section	01715064922	
3.	Mohammad Alamgir	Principal Scientific Officer Environment, Forests & Fisheries Section	01556555684	
4.	Dr. Aminul Haque	Principal Scientific Officer	01810172149	

Department of Environment

Sl.	Name	Designation	Phone Number	Email
1.	Md. Samsuzaman Sarker		01716861848	
2.	Farhana Mustari		01616323799	
3.	Md.Abdul Motalib		01716932131	
4.	Syed Nazmul Ahsan	Director(Environment Clearance(CC))	01819427358	
5.	Quazi Sarwar Imtiaz Hashmi,	Additional Director General, Department of Environment, , Ministry of Environment and Forests	01711145269	

Government Sector

Sl.	Name	Designation	Phone Number	Email
1.	Mr. Mohammad Alauddin	Member Of NRCC		
2.	Mr. Shahadat Hossain	Director	01841296286	
3.	Md. Manjur	Chief Hydrographer, CPA	01199030000	
4.	Mr. Pintu	Chief Scientific Officer, RRR	01768250796	
5.	Mr.Tareq	Govt. Officer	01733651507	
6.	Mohammad Nasir Uddin	Hydrographer	01554330893	

Researchers

Sl.	Name	Organization	Phone Number	Email
1.	Henk Blok	RHDHU IWT Project		Henk.blok@rhdhu.com
2.	Mr. Majibul Haque	CEGIS		mhuq@cegisbd.com

Private Stakeholder

Sl.	Name	Organization	Phone number	Email
1.	Mr. Saifuddin	Land Owner, Bancharampur	0181632965	

2.	Mr. Majibur Rahman	Land Owner, Bancharampur		
3.	Mr. S.S Biddya Baron Sarker	DDC Pvt. Ltd	01717232615	
4.	Mr.Rafiqul Islam	UNB	01818288857	
5.	Mr. Emran Chowdhury	A.K. Khan & Co	01847001283	
6.	Mr. Md. Rustam Alam	Bancharumpur	01761860921	
7.	Bushra Nishat	IWA		
8.	Mr. Mahabubur Rahman	Social Safety Net Foundation	01720811811	
9.	Mr. Ariful Hoque	S.R. SML Ltd	01716714885	
10.	Mr.Hassan Yusuf	Nadipokkho	01733955250	cedasbd@gmail.com
11.	Md. Mostafa Kamal	Bancharampur	01713561419	
12.	Md. Emdadul Haque		01711592404	
13.	Mr. Abdur Rahim	SIRDA		
14.	S.M. Sajid	CENDP	01712521041	
15.	Mr. Shahidul Islam Bhuiyan	Secretary Launch Owner Association	01919696865	
16.	Mr. Wajun	B.N. S.P		

Institute of Water Modelling

Sl.	Name	Designation	Phone number	Email
1.	Dr. A.F.M Afzal Hossain, PEng	Deputy Executive Director (P&D), Institute of Water Modelling	01841930002	
2.	Md. Moshiur Rahman	Associate Specialist	01847189319	mrr@ iwmbd.org
3.	Asish Sutradhar	Junior Specialist	01717444277	ash@iwmbd.org
4.	M.A.S Sikder	River Ecologist		abs@iwmbd.org
5.	Dr. Sheikh Muhammad Abdur Rashid,	River Ecologist		rashidswa@yahoo.co.uk
6.	Sakib Mahmud			Sakibmahmud7989@yahoo.com
7.	Mr. Khairul Matin,	Socio-Development Specialist, KMC		Khairulmatingmail.com
8.	Rubayat Alam	Senior Specialist		rba@ iwmbd.org
9.	Shume Akhter	Associate Specialist		sha@ iwmbd.org
10.	Dipen Saha	Junior Engineer		dpn@ iwmbd.org
11.	Shaikh Nahiduzzaman	Junior Specialist		snn@ iwmbd.org
12.	Md. Ziaur Rahman	Associate Specialist		zia@ iwmbd.org
13.	Syed Monower Hossain	Navigation Expert		Hossain.syed.monoewer@gmail.com
14.	Md. Shamsuddin	Environmental Specialist		m.shamsuddin51@yahoo.com
15.	Md. Ashraf Ali Khan	Manager, HRD		aak@ iwmbd.org
16.	Mr. Ruhul Amin	BD officer		rua@ iwmbd.org

17.	Md. Saiful Islam	Junior Specialist		mds@ iwmbd.org
18.	Farhan Md. Zahir	Junior Engineer		fmz@ iwmbd.org
19.	Md. Mainul Islam	Secretary, CPE		mis@ iwmbd.org
20.	Md. Raqubul Hasib	Junior Engineer		rqb@ iwmbd.org
21.	Morsheda Begum	Junior Engineer		mbm@ iwmbd.org
22.	Samiun Nabi	BD Manager	01841930001	mdn@ iwmbd.org
23.	Fowzia Amina Aurna	Programme Officer		faa@ iwmbd.org

World Bank

Sl.	Name	Designation	Organization	Phone number	Email
1.	Iqbal Ahmed	Environmental Specialist	World Bank		
2.	Kirti Nishan Chakma	Consultant	World Bank		knchakma@worldbank.as

Media

Sl.	Name	Designation	Organization	Phone number	Remarks
1.	Zaman	Reporter	B.T.V	01818541686	Electronic media
2.	Md. Mustafa		B.T.V	01674189004	Electronic media
3.	Md.Khalilur Rahman		Somoy	01964444021	Electronic media
4.	Papon	Cameraman	ATN Bangla	01819690398	Electronic media
5.	Md. Mohosiinur Rahman		Channel 24	01711392667	Electronic media
6.	Mahit		JTV	01712837807	Electronic media
7.	Saifuddin Robin		JTV	01715370087	Electronic media
8.	Imran utzaman	Reporter	B.T.V	01911752288	Electronic media
9.	Jabel		The Daily Jugantor	01712784329	Print media
10.	Riyad	Senior Reporter	SA. TV	01711307677	Electronic media
11.	Abdul Zaman		ETV	01712920205	Electronic media
12.	Mohammad Ali		Mohona	01914183898	Electronic media
13.	Sheikh Javed		Somoy	01964444174	Electronic media
14.	Zannatul Ferdausi		Baishakhi	01765755009	Electronic media
15.	Yasin		Baishakhi	01726326159	Electronic media
16.	Shahin Akhter		The Daily New Age	0191241140	Print media
17.	Imdadul Babu		ATN Bangla	01671807140	Electronic media
18.	Jahangir Alam		Channel 21	01716786776	Electronic media
19.	Monir Hossain	Cameraman	SA TV	01766666183	Electronic media

20.	Md. Masudur		The Daily Muktokhbor	01911083392	Print media
21.	Muntasir		The Daily Borer Patha	01819433718	Print media
22.	Yosuf Hassan		Bangladesh Betar	0173395525	Electronic media
23.	Tazrian	Announcer		01746541037	
24.	Muhib		Bangla Vision	01716699951	Electronic media
25.	Farhad		JTV	01777778632	Electronic media

The event was attended by senior government officials of the Shipping Ministry and representatives from relevant government departments including BIWTA, BIWTC, DoE, WARPO, BWDB, Development Partners, NGOs, Research Organizations, Private Sector, Print Media and Electronic Media.

Zikrur Reza Khanam, Additional Secretary, Ministry of Shipping addressed the workshop as the chief guest while BIWTA Chairman Commodore M Mozammel Haque presided over the workshop.

At the outset, Mr. Mahmud Hasan Salim, Project Director and Director (Planning), Bangladesh Inland Water Transport Authority (BIWTA) welcomed the distinguished participants. IWM Executive Director Prof Dr M. Monowar Hossain made a power-point presentation on the overview of the study "Environmental and Social Assessment Studies of Bangladesh Regional Waterways Transport Project"

Honourable chief guest Mrs. Zikrur Reza Khanam said along with economic development other types of developments are also related with this project. Bangladesh is a riverine country and river plays a major role in her socio-economic development. No development work should be done by destroying nature. Blue Economy, Green Economy emerges from the concept of not disturbing nature while doing any development works.

The chief guest said waterway is the most cheap and safe transportation system. But due to lack of planning and awareness we have lost the navigability of our rivers. Of 24000 km only 3800 km of waterways remain navigable during dry period, which is not acceptable at all. Bangladesh is a deltaic land having siltation problem since time immemorial. Besides, we don't get adequate water due to international politics. In accordance with the treaty with India we also need to keep the waterway of the project area navigable for our own interest. Majority of stakeholders of this project is mass people, so it is important to listen to their opinion during the second half of the consultation program. The chief guest wished and hoped that this project will play a major role in the socio-economic development of our country.

BIWTA acting chairman Commodore Mohammad Mozammel Haque expressed that the proposed project might result in significant environmental impacts, if the project activities are not properly planned, designed, executed and maintained in environmentally compatible manner to protect the ambient physical, biological and social environment. Through this project BIWTA will inaugurate Performance Based Contract program. He said that currently BIWTA is running dredging work through annual contract which is not so effective. But in this PBC system contractor will be responsible for maintaining the navigability of the route throughout the contract period of 6-7 years.

He said that BIWTA's target is to make 18,000 km waterways navigable along with the protocol and connecting routes so that inland water communication with India, Nepal and Bhutan improves. He mentioned that we don't have any vessel shelter station in Bangladesh. Six vessel shelter stations will be built under this project, which will enable vessels to take shelters during storms and avoid losses of lives and cargo.

He thanked IWM study team for their sincere and dedicated efforts to prepare overall environmental and social assessment document, EMP, EMF and RPF of the project within the stipulated time and date and in accordance with the safeguard policies of the World Bank. He also thanked the World Bank to come forward for funding such an important project and expressed his sincere thanks and gratitude to all participants, electronic and print media and the organizers.

The workshop was carried out in English language and it was recorded and filmed. The length of the event was three hours and 30 minutes. Project brief and its map were distributed among the participants. After the inaugural session of the workshop, three power-point presentations on environmental and social assessment of the study were presented during technical session followed by an open discussion.

Quazi Sarwar Imtiaz Hashmi, Additional Director General of Department of Environment, chaired the technical session. Following three power-point presentations were made:

A) Presentation on the Environmental Baseline, Project Impacts, EMP and EMF of the study by Mr. Md. Zahirul Haque Khan, Team Leader of the project and Director, Coast, Port and Estuary Management Division , IWM.

B) Presentation on Ecological Environment, Ecological Impacts and Biodiversity Management Plan of the Project by Mr. Dr. Sheikh Muhammad Abdur Rashid, River Ecologist.

C) Presentation on Resettlement Policy Framework (RPF) by Khairul Matin, Socio-Development Specialist.

Summary of Comments, Questions, and Feedback Received

The table below summarizes the key issues raised by stakeholders, and responses from BIWTA and IWM.

