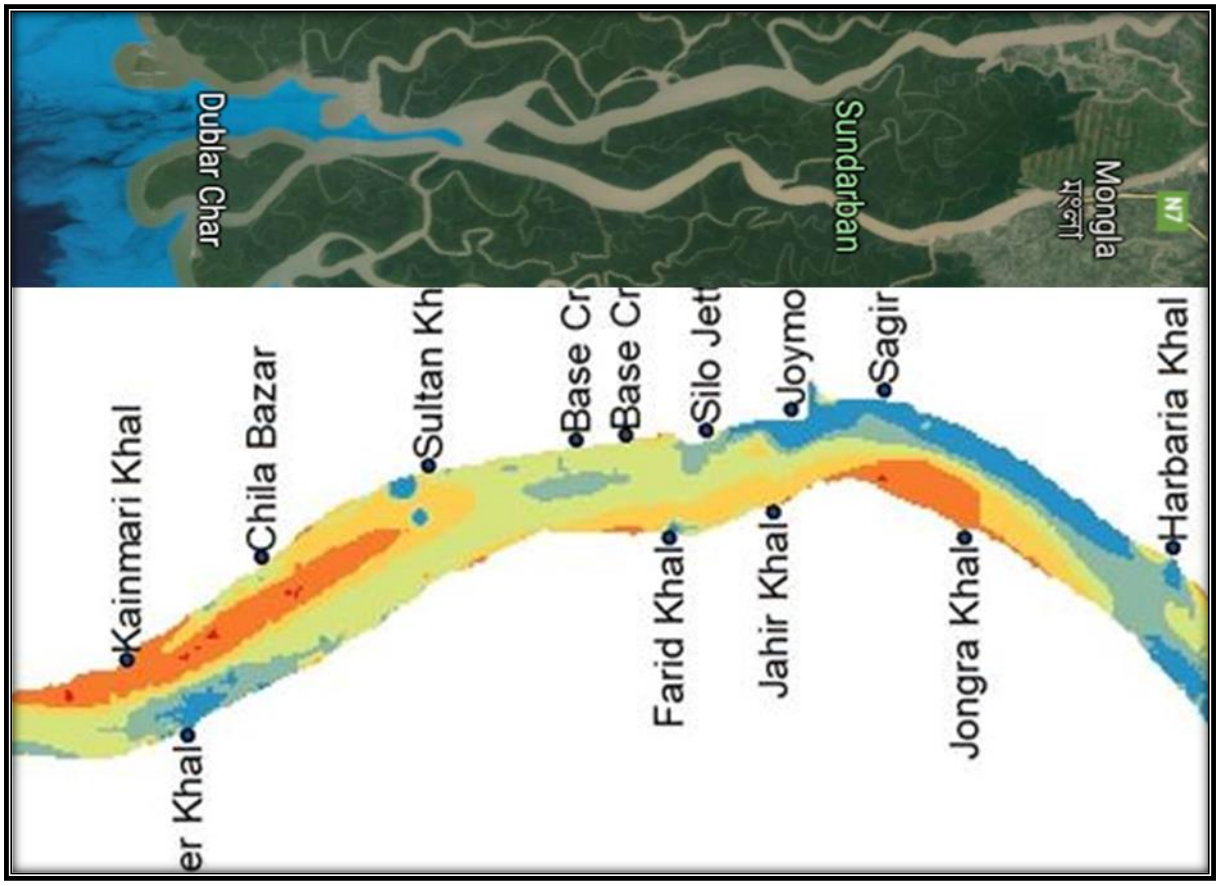
**Mongla Port Authority, Mongla, Bagerhat**
Ministry of Shipping
Government of People's Republic of Bangladesh