Name, Designation and Address of Participant	**Comment/Queries**	**Response**
1. Md. Rustam Alam, UP Chairman, B Baria	The Titas river is silted up with poor water quality and less fish production'	Chairman, BIWTA replied that the Titas River dredging project is already on the list and is expected to start from next year. However, IWM informed that this is a loop river of the Upper Meghna River and included under this project.
2. Mr. Saiful Islam, Joint Director, BIWTA	Is there any need of land Acquisition or requisition for the project intervention? Industries will be benefitted by the project.	Mr. Khairul Matin replied that according to BIWTA there will be requirement of land acquisition in various terminals. If it is not required during detailed design stage, no land acquisition plan will need to be prepared. But people living/having temporary installation for running business in the government land will be entitled to have compensation for their lost assets.
3. Mr. Saif Uddin Ahmaed, stakeholder, Nabinagar , B Baria	Expressed need for the dredging of the Titas river. Land requirement per kilometer reach of dredging.	As stated in comment 1
4. Mr. Mojibur Rahman, stakeholder, Bancharampur, B Baria	Land requisition will not be required if dredged material is given free of cost to the traders.	Mr. Khairul Matin replied that iff the dredged material is dumpped on private land, the land will need to be requisitioned as per law. Dredged materials will be free of cost for the community use, not for private use only.
5. Mr. Sahadat Hossain, Former Chairman,Chittagong Port Authority, Key stakeholder,	Disscussed benefit of use of water ways and expressed that in next 15 years container will be three fold. He suggested involvement of private sector with proper master plan and provision of facilities.	Chairman, BIWTA appriciated the suggestion made by Mr. Sahadat Hossain. He also informed to have a separate meeting.
6. Shahidur/Shajedur Rahman, SE	Raised 3 issues: 1. Special recommendation for disabled person, 2. Inclusion of dredged material management in case of filling; How the people will use the 6 vessel shelter during extreme weather condition?	Mr. Khairul Matin replied: Disabled persons will have evry possible facilities including wheel chair, separate arrangement for resting, etc. Dredge materials will primarily be deposited in the river. However, when appropriate in-river locations are not available, thye may be deposited on land. In those cases, they can be used

		for sand filling in play ground, yard of institutions, dyke and rural road construction as per needs of the community. During extreme weateher condition the passenger and cargo vessels will move to nearby shelter adjacent to the main route, where current and waves are less severe, mooring and pontoon facilities will be available.
7. Mr. Alamgir, WARPO	To consider National Water Master Plan, particularly MR 001-MR 003 & MR 006 for dredged management. Management of toxic spoil and inclusion of Transition Ecosystem in the report. Carrying capacity of the vessels should be considered Scour holes are important habitats for species, dredged spoil not to be dumped in scour holes Consideration of loop cut, afforestation and regional cooperation for disposal.	Dr SMA Rashid responded that treatment of toxic materials is mentioned in the EMP. Moreover the contractor will develop a toxic material management plan. Transition ecosystems represent the ecotones and have been addressed in the EIA, represented by the river banks, mudflats described as valued environmental components The EIA, EMP and BMP has categorically considered the scour holes.
8. Najmul Ahsan, Director, DOE.	TOR for ESIA was approved by DOE in February, 2016. This needs to be followed in the preparation of ESIA report.	The ESIA report has been prepared following approved TOR by DOE and WB Guidelines.
9. Commander Manjur, Chief Hydrologist,CPA	He expressed his concern that the proposed route near Hatiya Island may not serve more than 6 months a year. Alternative route to be considered to ensure year round navigability. For disposal of dredge materials BWDB use it for land reclamation purpose. He also added to consider more vessel shelter and salvage vessels.	BIWTA noted the comment for favourable consideration.
10. Mujib Haq, Advisor, CEGIS	Raised 4 issues: 1. Data at 12 locations only and not sufficient; 2. EMP to include monitoring as well; 3. EMP is not location specific; 4. 584 HH sample is scanty for socio-economic analyses.	1. Data are collected from the dredging locations. In addition, under the project, ongoing monitoring will be required including sampling of sediment and water quality, at locations where dredging is taking place.

		2. Monitoring plan is included in the EMP. 3. Location specific EMP will be prepared by the PBC Contractor.
11. Md. Ekramul ,WARPO	To follow NWMP guidelines for the study; BIWTA needs clearance from WARPO also; Who will monitor dredging operation? For disposal of dredge material on private land prior consultation is essential; WARPO may be sent the report for comments.	NWMP has been consulted. Project document would be sent to WARPO for clearance. BIWTA would monitor the dredging operation. Disposal sites for on land will be identified after consultation with local people. BIWTA will send the report to WARPO.
12. Imran Ch. GM, A.K .Khan Group	International and national companies will use these water ways. They should be invited by BIWTA.	Agreed.
13. Rakibul/Rafiqul Islam Talukder, XEN, BIWTA, Dredging Div.	In class 1 route only some 10 Km may require dredging. The proposed Sandwip Channel is not feasible. Dredged volume estimate seems optimistic. PBC contract may lead to risks for BIWTA as it is first time introduced.	Dredging locations and volume of dredging will be identified by the analyses of récent bathymetric / hydrographic charts. Alternate feasible route along Sandwip Channel will be considered. PBC contract approach has been agreed by MOS and they have practiced it in Payra Port.
14. Wahidul Islam Bulbul,Ship Master	Cited that there is obstruction in the navigation routes, navigation aids are not properly used and actual performance in drdging is needed.	Under the project appropriate navigation aids will be provided and effective dredging will be ensured for maintaining navigavility.
15. Alfaj Uddin, Hydrography Dept., BIWTA	Detail Hydrographic survey is needed.	Agreed.
16. Md.Ahmadul Haq, Former Director, BIWTA	For nontdal river bandalling is effective option for navigation; Need for visilent team to monitor the dredging operation with the key stakeholder.	River training works including bandalling on pilot basis will be tried under separate component of the project.
Imtiaz, Additional Director, DOE	Pollution sources like oil spill, ballast water, industrial wates to be considered. Toxicity test, BOD, COD of surface water. Multi-purpose use of the shelters.	These pollutants are considered in the EMP and monitoring plan. Tests have been conducted and results are incorporated in the EIA report.

	Improvement of inland transport would relieve the pressure on road transport.	

Event closing

The event closed at 13:20 pm and stakeholders were thanked for their attendance and active participation in providing valuable comments and suggestions to improve the study findings. They were also informed about the ongoing information on the projects' planning and development, and how to get in touch with BIWTA with any further questions, concerns or suggestions.

Participants were furthermore informed that this summary would be made publicly available (both in English and Bengali) by April, 2016 within 30 days of the event.

Appendix 1: detailed list of consultation participants

Ministry of Shipping

Attendance Sheet

National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016 | **Venue: BRAC Centre, 75 Mohakhali, Dhaka**

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
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	S. M. Sazid Raman	UNDP	01712 571041	
	Ainat Mahmuda	MoS.	01717514152	
	Md. Shahidul Isla	MOS	01712013836	
	Md. Moshiur Rahm	IWM	01847189319	
	Asish Sutradhar	IWM	01717444277	

World Bank

Attendance Sheet

National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016

Venue: BRAC Centre, 75 Mohakhali, Dhaka

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
1.	Iqbal Ahmed	Env. Sp, World Bank.		[signature]

Government Agencies

Attendance Sheet

National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016

Venue: BRAC Centre, 75 Mohakhali, Dhaka

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
1.	Md. Sarafat H. Khan	DG, WARPO	01715038519	
2.	Mohammad Nashir Uddin	Hydrographer	9554330873	
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4	MD. Mostafa	BTV	01674189004	
5.	MD. Khalilur Rah	Somoy TV	01969444021	
6.	MOHAMMAD ALAUDDIN	Member, NRCC		
7.	SHAHADAT Hossain	DIRECTOR	01841-296-236	
8.	Papun	ATN bangla. Cameraman.	01819690398	MAHTOB
9.	Md. Mohosinur Rahman	Channel 24	9711392667	
	Mahit	JTV	01812837807	
	SAIFUDDIN ROBIN	JTV	01715370087	
	Farhud	JTV	01777778632	
	Tareq	Govt. office	01733651507	
	R.S.I. Hashmi	ADG, DOF	01711143269	
	Pinto Kanungo	RRR, Chief Scientific officer	01768250796	
	Md. Ekram Ullah	PSO, WARPO	01715064922	

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
	MD. Mostafa Kamal	Banglarkam DU	01713561419	
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	Dr. Aminul Haque	WARPO PSO	01810172149	AH
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	Shahid Jahan Bhi		01919696865	
	Imran Uz Zaman	BTV Reporter	01911752288	
	Jabel	Jugantor	01712784329	
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	SAMIUN NABI	Mange BD IWM	01841930031	
	Syed Nazmul Ahsan	Director (E.C) DOE	01819427358	
	MD. ABDUL Motalib	SENIOR chemist DOE	01716932131	
	Rizad Ahsan	SA TV Senior Reporter	01716-307677	

Research Organizations

Attendance Sheet

National Stakeholder Consultation Workshop on

Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016 **Venue: BRAC Centre, 75 Mohakhali, Dhaka**

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
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21	মোর্শেদা বেগম	IWM	mbm@iwmbd.org	মোর্শেদা

BWDB

Attendance Sheet

National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016

Venue: BRAC Centre, 75 Mohakhali, Dhaka

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
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5	Sharmin Jahan Sumi	BWDB	01917749145	
6.	S. M Seraj	Climate	~~[illegible]~~ 01712 570742	
7.	Abdur Rahim	SIRDA	—	
8.	Md. Samsuzzaman Sarkar	DOE	01716861848	
9.	Farhana Mustari	DOE	01616-323799	
10	Dr. AFM Afzal Hossain	IWM, DED (PPD)	01841930002	

BIWTA

Attendance Sheet

National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016 **Venue: BRAC Centre, 75 Mohakhali, Dhaka**

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
5.	Md. Siddique Rah	Director Audit	01713076564	
6	M. / .			
7.	Md. Saiful Islam	BIWTA Joint Director	01819673257	30.03.16
8.	Rafiqul Islam	BIWTA Add. Dir.	01711363510	
9.	Zaved Anwar	BIWTA Joint Director	01713034638	
10	Md. Abu Jafor Howlader	Director BIWTA	01712096780	
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12	Mujibul Huq	CEGIS	mhuq@cegisbd.com	
13	M1)			
14	Md. Abdul Awal	Director Accounts	01713453211	
15	Gopal Chandra Saha	Director Finance	01712256768	
16	Md. Mizanur Rahman	Superintending Engineer	01917713554	

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
	SHAJADUR RAHMAN	BIWTA	01917545639	
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	Md. Abdul Matin	B/WTA	01551229977	Matin
	M. M. HAQUE	BIWTA Member (Engg	01718549528	
	Mahmud Hasan Salein	Director (Plng) BIWTA	01911914636 mhasansalu@gmail.com	
	Md. Sadiqul Islam	BIWTA	sadi.iwta@gmail.com 01555046999	
	Md. Monzurul Haque	BIWTA	01722179479	
	Md. Mahbub Alam	BIWTA	01711397277	
	Md. Saifur Rahm.	B/WTA	01552472062	
	Md. Emdadul Haque	ex BIWTA	01711592404	
	Md. Azhar Ali	BIWTA	01712-612922	
	Engr. Md. Ayub Ali	BIWTA	01716314580	
	Md. Alfaz Uddin	BIWTA	01913733916	
	Md. Saidur Rahman	B/WTA	01913048786	
	Bushra Nishat	IWA		B. Nishat

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
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Private Stakeholders

Attendance Sheet

National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016

Venue: BRAC Centre, 75 Mohakhali, Dhaka

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
	WAJUL	B-NSP	01711-128716	
	Saibuddin	land owner, Bancharampur	01816329665	
	Maji Bur Rahman	land owner, Bancharampur		
	S.S. Biddya Baron Sarker	DDC Pvt. Ltd	01717232615	
	Abdul Zaman	ETV	01712920205	
	Sheikh JAYED	Somoy TV	01964444174	
	Apon	ET.V	01722379375	
	mahmud Ali	mohona	01914183898	
	Zannatul Ferdaus	Baishakhi	01765755009	
	[illegible]	"	01726326159	
	Rafiqul Islam	UNB	01818288857	
	Muhit	Banglavision	01716699551	
	Emran Chowdhury	General Mgr A-K. Khan & Co	01847001283	
	Shahin Akhter	New Age	01812411406	
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Private Agencies

Attendance Sheet

National Stakeholder Consultation Workshop on
Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project

Date: 30 March 2016 | Venue: BRAC Centre, 75 Mohakhali, Dhaka

SL #	Name of the Participant	Organization and Designation	E-mail/ Mobile Number	Signature
1.	Yousuf Hassan	BD BETAR	01733955-25	[signature]
2.	JAHANGIR ALAM	CHANNEL 24	01716786776	[signature]
03	Monir Hossain	Cam/SATV	01768866183	[signature]
	Tazmian Robi	Announcer	01746541037	[signature]
06.	Md. Masudur	The daily Montro khabor	01911083392	[signature]
07	MUNTASIR	Boraer Patha	01819433718	[signature]

Appendix 2: Photo log of event

		
		Welcome Address by Mr. Mahmud Hasan Salim, Project Director
		
Presentation on overview of the study “Environmental and Social Assessment studies of Bangladesh Regional Waterways Transport Project” by Prof. Dr. M. Monowar Hossain, Executive Director, Institute of Water		Speech by Chief Guest Zikrur Reza Khanam, Additional Secretary, Ministry of Shipping

Modelling (IWM)		
		
Speech by Chairperson Commodore Mohammad Mozammel Haque, Chairman, Bangladesh Inland Water Transport Authority (BIWTA)		Presentation on the Environmental Baseline, Project Impacts, EMP and EMF of the study by Md. Zahirul Haque Khan, Team Leader and Director, CPE Division
		

	Presentation on Ecological Environment, Ecological Impacts and Biodiversity Management Plan of the Project by Mr. Dr. Sheikh Muhammad Abdur Rashid, River Ecologist