# Environmental Impact Assessment

## for

## Dredging at the Inner Bar of Mongla Port Channel

**February 2020**

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# Executive Summary

## Environmental Impact Assessment (EIA)

The proposed dredging project is located in the southwestern region of Bangladesh which is a part of alluvial delta formed by major rivers originating from the Himalayas. The project location is seismically lower active zone. The noteworthy aspects of the environment include rural setting, fish/shrimp farms, flat topography with some low lying area, tidal flushing, salinity dominant in both surface and ground water. The study area is also ecologically very important due to the world famous the Sundarbans mangrove Forest. A detail features of the Sundarbans ecosystem have been elaborated under the base line study. The Passur river is the only approach river of Mongla port. Water depth varies at different reach of the river. The reduction in dry flows in the Ganges distributaries to the southwest region is the most serious threat to this region. It shows a continuous process of siltation progressing generally from the northwest toward the southeast. The south-western coastal zone is in a state of transition from an active developing delta to a semi-moribund delta. In the last few years, the number of ships at Mongla Port has been increased tremendously. Due to huge congestion at the Chittagong Port, most of the ships are diverting to the Mongla Port. After completion of the Padma Bridge, Khulna-Mongla Rail Line, Rampal Power Plant and Khan Jahan Ali Airport, more loads are expected to come to this port. Considering the aforementioned issues, Mongla Port is planning to handle 10 m draft ship at Jetty and for this purpose, the navigation channel should be dredged up to 8.5 mCD and Jetty front is to be dredged up to 10.5 m CD. Based on recent bathymetric data of Passur Channel, it is evident that dredging is required for only 23.4 km from Mongla Port Jetty to Harbaria Khal.

The Environmental Impact Assessment (EIA) reveals that the majority of adverse impacts of the proposed dredging activities are on physical, ecological and social environment. However, these impacts are considered of low to medium significance and can be mitigated.

## Important Environmental Impacts

### *Impact on the Outstanding Universal Value (OUV) of the Sundarbans*

Outstanding Universal Value is one of the central ideas underpinning the World Heritage Convention (Department of the Environment and Energy, 2019). In 1997, the Sundarbans

was recognized as UNESCO World Heritage Site considering two (two) i.e. criterion (ix) and criterion (x).

- The potential impact of dredging is localized at the dredging and disposal locations. The project activities will have insignificant impact on on-going ecological and biological processes of the Sundarbans (Criterion ix, UNESCO World Heritage Site) since sediment plume won't have dispersed into the Sundarbans and won't increase the turbidity. In addition, the proposed dredging does not affect the Sundarbans' exceptional level of biodiversity in both the terrestrial and marine environment.
- The proposed dredging stretches will experience temporary loss of benthic environment though area of the dredging stretches is very small compared to the Passur Estuary and outer bar area. The dredging activity would have limited effects on habitats required to maintain the diversity of fauna and flora in the Sundarbans World Haritage Site (WHS, Criterion x) since chance of change of physical environment is very insignificant such as change of turbidity and other water quality parameter. In relation to retaining the integrity of the WHS (the Sundarbans), the proposed dredging Project does not cause loss to any whole OUV element (Wholeness Criterion), there will be no reduction in the size of the WHS property.

***Impact during Dredging Operation in Passur Channel***

The proposed dredging of the Passur Channel is located at the river stretch, which has been experiencing river bed scouring and formation of bars naturally over the years. The dredging will be done along the river flow, and turbidity of water is very likely to increase along the river not transversely. In addition, during full moon and new moon time, dredging work will remain suspended since high current due to higher tidal range is likely to disperse sediment plume to the Sundarbans. The dredging will be carried out following the natural thalweg and flow of the river only to increase navigability at the shallower stretch. Simulations of the hydrodynamic conditions reveal that dredging in the river does not increase current speed in the river and there is no change in current speed along the riverbanks due to dredging. However, current speed is slightly decreased along the dredged channel and the adjacent area. No significant change of current speed is evident near the banks of Passur river due to dredging operation along the proposed locations. This implies that the dredging in the proposed locations will not cause any significant erosion of the banks. The minor decrease in

mean current speed is very likely to cause re-siltation on the riverbed at the dredging locations. Re-siltation on riverbeds will decrease suspended sediment concentration of river water. The change of depth of channel will occur at the specific locations but at neither upstream or downstream nor left or right bank of the river.

***Impact of Dredged materials Disposal***

The dredged materials disposal plan includes disposing of dredged material on naturally accreting zone, eroding bank to reduce erosion of mangroves. Mangroves are very likely to grow on the reclaimed land and contribute in enhancement of the coastal ecology as it is recommended to keep low laying area at disposal location with specified distance, which will have served as pool of freshwater reservoirs (e.g. recharged from the monsoon rain) as discussed in the recommendation section of this EIA report. Placement of dredged materials causes the dispersion of sediments and release of high sediment laden runoff from the disposal sites. Thus, the filling process should be commenced from low water depth at the selected locations in disposal site and there should be a delta building process with geo-tubes filled by sand. Environment friendly silt curtain and/or other site specific measures would be used to prevent dispersion of sediment plume. **None of the disposal locations is within the WHS of the Sundarbans and there is no scope of loss of the mangrove forest due to dredging and dredged materials disposal locations.** Rather, there is a huge potential of growth of mangroves on the land reclaimed by the disposal of the dredged materials.