	
Presentation on Resettlement Policy Framework (RPF) by Khairul Matin, Socio-Development Specialist	Quazi Sarwar Imtiaz Hashmi, Additional Director General of Department of Environment along with other speakers in the technical session
	

Audience participated at the workshop		Audience participated at the workshop
		
A private stakeholder expressed his views about the impacts of the project		Open discussion
		
Audience participated at the workshop		Open discussion

Appendix 3: News Paper Notices of Public Consultation

শুক্রবার

মূল কাগজ ২০ পৃষ্ঠা
সঙ্গে ৮ পৃষ্ঠার ফিচার
আয়োজন–খেলারঘর
বিজ্ঞাপন বিরতি
দশদিক, কথায় কথায়
ও টুনটুন টিনটিন

কালের কণ্ঠ

www.kalerkantho.com

এখনো বিশ্বাস হচ্ছে না মাশরাফির ▶▶ পৃষ্ঠা। ১০ | মুহম্মদ জাফর ইকবালের কলাম : প্রিয় মানুষ ▶▶ পৃষ্ঠা। ১৪ | 'তুরস্কের সতর্কতা আমলে নেয়নি বেলজিয়াম' ▶▶ পৃষ্ঠা। ১৬

ঢাকা। ২৫ মার্চ ২০১৬। ১১ চৈত্র ১৪২২। ১৫ জমাদিউস সানি ১৪৩৭। বর্ষ ৭। সংখ্যা ৭৬ নগর সংস্করণ। দাম ১০ টাকা /kalerkantho /kalerkanthoNews

১৬ কালের কণ্ঠ শুক্রবার। ২৫ মার্চ ২০১৬। ১১ চৈত্র ১৪২২ দেশে দেশে www.kalerkantho.com

বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষ (বিআইডব্লিউটিএ)
১৪১-১৪৩, মতিঝিল বাণিজ্যিক এলাকা, ঢাকা-১০০০।

জাতীয় পর্যায়ে কর্মশালার বিজ্ঞপ্তি

বাংলাদেশ আঞ্চলিক অভ্যন্তরীণ নৌ-পরিবহন প্রকল্পের সামাজিক ও পরিবেশগত মূল্যায়ন এবং পুনর্বাসন কাঠামোর বিষয়ে মতবিনিময়

সমীক্ষা :

বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষের অধীনে বিশ্বব্যাংকের আর্থিক সহযোগিতায় বাংলাদেশ আঞ্চলিক অভ্যন্তরীণ নৌ-পরিবহন প্রকল্পের পরিবেশগত ও সামাজিক মূল্যায়নের জন্য সমীক্ষা পরিচালিত হচ্ছে। প্রস্তাবিত প্রকল্পের অন্যতম কার্যক্রমগুলো হলো :

উপাদান–(১) : ড্রেজিং-এর মাধ্যমে ঢাকা-চট্টগ্রামের সংযোগ এবং আশুগঞ্জ, নারায়ণগঞ্জ এবং বরিশালের সংযোগ পথ চালু রাখা, চাঁদপুর-শরীয়তপুর, লক্ষীপুর-ভোলা এবং ভেদুরিয়া-লাহারহাট-এর সংযোগ বরাবর তিনটি অগ্রাধিকার ফেরী পারাপারের জন্য ঘাট ও নৌ-পথ রক্ষণাবেক্ষণ এবং ঘূর্ণিঝড়ের সময় ব্যবহারের জন্য উক্ত সংযোগ বরাবর ছয়টি নৌযান পোতাশ্রয় নির্মাণ ও রক্ষণাবেক্ষণ;

উপাদান–(২) : পানগাঁও-এ একটি সাধারণ কার্গো টার্মিনাল নির্মাণ, আশুগঞ্জ এবং ভৈরবের বিদ্যমান কার্গো টার্মিনালসমূহ পুনর্বাসন, সদরঘাটের পাশাপাশি শ্মশানঘাটে একটি নতুন নদীবন্দর নির্মাণ, নারায়ণগঞ্জ ও চাঁদপুরের বিদ্যমান নদীবন্দরসমূহের পুনর্বাসন এবং বিদ্যমান ১৪টি লঞ্চঘাট উন্নয়ন; এবং

উপাদান–(৩) : প্রাতিষ্ঠানিক সক্ষমতা উন্নয়ন ও স্থায়িত্ব।

মতবিনিময় সভা :

প্রকল্পের সামাজিক ও পরিবেশগত প্রভাব সম্পর্কিত সমীক্ষাটি পরিচালনার কাজ ন্যস্ত করা হয় ইনস্টিটিউট অফ ওয়াটার মডেলিং (IWM)-এর উপর। এ সমীক্ষার অংশ হিসেবে এবং বিশ্বব্যাংকের পরিবেশগত প্রভাব নিরূপণ নীতিমালা ৪.০১ এবং বাংলাদেশ সরকার পরিবেশ সংরক্ষণ আইন (১৯৯৭)-এর নির্দেশনা অনুসারে প্রকল্পের সামাজিক ও পরিবেশগত প্রভাব এবং পুনর্বাসন কাঠামো নির্ধারণ বিষয়ে জাতীয় কর্মশালা আগামী ৩০ মার্চ ২০১৬ তারিখ (রোজ বুধবার) বেলা ১০:০০ ঘটিকায় ব্র্যাক সেন্টার, ৭৫, বীর উত্তম এ. কে. খন্দকার রোড, ঢাকা-ঠিকানায় অনুষ্ঠিত হবে। এ কর্মশালায় সমীক্ষার বিভিন্ন প্রতিবেদন যথা : ESIA, EMP, EMF, RPF ইত্যাদি উপস্থাপন করা হবে।

সমীক্ষাটির সুরক্ষা প্রতিবেদনসমূহ, নির্বাহী সারসংক্ষেপ (ES), পরিবেশগত ও সামাজিক মূল্যায়ন প্রতিবেদন (ESA), পরিবেশ ব্যবস্থাপনা পরিকল্পনা (EMP), পরিবেশ ব্যবস্থাপনা কাঠামো (EMF) এবং পুনর্বাসন নীতি কাঠামো (RPF) বিআইডব্লিউটিএ'র ওয়েবসাইটে (http://www.biwta.gov.bd) প্রকাশ করা হয়েছে। সমীক্ষাটির নির্বাহী সারসংক্ষেপ (ES) এবং পুনর্বাসন নীতিকাঠামো (RPF) বিআইডব্লিউটিএ'র নিম্নলিখিত আঞ্চলিক দপ্তরসমূহে জনসাধারণকে অবহিতকরণের সুবিধার্থে রক্ষিত রয়েছে :

১. ঢাকা নদীবন্দর;
২. নারায়ণগঞ্জ নদীবন্দর;
৩. বরিশাল নদীবন্দর;
৪. চাঁদপুর নদীবন্দর;
৫. বিআইডব্লিউটিএ চট্টগ্রাম দপ্তর; এবং
৬. ভৈরব-আশুগঞ্জ নদীবন্দর।

নৌ-পরিবহন মন্ত্রণালয়ের দায়িত্বে নিয়োজিত মাননীয় মন্ত্রী, জনাব শাজাহান খান, এমপি, সভায় প্রধান অতিথি হিসেবে উপস্থিত থাকার সদয় সম্মতি জ্ঞাপন করেছেন। জনাব অশোক মাধব রায়, মাননীয় সচিব (ভারপ্রাপ্ত), নৌ-পরিবহন মন্ত্রণালয় উক্ত কর্মশালায় বিশেষ অতিথি হিসেবে উপস্থিত থাকবেন।

উক্ত কর্মশালায় প্রকল্প সংশ্লিষ্ট সুশীল সমাজের প্রতিনিধিগণ সমীক্ষা দলের সাথে সাক্ষাৎ করতে পারেন। প্রকল্পের ফলাফল, সামাজিক ও পরিবেশগত দিকগুলো এবং প্রধান সামাজিক ও পরিবেশগত প্রভাব প্রশমন ব্যবস্থা, পুনর্বাসন নীতি কাঠামো ইত্যাদি বিষয়ে আলোচনা এবং সমীক্ষার ফলাফল সম্পর্কে মতামত প্রদান করতে পারেন। সংশ্লিষ্ট এবং আগ্রহী ব্যক্তিবর্গকে এই কর্মশালায় উপস্থিত থাকার জন্য আমন্ত্রণ জানানো যাচ্ছে। এছাড়া এ কর্মশালায় বিভিন্ন শ্রেণী-পেশার ব্যক্তিবর্গকেও আনুষ্ঠানিক আমন্ত্রণ করা হবে।

মন্তব্য :

উক্ত সমীক্ষা সংক্রান্ত আপনাদের কোন মন্তব্য থাকলে আমরা সেটা শুনতে আগ্রহী। ব্যক্তিগত তথ্য ব্যতীত সব মন্তব্য পাবলিক রেকর্ডের অংশ হিসেবে বিবেচিত হবে। উপরন্তু, একটি মন্তব্য শীট থাকবে। অনুগ্রহ করে নিম্নলিখিত ঠিকানায় উক্ত মন্তব্য শীটটি প্রেরণ করবেন অথবা মেইল করবেন :

মাহমুদ হাসান সেলিম
প্রকল্প পরিচালক
বাংলাদেশ বাণিজ্য এবং পরিবহন গবেষণা আরইটিএফ প্রকল্প (বিআইডব্লিউটিএ উপাদান)
ঠিকানা : বিআইডব্লিউটিএ ভবন, ১৪১-১৪৩
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ঠিকানা : বাড়ি # ৪৯৬, রোড # ৩২
নিউ ডিওএইচএস, মহাখালী, ঢাকা-১২০৬।
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BIWTA to restore smooth water transport in country

▸Staff Correspondent

Bangladesh Inland Water Transport Authority (BIWTA) has set a target to restore the navigability of about 18,000 kilometers of waterways in the coming years, aiming to ensure smooth movement of water vessels, said its chairman Commod-ore Mohammad Mozammel Haque yesterday.

"We've already restored the navigability of 1,000 kilometers of river routes through dredging in the last one year," he said while addressing the inaugural session of a workshop at city's BRAC Centre Inn yesterday.

BIWTA and the Institute of Water Modeling (IWM) jointly organized the 'National Stakeholder Consultation Workshop on Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project.' The BIWTA chairman said once Bangladesh had about 24,000 kilometers of river routes, but it has declined to about 6,000 kilometers during monsoon while about 3,900 kilometers during the dry season.

The BIWTA is currently implementing 24 dredging projects and many other schemes, including the Bangladesh Regional Waterways Transport Project. "If those are implemented, we'll be able to restore the navigability of rivers we have lost." Mozammel said Bangladesh experiences ay accidents each year due to extreme climatic events like cyclone and storm. To save the lives of passengers on river routes, he said, the BIWTA will set up six vessel shelter stations on different river routes.

In his power-point presentation, IWM executive director Prof Dr M Monowar Hossain said Dhaka-Chittagong corridor and adjoining routes provides more than 70 percent of total IWT output. About 2 lakh passengers traveling every day through these routes, he said the movement of

▸See page 2 col 3

BIWTA to restore smooth

▸▸ CONTINUED FROM PAGE 16

break bulk cargo and POL (Petroleum Oil and Lubricant) largely depends on the routes.

Prof Monowar projected that about 8.52 million TEUs (twenty-foot equivalent units) of inland water transport (IWT) container traffic will ply Dhaka-Chittagong Inland Water transport corridor by 2035. He also predicted the IWT container traffic will increase to about 20 million TEUs by 2055 on waterways. Giving an overview on the Environmental and Social Assessment Studies for the proposed Bangladesh Regional Waterways Transport Project, the water expert said the Dhaka-Chittagong corridor is the main traffic route for inland water transport as it carries about 80 percent all of IWT traffic. He said the government has given priority to the full utilization of Dhaka-Chittagong waterway corridor to reduce pressure on roads.

The proposed World Bank-financed Bangladesh Regional Waterways Transport Project aims to pilot a new approach for maintenance of Dhaka-Chittagong corridor and two key connecting routes; maintenance of three priority ferry crossings along these corridors; and construction and maintenance of an estimated six vessel shelters along the corridors for use during cyclones or storms.

Shipping Ministry additional secretary Zikrur Reja Khanam also spoke at the inaugural session of the workshop.

Annex J: Chance Find Procedures

Chance Find Procedures

(Ref: The World Bank Operational Manual, 1999 OP4.11)

Works could impact sites of social, sacred, religious, or heritage value. "Chance find" procedures would apply when those sites are identified during the design phase or during the actual construction period and the related activity will not be eligible for financing under the project.

(1) Cultural property includes monuments, structures, works of art, or sites of significant points of view, and are defined as sites and structures having archaeological, historical, architectural, or religious significance, and natural sites with cultural values. This includes cemeteries, graveyards and graves.

(2) The list of negative subproject attributes which would make a subproject ineligible for support includes any activity that would adversely impact cultural property.

(3) In the event of finding of properties of cultural value during construction, the following procedures for identification, protection from theft, and treatment of discovered artifacts should be followed and included in standard bidding document.

(a) Stop the construction activities in the area of the chance find;

(b) Delineate the discovered site or area;

(c) Secure the site to prevent any damage or loss of removable objects.

(d) Notify the supervisory Engineer who in turn will notify the responsible local authorities;

(e) Responsible local authorities and the relevant Ministry would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures.

(f) Decisions on how to handle the finding shall be taken by the responsible authorities and the relevant Ministry. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance), conservation, restoration and salvage.

(g) Implementation of the authority decision concerning the management of the finding shall be communicated in writing by the relevant Ministry.

(h) Construction work could resume only after permission is given from the responsible local authorities and the relevant Ministry concerning safeguard of the heritage.

(4) These procedures must be referred to as standard provisions in construction contracts. During project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered.

(5) Relevant findings will be recorded in World Bank Supervision Reports and Implementation Completion Reports will assess the overall effectiveness of the project's cultural property mitigation, management, and activities, as appropriate.

Annex K: Dredge Material Management Plan

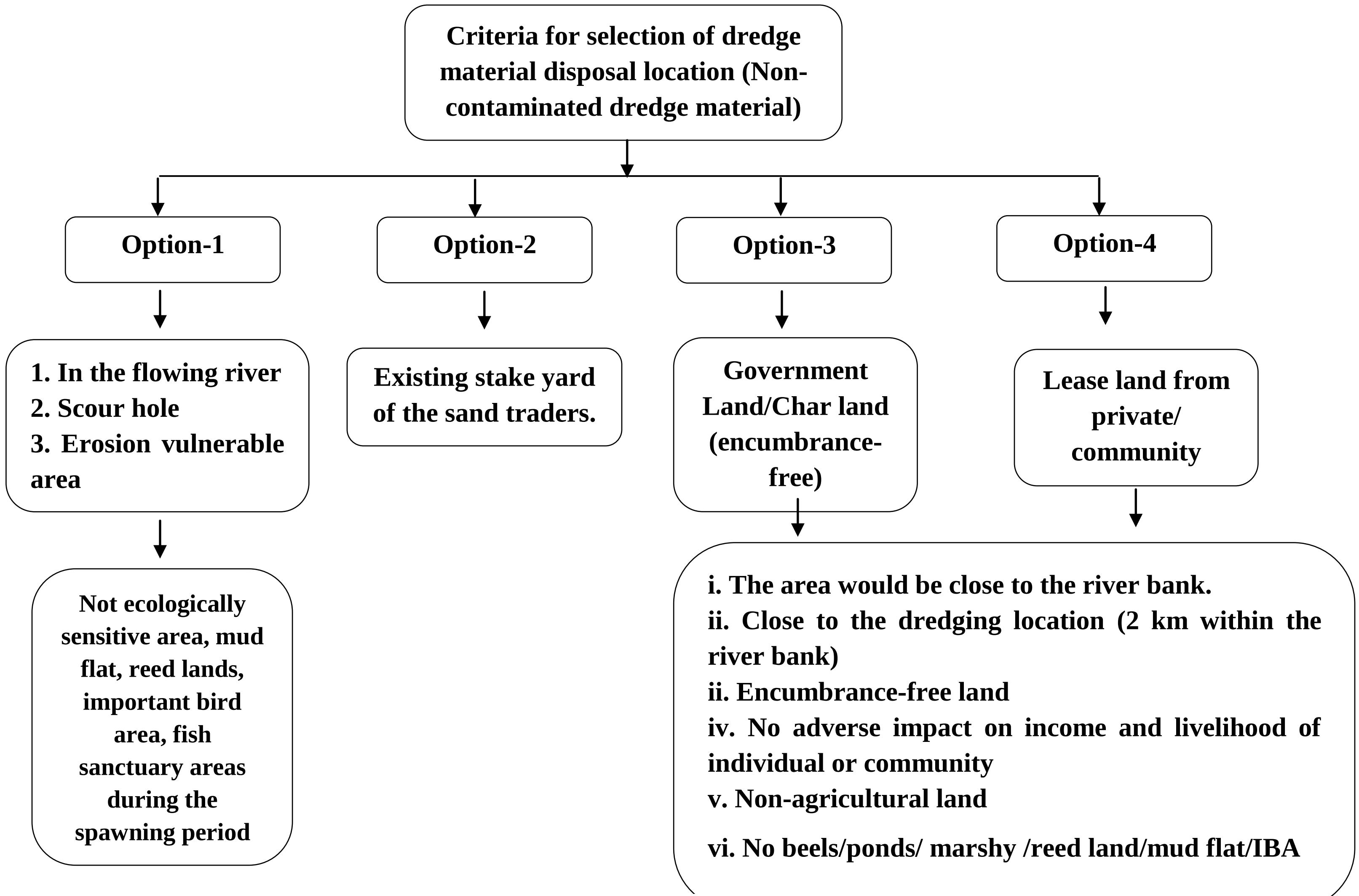
Dredged Material Management Plan

Dredge material management meeting the environmental and social requirement is a huge challenge. Criteria for selection of site for dredged material disposal in the Upper Meghna, Lower Meghna and Meghna Estuary has been devised considering environmental and social criteria and draft national guidelines which is presented in the following Figure-1. Approximate annual volume of dredged materials in the project's rivers is 5.8 million m^3. Composition of the dredged material is dominated by sand followed by silt and clay in the lower stretches of the river and Meghna Estuary.

The Figure -2 and Table-1 provide locations and options for disposal of dredged material.

It is important to dispose the dredge material at the downstream of the dredge locations at erosion vulnerable area and scour holes since the river sediment transport capacity is higher at this location and additional sediment disposal will reduce the erosion vulnerability. The disposal needs to be submerged disposal. It is essential to monitor the sediment concentration at the dredge location as well as at the disposal location by the contractor to examine the excess sediment concentration and its extent from the center of disposal and dredging location. The environmental criteria has also to be followed during disposal. Disposal in the river should avoid the Hilsha sanctuary, reed lands, mud flat, important bird area, fish and Dolphin habitats and other environment sensitive area and issues. Dredging also has to be avoided at specific period as mentioned in the EMP

Al the rivers for the navigation routes are morphologically very active and dredging location and dredging volumes are likely to be changed in future. It is the responsibility of Bangladesh Inland Water Transport Authority to identify the dredging location considering the environmental and social criteria. There are some very narrow river branches at the Upper Meghna river, where disposal in the river is very critical, at this location disposal on land is preferable since disposal on river will increase the sediment backfilling rate.



Note: There is no contaminated dredge material within the study area of the project (Bangladesh Regional Waterway Transport Project 1)

Figure-1: Criteria for selection of dredge material disposal location

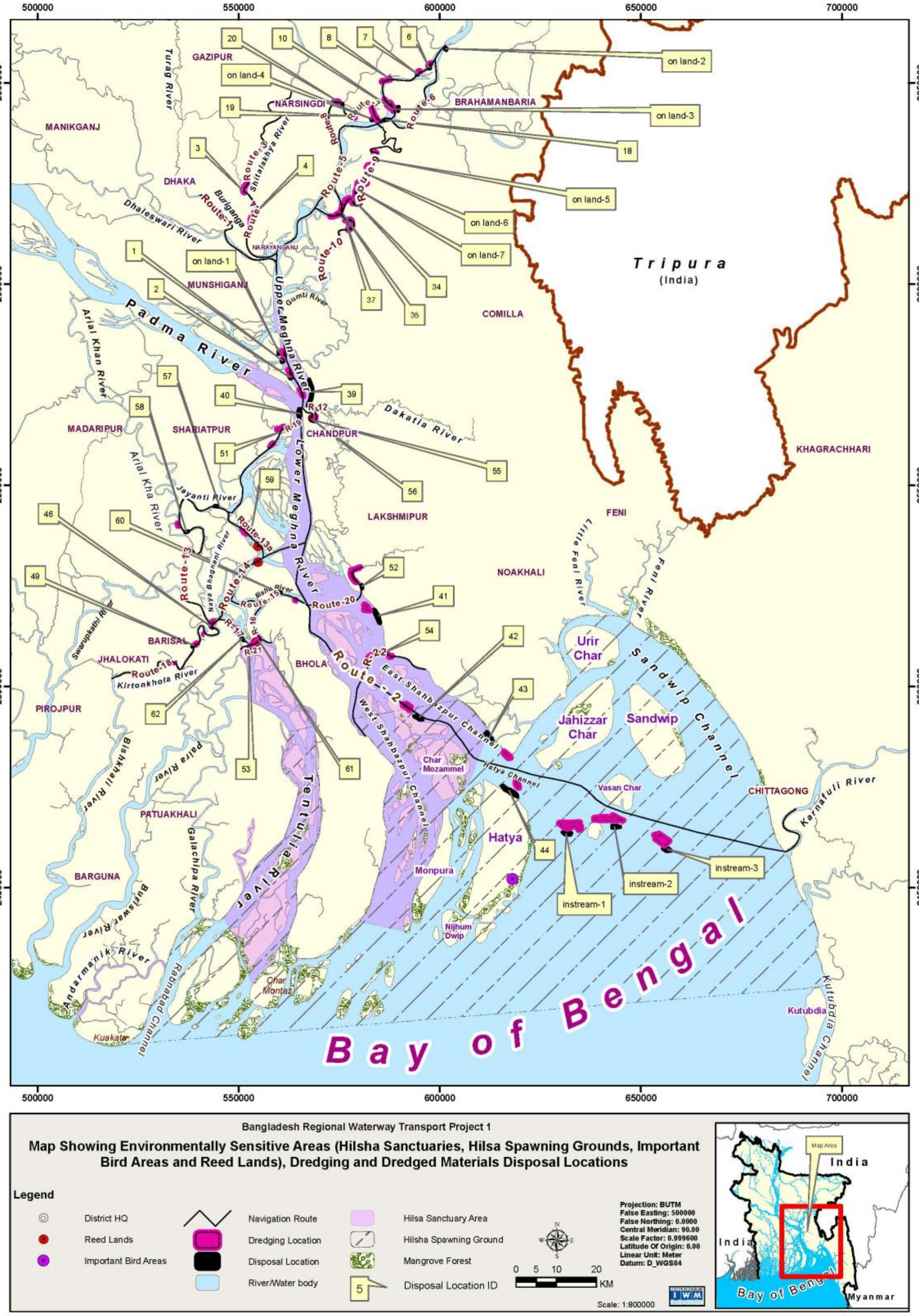


Figure-2: Locations for disposal of dredge material

Table-1: Options for disposal of dredge material

Location of Target Dredging	Options for disposal of dredge material									
	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting(m)	Northing(m)	Proposed Location	Easting(m)	Northing(m)	Proposed Location				
Algi Bazar, Raipura				597449	653482	Algi Bazar, Raipura			Uttar Araisidha	
Hashempur Moulovi bazar				594420	651977	Hashempur Moulovi bazar				
Noorpur Bazar				587293	650907	Noorpur Bazar				
Char Madua Bazar				588582	643238	Char Madhua			Char Madhua	
Barikandi				586599	640644	Barikandi				
Delarpur Bazar				577879	641578	Delarpur Bazar				
Hazipur Bazar				575680	644652	Hazipur Bazar				
Sreemoddi Bazar				578184	621109	Purba Uzan Char South				
Uttar Homna				575286	617252	Uttar Homna				