***Impact of Noise during Dredging***

Noise during dredging operation would cause disturbance to the neighboring terrestrial animals and birds and disruption to migration of fish and dolphins. In this context, efficient dredging equipment should be selected to reduce the noise both above and under water during dredging operation (e.g. isolation of exhaust systems, by keeping close the door of the engine room). The dredging work should be carried out during daytime, where possible, rather than at sunrise or sunset (e.g. significant disturbance to wildlife) or during night time. Otherwise, the dredger should be ramp up slowly at the starting time to the levels of engines so that minimum disturbance would happen to the marine and terrestrial fauna for them to move away from the dredging area for significant noise emissions.

***Remarks on Overall Environmental Impacts***

The potential benefits of the project will compensate the negative impact if the prescribed Environmental Management Plan (EMP) were implemented. The proposed project will create enormous potentiality of economic and social development of the region. The negative impact of the project on Physical, Water resources, Forest, Land and soil, Fisheries, Ecology and Socio-economic environment was found minor and can be mitigated/compensated by adoption of different environmental and pollution abatement measures.

**Social Impact Assessment**

In order to pursue the social impact assessments (SIA) of the dredging project, focus group discussion (FGD) and public consultation (PC) methods were used. The outcomes of the SIA study of the project are as follows:

**Property Loss**

The consultant, after conducting site visit, found that there is no private residential or make shift structures which are likely to be affected due to the activities of the project. Therefore, there is no possibility of property loss.

**Income Loss**

There is no likelihood of loss of income arising from the implementation of the proposed project. Rather, additional facilities provided at the port will increase employment opportunities and perhaps higher income with higher productivity.

**Economic Development**

The proposed project will provide a vital work to progress the overall business framework in southern part of Bangladesh. This project will support development of the overall Mongla Port area due to increased level of Export/Import activities.

**Dredged materials Disposal Site**

The proposed disposal sites for the dredged materials along the river side (from Chilla bazar to Joymonir gol) are now used as fish farming (gher). The people involved with this fish farming will be compensated by the MPA. Therefore, implementation of the proposed

project would have no direct adverse impact. On the other hand, there are significant positive impacts due to development of the port facilities as well as increase of employment opportunities in various tiers in port activities. Therefore, it can be concluded that the proposed project is socially feasible.

**Conclusions**

Based on the detailed environmental impact assessment (EIA), it was found that the proposed dredging project will generate overall positive impacts on the socioeconomic conditions of the entire Khulna region. However, minor adverse impacts would occur on the existing environment, which could be mitigated through the proposed environmental management plan. Therefore, it can be concluded that the proposed project is socially viable and environmentally feasible.

# Table of Contents

## List of Tables

## List of Figures

# Chapter 1
# INTRODUCTION

## 1.1 General

This Environmental Impact Assessment (EIA) report has been prepared in connection with the proposed Feasibility Study for Dredging in Passur Channel of Mongla Port project. Mongla Port Authority (MPA) has engaged the Consultancy Research and Testing Services (CRTS), Department of Civil Engineering, Khulna University of Engineering & Technology (KUET) through a formal contract agreement signed on 3rd March, 2018. The EIA study team comprising of multi-disciplinary specialists conducted several field visits at the proposed site and carried out detailed field and laboratory investigations as well as required survey on stakeholders to prepare the present report. This EIA report has been prepared complying with the requirements of Department of Environment (DoE) under the Ministry of Environment and Forest (MoEF).

## 1.2 Background

Sea ports are important gateways for effective trading between countries. Currently, there is a huge gap between available capacities of Ports and the demand for services in Bangladesh. Mongla Port, once economic nerve-center in the south-western region of Bangladesh after the Chittagong port, is now in a dire situation with its years-old infrastructure due to insufficient docking, storage and delivery capacity, and lack of appropriate modernization. Mongla Port, approximately 71 nautical miles upstream of the Bay of Bengal, is located at the confluence of Passur River and Mongla Nulla (Figure 1.1). The port is well protected by the largest mangrove forest the Sundarbans. The port has been serving as an important economic hub for the greater Khulna and Jessore districts of Bangladesh from decades ago.