Location of Target Dredging	Options for disposal of dredge material									
	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting(m)	Northing(m)	Proposed Location	Easting(m)	Northing(m)	Proposed Location				
Dhanukunda Bazar				553077	616517	Dhanukunda Bazar				
Tarabo Bazar-2				550977	623029	Demra				
Ekhlaspur				560847	580770	Kachikata Bazar			Eklaspur	
Rajrajeswar				562819	576649	Rajrajeswar				
Kallyanpur				568137	572895	Kallyanpur				
Kallyanpur				565336	567631	Puran Bazar, Chandpur				
Eidgah Bazar				560010	563081	Eidgah Bazar				
Char Fatejonpur Bazar				557755	559466	Char Fatejonpur Bazar				
Akhanar Hat				544348	544621	Akhanar Hat				
Nazirpur				537119	538240	Nazirpur				
Hijla				553122	537217	Hijla				
Koter Hat				559798	523076	Koter Hat				
Zia Bazar				554629	511315	Zia Bazar				

Location of Target Dredging	Options for disposal of dredge material									
	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting(m)	Northing(m)	Proposed Location	Easting(m)	Northing(m)	Proposed Location				
Jangalia				550847	511709	Jangalia				
Mokrampotab Bazar				543028	514797	Mokrampotab Bazar				
Barisal				538761	510046	Barisal				
Shaheber Bazar				584411	517266	West Kadir Panditer Hat				
Selim Bazar				594599	492033	Selim Bazar				
Chandnandi				612697	486702	Chandnandi				
Nalchira				617769	473548	Nalchira				
Alokbali									Alokbali	
Paschim Saifullakandi									Paschim Saifullakandi	
Salimabad									Salimabad	
Paschim Ghagutia									Paschim Ghagutia	
Meghna Estuary -1	632863	461274	Meghna Estuary - 1							
Meghna Estuary	643581	461133	Meghna							

Location of Target Dredging	Options for disposal of dredge material									
	Option 1						Option 2	Option 3*	Option 4*	
	In the river (Coordinates in BTM)			Scour hole (Coordinates in BTM)			Existing stake yard of the sand traders (to be identified)	Government Land/Char land (encumbrance-free)	Lease land from the private	Community
	Easting(m)	Northing(m)	Proposed Location	Easting(m)	Northing(m)	Proposed Location				
-2			Estuary - 2							
Meghna Estuary -3	653946	457537	Meghna Estuary - 3							

1. Contaminated sediment (a permanent disposal site is required)
    - No beels/reed areas
    - Government owned land (encumbrance free)
    - Private land (non agricultural)

   Details of the safeguard measures of the contaminated sediment disposal is included in the Environment Management Plan (EMP)

Principles for lease agreement

The Project Management Unit of the Bangladesh Inland Water Transport Authority (BIWTA) will arrange land for disposal of the dredged materials following GoB law i.e. Acquisition and Requisition of Immovable Property Ordinance 1982 (Ordinance No. 2) and subsequent amendment until 1994. The land will be requisitioned through the concerned Deputy Commissioners of the project districts. The PMU will pay the required amount to DC office as per law as required for renting/leasing for the particular land for the sand deposition. DC office will annually assess the rent for the land and claim fund from the PMU to disburse to the lessees.

A lease agreement would be signed between the PMU and the land owners according to the broad principles as under-

1. DC will identify the actual owners of the proposed land taking into account of the record of rights to the property
2. Rent would be paid through the DC office on yearly basis at the beginning of the year
3. Land will be used for project purposes only (sand deposition)
4. Land will be restored to original condition and returned to the land owners after agreed lease period.

The lease agreement will be based on requisition of land

Annex L: Terms of Reference for Biodiversity Management Consultants

Terms of Reference for Biodiversity Management Consultants

Objective

The objective of the proposed consulting services is to develop detailed biodiversity management plans to address environmental issues with the implementation of various project activities and carry out regular monitoring of the impacts on sensitive habitats and species.

Activities

The key activities to be carried out by the **Biodiversity Monitoring Consultants** are:

- Review the baseline data carried out by ESIA consultants of Component 1 and carry out additional baseline data collection on biodiversity in the project area and identification of sensitive habitats in the project area, i.e. habitats of endangered and keystone species
- Mapping of the above sensitive habitats
- Develop the biodiversity management plans to address impacts associated with various project interventions
- Develop habitat enhancement and protection for the key species.
- Regular monitoring of the impacts associated with dredging and dredge material disposal; and construction and operation of terminals, on the biodiversity.

Key Qualifications

The consulting firm or NGO should have minimum 5 years of experience in carrying out the assignments preferably international assignments and World Bank funded projects, related to collection of baseline ecological data, development and implementation of biodiversity and environmental management programs, and development and implementation of conservation programs in developing countries

Estimated Man months

The baseline study will be carried out over a period of one year covering all seasons; and biodiversity management plans will be prepared in the first years. The implementation of of biodiversity enhancement measures will be carried out in the second year. The monitoring will be carried out during the entire dredging period of six years and one year after the dredging period. Monitoring will also be carried out during the construction of the terminals. The key staff and their estimated man months for the assignment are given below.

No.	International Consultants		National Consultants	
	Position	Man month	Position	Man month
1	Aquatic Ecologist/team leader	30	Fish biologist/ Deputy Team Leader	40
2	Wildlife biologist	10	Wildlife biologist	30
3	River morphologist	20	River morphologist	30
4			Bird Expert	30
5			Conservation	20

			specialist	
6			Limnologist	20

Annex M: Terms of Reference for PIU Environmental Staff

Terms of Reference for PIU Environmental Staff

Objective

Two environmental consultants, one environmental expert and one Environmental Officer, will be hired under the Project Implementation Unit (PIU) to support the Project Director (PD) in implementing the Environmental Management Plans of the Project and preparation of Environmental Assessment for Component 2 of the Project and finalization of the same in close co-ordination with the design consultants and the World Bank.

Activities

The key activities to be carried out by the **Environmental Specialist** are:

- Finalizing the terms of references and request for proposals for various environmental consulting firms or NGOs to be hired for implementation of the EMP
- Undertake environmental screening, assessment and management of any activities under Component 3 with environmental implications (including preparatory studies for future projects),
- Oversee the pre-construction baseline monitoring of air, noise, water, soil and sediment quality to be carried out by the construction supervision consultant
- Ensure integration of the EA and resulting EMP into the project redesign and implementation plans (contract documents);
- Ensure compliance of the mitigation measures by the Contractors;
- Liaison with the DOE on environmental and other regulatory matters; including renewal of environmental clearance documents as and when required
- Develop training program on environmental aspects for the key stakeholders (BIWTA, contractors, public representatives and local government institutions/ NGOs;
- Maintaining project-specific Database for Environmental Management
- Compiles monthly, quarterly and annual reports to update ongoing environmental processes and address current issues. Provide recommendations for implementation of corrective actions and suggest program improvements.

The key activities to be carried out by the **Environmental Officer** are:

- Review the contractor's Implementation Plan for the environmental and social mitigation measures, as per the EMP;
- Liaison with the contractors and CSC on the implementation of the EMP;
- Carry out site inspections, check and undertake periodic environmental monitoring and initiate necessary follow-up actions;
- Undertaking environmental monitoring and reporting to the Project Director and follow-up activities;
- Assist the PD to arrange for the Environmental Auditing and follow up action on the Audit recommendation.
- Document the good practices in the project on incorporation and integration of environmental issues into engineering design;
- Report to the PD on the environmental aspects pertaining to the project;
- Assist in the preparation of periodic reports for dissemination to the PIU, and World Bank.

key skills

The Environmental Specialist should have 10 years of experience and the Environmental Officer should have 5 years of experience in planning, implementation and monitoring of environmental management for large infrastructure projects. Both the consultants should have masters in environmental engineering or environmental sciences.

Estimated Man months

The consultants will be hired for a period of 72 months (6 years).

Annex N: Terms of Reference for Environmental Staff of Monitoring and Evaluation Consultants

Terms of Reference for Environmental Staff of Monitoring and Evaluation Consultants

Objective

The Project will be supported by a specialized an External Monitoring and Evaluation (M&E) firm that will be responsible for monitoring and evaluation of implementation progress of all project works and activities and it's impacts as well the implementation of the EMP. The M&E reports will evaluate the success in project implementation in terms of meeting the project's objectives, and assess its economic impacts. The M&E activities will provide continuous feedback to the PIU on the project's performance, and on mitigation of negative impact under various components, so that corrective actions can be undertaken in a timely manner if necessary.

Activities

The key activities to be carried out by the **M&E Consultants** are:

- To develop specific monitoring indicators, checklists, and questionnaires to undertake external monitoring (a preliminary list of monitoring indicators has been given in the ESMP) in consultation with BIWTA and WB.
- To review and verify the implementation progress of various EMP elements, particularly, mitigation plan, compliance and effects monitoring, environmental trainings, documentation, and grievance redress mechanism.
- To review and verify the functioning of the key entities – E&S Cell, DSC, CSC, and contractors for environmental management.
- Identify the strengths and weaknesses of the design of EMP and its implementation, and also the entities tasked to undertake various tasks detailed in the EMP.
- Evaluate and assess the adequacy of the mitigation measures proposed in the Mitigation Plan in addressing the potentially negative impacts of the project activities and propose changes as appropriate.
- Review results of internal monitoring (compliance and effects monitoring) and verify its effectiveness through community consultations, spot checks, and field observations.
- Review the process and outcome of environmental trainings conducted by different project entities in line with the training program given in the EMP.
- Review the process and outcome of the documentation and reporting being carried out by various project entities in line with the EMP requirements.
- Identify, quantify, and qualify the types of EMP-related conflicts and grievances reported and resolved and the consultation and participation procedures. Provide recommendations to strengthen the grievance management and redress system.
- Recommend and describe any additional measures to strengthen capacity of implementing entities to ensure full and effective implementation of required mitigation and management measures.
- Describe any lessons learned that might be useful for environmental assessment and management of future projects.

key skills

The consultants should have minimum 10 years of experience in carrying out similar assignments.

Staff requirements and Estimated Man months

S.No.	Position	Man months

1	EMP Implementation Specialist	20
2	Environmental Specialist	20
3	Ecologist	20

Annex O: Environment Conservation Rules (ECR) '97 Standards

SCHEDULE – 2

Standards for Air
[See Rule 12]

Density in microgram per cusec meter

Sl. No.	Categories of Area	Suspended Particulate Maters (SPM)	Sulphur-dioxide	Carbon Monoxide	Oxides Nitrogen
a.	Industrial and mixed	500	120	5000	100
b.	Commercial and mixed	400	100	5000	100
c.	Residential and rural	200	80	2000	80
d.	Sensitive	100	30	1000	30

Notes:

(1) At national level, sensitive area includes monuments, health center, hospital, archeological site, educational institution, and government designated areas (if any).

(2) Industrial units located in areas not designated as industrial areas shall not discharge pollutants which may contribute to exceeding the standard for air surrounding the areas specified at Sl. nos. c and d above.

(3) Suspended Particulate Matter means airborne particles of a diameter of 10 micron or less.

SCHEDULE – 3

Standards for Water

[See Rule 12]

(A) Standards for inland surface water

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

Notes:

1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.

2. Electrical conductivity for irrigation water – 2250 μmhoms/cm (at a temperature of 25°C); Sodium less than 26%; boron less than 0.2%.

(B) Standards for drinking water

Sl. No.	**Parameter**	**Unit**	**Standards**
1	**2**	**3**	**4**
1.	Aluminum	mg/l	0.2
2.	Ammonia (NH_3)	,,	0.5
3.	Arsenic	,,	0.05
4.	Balium	,,	0.01
5.	Benzene	,,	0.01

1	2	3	4
6.	BOD_5 20°C	,,	0.2
7.	Boron	,,	1.0
8.	Cadmium	,,	0.005
9.	Calcium	,,	75
10.	Chloride	,,	150 – 600*
11.	Chlorinated alkanes		
	carbontetrachloride	,,	0.01
	1.1 dichloroethylene	,,	0.001
	1.2 dichloroethylene	,,	0.03
	tetrachloroethylene	,,	0.03
	trichloroethylene	,,	0.09
12.	Chlorinated phenols		
	- pentachlorophenol	mg/l	0.03
	- 2.4.6 trichlorophenol	,,	0.03
13.	Chlorine (residual)	,,	0.2
14.	Chloroform	,,	0.09
15.	Chromium (hexavalent)	,,	0.05
16.	Chromium (total)	,,	0.05
17.	COD	,,	4
18.	Coliform (fecal)	n/100 ml	0
19.	Coliform (total)	n/100 ml	0
20.	Color	Hazen unit	15
21.	Copper	mg/l	1
22.	Cyanide	,,	0.1
23.	Detergents	,,	0.2
24.	DO	,,	6
25.	Fluoride	,,	1
26.	Hardness (as $CaCO_3$)	,,	200 – 500
27.	Iron	,,	0.3 – 1.0
28.	Kjeldhl Nitrogen (total)	,,	1
29.	Lead	,,	0.05

1	2	3	4
30.	Magnesium	,,	30 – 35
31.	Manganese	,,	0.1
32.	Mercury	,,	0.001
33.	Nickel	,,	0.1
34.	Nitrate	,,	10
35.	Nitrite	,,	<1
36.	Odor	,,	Odorless
37.	Oil and grease	,,	0.01
38.	pH	,,	6.5 – 8.5
39.	Phenolic compounds	,,	0.002
40.	Phosphate	,,	6
41.	Phosphorus	,,	0
42.	Potassium	,,	12
43.	Radioactive materials (gross alpha activity)	Bq/l	0.01
44.	Radioactive materials (gross beta activity)	Bq/l	0.1
45.	Selenium	mg/l	0.01
46.	Silver	,,	0.02
47.	Sodium	,,	200
48.	Suspended particulate matters	,,	10
49.	Sufide	,,	0
50.	Sulfate	,,	400
51.	Total dissolved solids	,,	1000
52.	Temperature	°C	20-30
53.	Tin	mg/l	2
54.	Turbidity	JTU	10
55.	Zinc	mg/l	5

SCHEDULE – 4

Standards for Sound
[See Rule 12]

Sl. No.	Category of areas	Standards determined at dBa unit Day	Night
a.	Silent zone	45	35
b.	Residential area	50	40
c.	Mixed area	60	50
	(mainly residential area, and also simultaneously used for commercial and industrial purposes)		
d.	Commercial area	70	60
e.	Industrial area	75	70

Notes:

1. The time from 6 a.m. to 9 p.m. is counted as daytime.
2. The time from 9 p.m. to 6 a.m. is counted as night time.
3. Area up to a radius of 100 meters around hospitals or educational institutions or 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.

SCHEDULE – 5

Standards for Sound originating from Motor Vehicles or Mechanized Vessels
[See Rule 12]

Category of Vehicles	Unit	Standards	Remarks
*Motor Vehicles (all types)	dBa	85	As measured at a distance of 7.5 meters from exhaust pipe.
		100	As measured at a distance of 0.5 meter from exhaust pipe.
Mechanized Vessels	dBa	85	As measured at a distance of 7.5 meters from the vessel which is not in motion, not loaded and is at two thirds of its maximum rotating speed.
		100	As measured at a distance of 0.5 meter from the vessel which is in the same condition as above.

* At the time of taking measurement, the motor vehicle shall not be in motion and its engine conditions shall be as follows:-

(a) Diesel engine – maximum rotating speed.

(b) Gasoline engine –at two thirds of its maximum rotating speed and without any load.

(c) Motorcycle – If maximum rotating speed is above 5000 rpm; two-thirds of the speed, and if maximum rotating speed is less than 5000 rpm, three-fourth of the speed.

SCHEDULE – 6

Standards for Emission from Motor Vehicles
[See Rule 12]

Parameter	Unit	Standard Limit
Black Smoke	Hartridge Smoke Unit (HSU)	65
Carbon Monoxide	gm/k.m. percent area	24 04
Hydrocarbon	gm/k.m. ppm	02 180
Oxides of Nitrogen	gm/k.m. ppm	02 600

* As measured at two thirds of maximum rotating speed.

SCHEDULE – 7

Standards for Emission from Mechanized Vessels
[See Rule 12]

Parameter	Unit	Standard Limit
Black Smoke*	Hartridge Smoke Unit (HSU)	65

* As measured at two thirds of maximum rotating speed.

SCHEDULE – 8

Standards for Odor
[See Rule 12]

Parameter	Unit	Standard Limit
Acetaldehyde	ppm	0.5 – 5
Ammonia	,,	1 – 5
Hydrogen Sulfide	,,	0.02 – 0.2
Methyl Disulfide	,,	0.009 – 0.1
Methyl Sulfide	,,	0.01 – 0.2
Styrene	,,	0.4 – 2.0
Trim ethylamine	,,	0.005 – 0.07

Notes :

(1) Following regulatory limit shall be generally applicable to emission/exhaust outlet pipe of above 5 meter height:

Q = 0.108 x He^2Cm (Where Q = Gas Emission rate Nm^3/hour)
He = Height of exhaust outlet pipe (m)
Cm = Above mentioned limit (ppm)

(2) In cases where a special parameter has been mentioned, the lower limit shall be applicable for warning purposes, and the higher limit shall be applicable for prosecution purpose or punitive measure.

SCHEDULE – 9

Standards for Sewage Discharge
[See Rule 12]

Parameter	Unit	Standard Limit
BOD	miligram/l	40
Nitrate	,,	250
Phosphate	,,	35
Suspended Solids (SS)	,,	100
Temperature	Degree Centigrade	30
Coliform	number per 100 ml	1000

Notes :

(1) This limit shall be applicable to discharges into surface and inland waters bodies.
(2) Sewage shall be chlorinated before final discharge.

SCHEDULE – 10

Standards for Waste From Industrial Units or Projects Waste
[See Rule 13]

Sl. No.	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
1	2	3	4	5	6
1	Ammonical Nitrogen (as elementary N)	mg/l	50	75	75
2	Ammonia (as free ammonia)	,,	5	5	15
3	Arsenic (as)	,,	0.2	0.05	0.2
4	BOD_5 at 20^oC	,,	50	250	100
5	Boron	,,	2	2	2

1	2	3	4	5	6
6	Cadmium (as CD)	,,	0.50	0.05	0.05
7	Chloride	,,	600	600	600
8	Chromium (as total Cr)	,,	0.5	1.0	1.0
9	COD	,,	200	400	400
10	Chromium (as hexavalent Cr)	,,	0.1	1.0	1.0
11	Copper (as Cu)	,,	0.5	3.0	3.0
12	Dissolved Oxygen (DO)	,,	4.5 – 8	4.5 – 8	4.5 – 8
13	Electro-conductivity (EC)	micro mho/ cm	1200	1200	1200
14	Total Dissolved Solids	,,	2,100	2,100	2,100
15	Fluoride (as F)	,,	2	15	10
16	Sulfide (as S)	,,	1	2	2
17	Iran (as Fe)	,,	2	2	2
18	Total Kjeldahl Nitrogen (as N)	,,	100	100	100
19	Lead (as Pb)	,,	0.1	1.0	0.1
20	Manganese (as Mn)	,,	5	5	5
21	Mercury (as Hg)	,,	0.01	0.01	0.01
22	Nickel (as Ni)	,,	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/l	10.0	Not yet Fixed	10
24	Oil and Grease	,,	10	20	10
25	Phenolic Compounds (as C_6H_5OH)	,,	1.0	5	1
26	Dissolved Phosphorus (as P)	,,	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)	Degree	5	10	10

1	2	3	4	5	6
31	Total Dissolved Solids	,,	2,100	2,100	2,100
32	Temperature	Centig rade	40	40	40-Summer
			45	45	45-Winter
33	Suspended Solids (SS)	mg/l	150	500	200
34	Cyanide (as Cn)	,,	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.

SCHEDULE – 11

Standards for Gaseous Emission from Industries or Projects
[See Rule 13]

Sl.No.		Parameters	Standard present in a unit of mg/Nm^3
1		**2**	**3**
1.		Particulate	
	(a)	Power plant with capacity of 200 Megawatt or above.	150
	(b)	Power plant with capacity less than 200 Megawatt.	350
2.		Chlorine	150
3.		Hydrochloric acid vapor and mist	350
4.		Total Fluoride F	25
5.		Sulfuric acid mist	50
6.		Lead particulate	10
7.		Mercury particulate	0.2
8.		Sulfur dioxide	kg/ton acid
	(a)	Sulfuric acid production (DCDA* process)	4
	(b)	Sulfuric acid production (SCSA* process)	10

(* DCDA: Double Conversion, Double Absorption;

SCSA: Single Conversion, Single Absorption.)

Lowest height of stack for dispersion of sulfuric acid (in meter).

(a)	Coal based power plant		
	(1)	500 Megawatt or above	275
	(2)	200 to 500 Megawatt	220
	(3)	Less than 200 Megawatt	$14(Q)^{0.3}$
(b)	Boiler		
	(1)	Steam per hour up to 15 tons	11
	(2)	Steam per hour more that 15 tons	$14(Q)^{0.3}$

[Q = Emission of Sulfur dioxide (kg/hour)].

1	2	3
9.	Oxides of Nitrogen	
(a)	Nitric acid production	3 kg/ton acid
(b)	Gas Fuel based Power Plant	50 ppm
	(1) 500 Megawatt or above	50 ppm
	(2) 200 to 500 Megawatt	40 ppm
	(3) Below 200 Megawatt	30 ppm
(c)	Metallurgical oven	200 ppm
10.	Kiln soot and dust	mg/Nm^3
(a)	Blast Furnace	500
(b)	Brick Kiln	1000
(c)	Coke oven	500
(d)	Lime Kiln	250

SCHEDULE – 12

Standards for Sector-wise Industrial Effluent or Emission
[See Rule 13]

(A) Fertilizer Plant

Nitrogenous fertilizer plant

Effluent (liquid waste)

Parameters	**Standard presence in a unit of mg/l**
As Nitrogen	50 (New) 100 (Old)
Total Kjieldahl Nitrogen	100 (Old) 250 (New)
pH	6.5 – 8
Chromium at discharge point of the chromate removal plant (as total Cr)	0.5
Hexavalent Chromium	0.1
Suspended Solids	100
Oil and Grease	10
Wastewater flow	$10m^3$/t Urea

Gaseous Emission

Source	**Parameters**	**Standard of presence in a unit of mg/Nm^3**
Urea Prilling Tower	Particulate	150 dry de dusting
		50 wet de dusting and new plant

Phosphatic

Effluent (liquid waste)

Parameters	Standard of presence in a unit of mg/l
Fluoride at the exhaust of Fluoride removal plant (as F)	10
Phosphate (as P)	5
Suspended Solids Chromium at the discharge point of	100
Chromate removal plant (as Cr)	
Total	0.5
Hexavalent Cr	0.1
Oil and Grease	10

Gaseous Emission

Source	Parameters	Standard of presence in a unit of mg/Nm^3
Granulation, Mixing and Grinding section	Particulate	150
Phosphoric acid preparation	Total Fluoride (as F)	25
Sulfuric acid plant	Sulfur dioxide	
	DCDA	4 kg/t of Sulfuric acid (100%)
	SCSA	10 kg/t of Sulfuric acid (100%)
	Sulfuric acid mist	50

(B) Composite textile plant and large processing unit (in which capital investment is more than thirty million Taka)

Effluent (liquid waste)

Parameters	Standard and presence in a unit of mg/l
pH	6.5 – 9
Suspended solids	100

BOD_5 20°C	150
Oil and Grease	10
Total dissolved solids	2100
Wastewater flow	100 per kg of fabric processed

Note: BOD limit of 150 mg/l implies only with physico chemical processing.

Special parameters based on classification of dyes used

Total Chromium, as Cr	2
Sulfide, as S	2
Phenolic compounds, as C_6H_5OH	5

(C) Pulp and Paper Industry

Gaseous Effluent

Parameter	Standard and presence in a unit of mg/l, except pH	
	Large plant with production capacity of above 50 tons per day.	Small plant with production capacity of less than 50 tons per day.
pH	6 – 9	6 – 9
Suspended Solids	100	100
BOD_5 20°C	30	50
COD	300	400
Wastewater flow	200 cubic meter per ton of paper	200 cubic meter per ton of paper produced of agricultural raw materials. 75 cubic meter per ton of paper produced of wastepaper.

(D) Cement Industry

Gaseous Emission

1. Basic units for manufacturing cement

Source	Parameters	Standards for presence in a unit of mg/Nm_3
All sections	Particulate	250

2. Clinker Grinding units

Source	Parameters	Standards for presence in a unit of mg/Nm_3
All sections	Particulate	
	Daily production capacity above 1000 ton	200
	Daily production capacity 200-1000 ton	300
	Daily production capacity up to 200 ton	400

(E) Boiler of Industrial unit

Gaseous Emission

Parameters	Standards for presence in a unit of mg/Nm_3
1. Soot and particulate (fuel based)	
(a) Coal	500
(b) Gas	100
(c) Oil	300
2. Oxides of Nitrogen (fuel based)	
(a) Coal	600
(b) Gas	150
(c) Oil	300

(F) Nitric Acid Plant

Gaseous Emission

Parameters	Standards for presence in a unit of mg/Nm_3
Oxide of Nitrogen	3 kg/ton of weak nitric acid produced

(G) Distillery

Effluent (liquid waste)

Parameters	Standards for presence in a unit of mg/l
pH	6 – 9
Suspended solids	150

BOD_5 20°C	5000 (standard for 2 years transitional period) 500 (standard for 74 years transitional period)
Oil and Grease	10

(H) Sugar Industry

Effluent (liquid waste)

Parameters	**Standard for presence in a unit of mg/l**
pH	6 – 9
Suspended solids	150
BOD_5 20°C	50
Oil and Grease	10
Wastewater per ton of sugarcane crushing (in Cubic meter)	0.5

Gaseous Emission

Boiler using baggasse		
Particulate, mg/Nm_3	Stepgrade	250
	Pulsating/ horse shoe	500
	Spreader Stocker	800

(I) Tannery Industry

Effluent (liquid waste)

Parameters	**Standard for presence in a unit of mg/l**
pH	6 – 9
Suspended solids	150
BOD_5 20°C	100
Sulfide (as S)	1
Total Chromium (as Cr)	2
Oil and Grease	10

Total dissolved solids	2100
Wastewater per ton of hide processing (in cubic meter)	30

Note: Soak liquor shall be separated from wastewater.

(J) Food Processing, Fish Canning, Dairy, Starch and Jute Industries

Effluent (liquid waste)

Parameters	**Maximum Limit of Values in mg/l**
Suspended solids	6 – 9
BOD_5 20°C	150
Wastewater flow	100
Starch	8 Cubic Meter per Ton of raw materials
Jute processing	1.5 Cubic Meter per Ton product
Dairy products	3 Cubic Meter per Ton of Milk

(K) Crude Oil Refinery

Gaseous Emission

Parameter	**Source**	**Standards for maximum presence**	**Unit**
Sulfur dioxide	Distillation	0.25	kg/ton
	Catalytic Cracker	2.5	kg/ton

Effluent (liquid waste)

Parameters	**Standards for maximum presence**	**Unit**
Suspended solids (SS)	100	mg/l
Oil and Grease	10	,,
BOD_5 20°C	30	,,
Phenol	1	,,
Sulfide (as S)	1	,,
Wastewater flow	700	Cubic Meter/1000 Ton of treated crude oil

Notes:

(1) All new industrial units from the beginning of their operation shall abide by these standards while discharging/emitting wastes. All existing industrial units shall install necessary treatment facilities within 2 years (if not otherwise directed) from the date of the notification of these rules. In special cases, the Department may extend the deadline on valid reasons.

(2) These standards shall apply irrespective of the discharge/emission points.

(3) These standards shall never be violated at the time of sample collection. These standards may be enforced in a more stringent manner, if considered necessary in view of the surrounding conditions of a particular situation.

Annex P: The Environmental Codes of Practice (ECoPs)

ECoP 1: Dredging Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Locations of dredging	Impact on habitats of sensitive species such dolphin and migratory birds, and fish habitats	The Contractor shall • Avoid sensitive areas identified in the ESIA. No dredging will be carried out within one hundred meters from these sensitive areas. • Obtain approval from Engineer/DSC (dredging supervision consultant) before starting dredging from any location
Preconstruction studies	Quality of river bed sediments are to be established to identify potential impacts associated with dredging and placement. Proposed dredging locations are to be studied for their ecological sensitivity.	The Contractor shall • Will evaluate the river bed materials for their physical, chemical, biological, and engineering properties prior to initiation of dredging activities, at least once per year at the start of the dry season, at locations and according to parameters approved in advance by the Engineer / DSC. Sediment quality studies for nutrients and pollutants are particularly important to monitor the impacts of dredging. • Carry out survey of the area prior to dredging, and design the navigation alignment in a manner that minimizes dredging needs • Identify any sensitive receptors/habitats (e.g., turtle nesting area, birds colony) at or near the proposed dredging locations. These results are presented in the contractor's monthly plans. • Determine 'no-go' areas for dredging, based upon the above survey, and design the design the navigation alignment to avoid these areas. • Where avoidance is not possible, propose detailed site-specific mitigation and management measures in accordance with the EMP as part of the monthly dredging plan, • Survey the area after dredging to

		identify any leftover impacts.
Dredging - Excavation	Increased turbidity, loss of transparency and increased suspended sediment concentrations. Impact on benthic habitats.	The Contractor shall • Select dredging equipment which are known to have a low risk of sediment dispersal. The suction action inside the Cutter Suction Dredger means that most of the sediment removed by the cutter is captured. As high dredging efficiency and low turbidity at the cutter head are closely linked, it is uncommon for turbidity generated by the cutter head to cause environmental concern. • Monitor the dredging operation and, if necessary, change the dredge location to minimise fines or modify operations, e.g. restrict the amount of material being dredged (or the number of dredgers allowed to operate) at any one time. • Maintain record of all sand or sediment extraction (quantities, location shown on map, timing, any sighting of key species)
Dredging: Lifting	The release of suspended sediments during lifting can cause mortality to fish. The re-suspension of sediments can also release toxic chemicals or nutrients such as phosphates and nitrates, which may increase the eutrophic status of the system. Release of anaerobic sediment and organic matter in high concentrations may in some cases deplete the dissolved oxygen.	The Contractor shall • Select dredging equipment (which are known to have a low risk of sediment releases from lifting. • Reduce the suspended material released into the water column by adjusting the ratio of cutter revolutions to pump velocity to ensure that the cutter advancement rate is not greater than the ability of the suction pump to remove the material that has been cut. • Monitor the lifting operations and if required use techniques (e.g. silt curtains) to minimize adverse impacts on aquatic life from the resuspension of sediments.
Dredging: Transportation	Leakages and spillage from the hydraulic pipeline	The Contractor shall • Regularly inspect and maintain equipment and pipelines in order to prevent leaks.

		• Develop and implement a spill prevention plan to prevent and contain accidental spills
Dredging: Placement	Dispersion of sediments and release of high sediment laden runoff from the placement sites.	The Contractor • Shall directly place the sediments for filling the proposed disposal areas. Prior to filling commencing, the areas being filled will be subdivided into compartments by construction of temporary containment bunds of suitable material (e.g. dredged sand). Filling will be achieved by progressively pumping a slurry of sand and water into the bunded areas, allowing the surplus water to drain away to artificial and natural waterways in a controlled manner through the pipeline, without affecting floodplains. • Control the discharge of site runoff, including excess dredge water, by the installation and correct use of containment walls, bunds and weirs. • Monitor the quality of water (e.g. sediment content) in site runoff to confirm that the design and operation of the bunds and weirs, and the retention time for dredge waters which facilitates the settlement out of fine sediments prior to discharge off site, is adequate. If required, additional siltation ponds are to be provided to divert the runoff water before discharging in to the river.
River Traffic	The presence of barges and associated vessels and discharge pipelines will pose a risk to local river traffic. There is also risk of collision of construction boats with dolphins.	The Contractor shall • Provide proper navigational lighting for the barges and associated vessels • Provide appropriate lighting to all floating pipelines and buoys • Check all navigational lights routinely to ensure that they are working properly. • Limit the motor boat speed to 15 km/h in accordance with best international practices and to avoid any collision with dolphins. . Pingers will be used to chase away dolphins form the construction

		areas thus minimizing the chances of any collision • • Provide advance notification to local communities and users of the river who may be at risk of collision with dredging equipment and vessels, including notification of measures to be undertaken to minimize risks.
Noise from dredging activities	Noise and vibration under water: Disruption to fish migration and disturbance to dolphins Noise and vibration above water: Nuisance to local community, disturbance to birds	The Contractor shall • Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. • Limit the noisy dredging to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife) or during night time hours. Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. This will encourage riverine and terrestrial fauna to move away from the source area prior to significant noise emissions • Inspect and maintain equipment in good working condition
Exhaust emissions	Air pollution and release of greenhouse gases from construction equipment	The Contractor shall • Inspect and maintain equipment in good working condition. Proper maintenance of engines ensures full combustion with low soot emissions. • Select and operate equipment and manage operations to reduce engine emissions. • Use low-Sulphur heavy fuels to reduce noxious emissions. • Provide Exhaust filtering.
Oil spills	Oil spills	The Contractor shall • Refuel of barges and boats with a proper care to avoid any spills. • Make available spill kits and other absorbent material at refueling points on the barges

		• • Immediately contain and remediate the impacts of any spills for which they hold responsibility
Bilge water	Waste water disposal from the barges and associated vessels	The Contractor shall • Properly collect, treat and dispose the bilge water from of barges, and boats. • Empty barge or hopper from rest load by washing or mechanical cleaning before moving between different dredging areas to prevent distribution of contaminated material through residual loads.

ECoP 2: Waste Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to supervision consultant for approval. • Organize disposal of all wastes generated during construction in the designated disposal sites approved by the Project. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • CPE • Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.
Hazardous Waste	Health hazards and environmental impacts due to improper waste management	The Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	practices	• Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills.

ECoP 3: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit the plan for supervision consultant approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on a top of a sealed plastic sheet away from watercourses. • Refueling shall occur only within bunded areas. • Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored; and ensure personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to materials in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store hazardous materials above flood level. • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		environmentally friendly materials. • Return the gas cylinders to the supplier. However, if they are not empty prior to their return, they must be labeled with the name of the material they contained or contain, information on the supplier, cylinder serial number, pressure, their last hydrostatic test date, and any additional identification marking that may be considered necessary.

ECoP 4: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste, and accidental spillage	The Contractor shall • Follow the management guidelines proposed in ECoPs 2 and 3. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems.
Discharge from construction sites	Construction activities, sewerages from construction sites and work camps may affect the surface water quality. The construction works will modify groundcover and topography changing the surface water drainage patterns of the area. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased	The Contractor shall • Install temporary drainage works (channels and bunds) in areas required for sediment and erosion control and around storage areas for construction materials. • Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site. • Divert runoff from undisturbed areas around the construction site. • Stockpile materials away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to a approved waste disposal site or recycling depot. • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This should be done in every exit of each construction vehicle to ensure the local roads are kept clean.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	flooding, and effect habitat of fish and other aquatic biology.	
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove sediment. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).
Construction activities in water bodies	Construction works in the water bodies will increase sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump directly off site. • Monitor the water quality in the runoff from the site or areas affected by dredge/excavation plumes, and improve work practices as necessary. • Protect water bodies from sediment loads by silt screen or bubble curtains or other barriers. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems. • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
Drinking water	Untreated surface water is not suitable for drinking purposes due to presence of suspended solids and ecoli.	The Contractor Shall • Provide the drinking water that meets NEQS standards.

ECoP 5: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing	The Contractor shall • Prepare a program for prevent/avoid standing waters, which supervision consultant will verify in advance and confirm during implementation.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	to the construction activities harms environment in terms of water and soil contamination, and mosquito growth.	• Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line. • Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there. • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to NEQS, before it being discharged into the recipient water bodies. • Ensure that there will be no water stagnation at the construction sites and camps. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion. • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem.
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps. • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position.

ECoP 6: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECoP2 and storage of materials in ECoP3. • Construct appropriate spill contaminant facilities for all fuel storage areas. • Establish and maintain a hazardous materials register detailing the location and quantities of hazardous substances including the storage, use of disposals. • Train personnel and implement safe work practices for minimizing the risk of spillage. • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the source or implementing controls around the affected site. • Remediate the contaminated land using the most appropriate available method.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds.

ECoP 7: Erosion and Sediment Control

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, which affects the growth of vegetation and causes ecological imbalance.	The Contractor shall • Reinstate and protect cleared areas as soon as possible. • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turfings/tree plantations.
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream, and (ii) destruction of aquatic environment by erosion and/or deposition of sediment damaging the spawning grounds of fish	The Contractor shall • Locate stockpiles away from drainage lines. • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds. • Remove debris from drainage paths and sediment control structures. • Cover the loose sediments of construction material and water them if required. • Divert natural runoff around construction areas prior to any site disturbance. • Install protective measures on site prior to construction, for example, sediment traps. • Install ‘cut off drains’ on large cut/fill batter slopes to control water runoff speed and hence erosion. • Observe the performance of drainage structures and erosion controls during rain and modify as required.

ECoP 8: Top Soil Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	for plant growth or agricultural development.	• The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites. • Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside ROW or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone. • Plan construction access to make use, if possible, of the final road alignment.

ECoP 9: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as will change the local landscape.	The Contractor shall • Ensure the topography of the final surface of all raised lands (on-land dredged material disposal sites, construction yards, approach roads and rails, access roads, etc.) are conducive to enhance natural draining of rainwater/flood water. • Keep the final or finished surface of all the raised lands free from any kind of depression that causes water logging. • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of topography. • Cover immediately the uncovered open surface that has no use of construction activities with grass-cover and tree plantation to prevent soil erosion and bring improved landscaping. • Reinstate the natural landscape of the ancillary construction sites after completion of works.

ECoP 10: Borrow Areas MANAGEMENT

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Development and operation of borrow areas	Borrow areas will have impacts on local topography, landscaping and natural drainage.	The Contractor shall • Use only approved quarry and borrow sites • Identify new borrow and quarry areas in consultation with WAPDA, if required. • Reuse excavated or disposed material available in the project to the maximum extent possible. • Store top soil for reinstatement and landscaping. • Develop surface water collection and drainage systems, anti-erosion measures (berms, revegetation etc.) and retaining walls and gabions where required. • Control dust by application of watering. • Noise control, installation of mufflers on equipment, daytime works.

ECoP 11: Air Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner. • Cover haul vehicles carrying dusty materials moving outside the construction site. • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions. • Control the movement of construction traffic. • Water construction materials prior to loading and transport. • Service all vehicles regularly to minimize emissions. • Limit the idling time of vehicles not more than 2 minutes.
Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors. • Focus special attention on containing the emissions from generators. • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites. • Service all equipment regularly to minimize emissions.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations.
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard.	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted. • Minimize the extent and period of exposure of the bare surfaces. • Restore disturbed areas as soon as practicable by vegetation/grass-turfing. • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations. • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems.

ECoP 12: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures. • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site.
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately site all noise generating activities to avoid noise pollution to local residents. • Use the quietest available plant and equipment. • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Avoid the unnecessary use of alarms, horns and sirens.
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours. • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions. • Employ best available work practices on-site to minimize occupational noise levels. • Install temporary noise control barriers where appropriate. • Notify affected people if major noisy activities will be undertaken, e.g. blasting. • Plan activities on site and deliveries to and from site to minimize impact. • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas.

ECoP 13: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very friendly to human-living. As such damage to flora has wide range of adverse environmental impacts.	The Contractor shall • Minimize disturbance to surrounding vegetation. • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetations. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the engineering plans and designs. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill a, etc. • Not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas,

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		temporary access tracks or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work camps to prevent fuel wood collection.

EoCP 14: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality,	The Contractor shall • Limit the construction works within the designated sites allocated to the contractors. • Check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal.
	Impact on migratory birds, its habitat and its active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of migratory birds. • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and locate active nests. • If bird nests are located/ detected within the ledges and roadside embankments then those areas should be avoided. • Petroleum products should not come in contact with the natural and sensitive ecosystems. Contractor must minimize the release of oil, oil wastes or any other substances harmful to migratory birds' habitats, to any waters, wetlands or any areas frequented by migratory birds.
Vegetation clearance	Clearance of vegetation may	The Contractor shall • Restrict the tree removal to the minimum numbers required.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	• Relocate hollows, where appropriate. • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Night time lighting	Lighting from construction sites and construction camps may affect the visibility of night time migratory birds that use the moon and stars for navigation during their migrations	The Contractor shall • Use lower wattage flat lens fixtures that direct light down and reduce glare, thus reducing light pollution, • Avoid flood lights unless they are absolutely required. • Use motion sensitive lighting to minimize unneeded lighting. • Use, if possible, green lights that are considered as bird's friendly lighting instead of white or red colored lights.
Construction camps	Illegal poaching	The Contractor shall • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching. • Ensure that staff and Subcontractors are trained and empowered to identify, address and report potential environmental problems.

ECoP 15: Protection of Fisheries

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The main potential impacts to fisheries are hydrocarbon spills and leaks from riverine transport and disposal of wastes into the river	The Contractor shall • Ensure the construction equipment used in the river are well maintained and do not have oil leakage to contaminate river water. • Contain oil immediately on river in case of accidental spillage from equipment; make an emergency oil spill containment plan to be supported with enough equipments, materials and human resources. • Do not dump wastes, be it hazardous or non-hazardous into the nearby water bodies or in the river.
Construction activities on the land	The main potential impacts to aquatic flora and fauna River are increased	The Contractor shall • Follow mitigation measures proposed in ECoP 4 : Water Resources Management and ECoP 5: Drainage Management.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	

ECoP 16: Road Transport and Road Traffic Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Strictly follow the Project's 'Traffic Management Plan' and work with close coordination with the Traffic Management Unit. • Prepare and submit additional traffic plan, if any of his traffic routes are not covered in the Project's Traffic Management Plan, and requires traffic diversion and management. • Include in the traffic plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges temporary diversions, necessary barricades, warning signs / lights, road signs etc. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the Pakistan Traffic Regulations.
	Accidents and spillage of fuels and chemicals	The Contractor shall • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit.

ECoP 17: RIVER TRANSPORT Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The presence of construction and dredging barges, pipe lines and other construction activities in the river can cause	The Contractor shall • Not obstruct other normal riverine transport while doing riverine transport and works • Identify the channel to be followed clearly using navigation aids such as buoys, beacons, and lighting

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	hindrance and risks to the river traffic.	• Provide proper buoyage, navigation lights and markings for bridge and dredging works to guide the other normal riverine transport • Keep regular and close contacts with Bangladesh Inland Water Transport Authority (BIWTA) regarding their needs during construction of the project • Plan the river transport and transportation of large loads in coordination with BIWTA to avoid traffic congestions. • Provide signage for river traffic conforming to the BIWTA requirements • Position the dredge and pipeline in such a way that no disruption to the channel traffic will occur
	Accidents	The Contractor shall • Prepare an emergency plan for dealing with accidents causing accidental sinking of the vessels and ships • Ensure sufficient equipment and staffs available to execute the emergency plans • Provide appropriate lighting to barges and construction vessels.

ECoP 18: Labor Camp Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Siting and Location of construction camps	Campsites for workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Locate the labor camps within the designed sites or at areas which are acceptable from environmental, cultural or social point of view; and approved by the supervision consultant. • Consider the location of labor camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the supervision consultant for approval a detailed layout plan for the development of the camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters.
Labor Camp Facilities	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers. • Safe and reliable water supply, which should meet NEQS. • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by wall or by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes. • Storm water drainage facilities. • Paved internal roads. • Provide child crèches for women working construction site. The crèche should have facilities for dormitory, kitchen, indoor and outdoor play area. Schools should be attached to these crèches so that children are not deprived of education whose mothers are construction workers. • Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the camps. • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipments/vehicles needed. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will	The Contractor shall • Provide fuel to the camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
	impact the natural flora and fauna	on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections and HIV/AIDS.	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas. • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis. • Complement educational interventions with easy access to condoms at campsites as well as voluntary counseling and testing. • Develop and disseminate code of conduct for all workers, outlining expectations for worker behaviors whenever at the worksite or at the camp. This includes for example, expectations of workers to act in accordance with applicable laws with respect to alcohol and substance use, prostitution, crime and violence, etc. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellent sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices.
Safety	In adequate safety facilities to the construction camps may create security problems	The Contractor shall • Provide appropriate security personnel (police or private security guards) and enclosures to prevent unauthorized entry in to the camp area and all other work sites and facilities. • Maintain register to keep a track on a head count of persons

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	and fire hazards	present in the camp at any given time. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of fire fighting equipments suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. • Give prior notice to the laborers before demolishing their camps/units. • Maintain the noise levels within the national standards during demolition activities. • Different contractors should be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.

ECOP 19: Cultural and Religious Issues

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, and contractors lack of knowledge on cultural issues cause social	The Contractor shall • Communicate to the public through community consultation regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction. • Do not block access to cultural and religious sites, wherever possible. • Restrict all construction activities within the foot prints of the construction sites.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	disturbances.	• Stop construction works that produce noise (particularly during prayer time) should there be any mosque/religious/educational institutions close to the construction sites and users make objections. • Develop and disseminate code of conduct for all workers, outlining expectations for worker behaviors whenever at the worksite or at the camp. This includes for example, expectations of workers to act in accordance with applicable laws with respect to alcohol and substance use, prostitution, crime and violence, etc. o Stop work immediately and notify the site manager if, during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until approval to continue is given. o Delineate the discovered site or area; o Secure the site to prevent any damage or loss of removable objects, as per instruction of the responsible local authorities and the relevant Ministry. o It is an offence to recommence work in the vicinity of the site until approval to continue is given. Responsible local authorities and the relevant Ministry will instruct on how to handle the finding. This could include changes in the dredging alignment or layout of construction works (such as when finding an irremovable remain of cultural or archeological importance), conservation, restoration and salvage. o Construction work may resume only after permission is given from the responsible local authorities and the relevant Ministry concerning safeguard of the heritage. • Provide separate prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people. • Allow the workers to participate in praying during construction time. • Resolve cultural issues in consultation with local leaders and supervision consultants. • Establish a mechanism that allows local people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		health, social and security matters.

ECOP 20: Worker Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g. noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases etc), (ii) risk factors resulting from human behavior (e.g. STD, HIV etc) and (iii) road accidents from construction traffic.	The Contractor shall • Implement suitable safety standards for all workers and site visitors which should not be less than those laid down on the international standards (e.g. International Labor Office guideline on 'Safety and Health in Construction; World Bank Group's 'Environmental Health and Safety Guidelines') and contractor's own national standards or statutory regulations, in addition to complying with Pakistan standards. • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas. • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Safety procedures include provision of information, training and protective clothing to workers involved in hazardous operations and proper performance of their job. • Appoint an environment, health and safety manager to look after the health and safety of the workers. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters.
	Child and pregnant labor	The Contractor shall • Not hire children of less than 14 years of age and pregnant women or women who delivered a child within 8 preceding weeks.
Accidents	Lack of first aid facilities and health	The Contractor shall

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
	care facilities in the immediate vicinity will aggravate the health conditions of the victims	• Ensure health care facilities and first aid facilities are readily available. Appropriately equipped first-aid stations should be easily accessible throughout the place of work. • Document and report occupational accidents, diseases, and incidents. • 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, in a manner consistent with good international industry practice. • Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules. • Provide adequate lighting in the construction area and along the roads.
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECoP 18 Construction Camp Management • Adequate ventilation facilities • Safe and reliable water supply. • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECoP 3 • Solid waste collection and disposal system in accordance with ECoP2. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height. • Sick bay and first aid facilities
Water and sanitation facilities at the construction sites	Lack of Water sanitation facilities at construction sites cause inconvenience to the construction workers and affect their personal hygiene.	The contractor shall • Provide portable toilets at the construction sites, if about 25 people are working the whole day for a month. Location of portable facilities should be at least 6 m away from storm drain system and surface waters. These portable toilets should be cleaned once a day and all the sewerage should be pumped from the collection tank once a day and should be brought to the common septic tank for further treatment. • Provide bottled drinking water facilities to the construction

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		workers at all the construction sites.
Other ECoPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECoPs to reduce health risks to the construction workers and nearby community • ECoP 3: Fuels and Hazardous Goods Management • ECoP 5: Drainage Management • ECoP 11: Air Quality Management • ECoP 12: Noise and Vibration Management • ECoP 16: Road Transport and Road Traffic Management
Trainings	Lack of awareness and basic knowledge in health care among the construction workforce, make them susceptible to potential diseases.	The Contractor shall • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria and transmission of sexually transmitted infections (STI) HIV/AIDS. • Train all construction workers in general health and safety matters, and on the specific hazards of their work. Training should consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. • Complement HIV/AIDS and STI education campaign with a strong condom marketing, increased access to condoms in the area as well as to voluntary counseling and testing. • Implement malaria, HIV/AIDS and STI education campaign targeting all workers hired, international and national, female and male, skilled, semi- and unskilled occupations, at the time of recruitment and thereafter pursued throughout the construction phase on ongoing and regular basis. This should be complemented by easy access to condoms at the workplace as well as to voluntary counseling and testing.