Bangladesh is targeting an industrial growth rate of over 7% per year, and there has been an increased emphasis on the expansion and growth of infrastructure sectors to meet the SDG (Sustainable Development Goal) of Govt. by 2030. The prospects of rapid growth in infrastructure sectors is driven by two factors – (1) sustainable economic growth is contingent upon the support of strong infrastructure development and (2) the Government's thrust on private sector participation in development of these sectors. Since ports are the trade gateways for a state, their ability to meet the

increasing demands of a rapidly growing economy is crucial for addressing the rising import and export traffic.

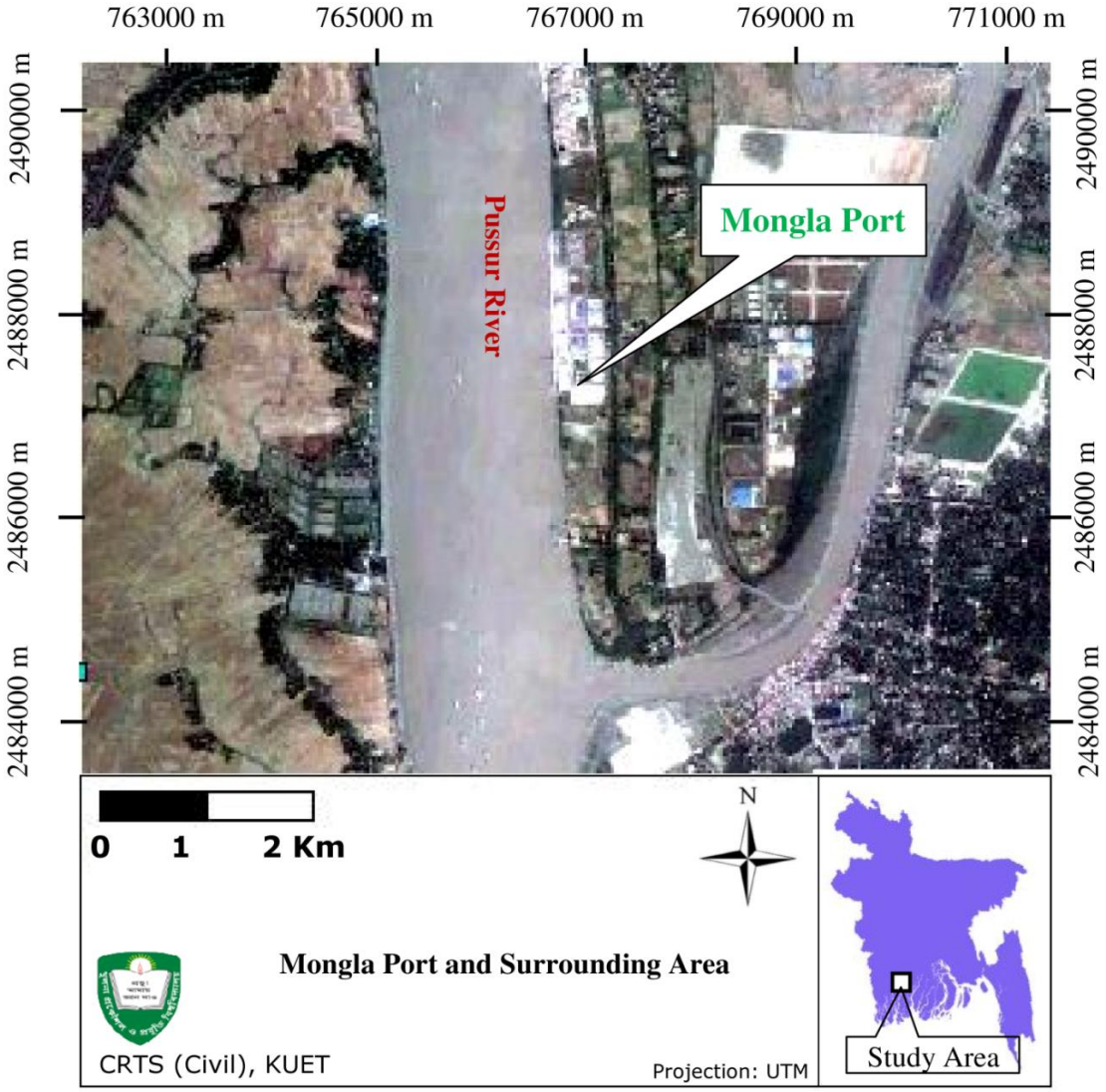



Figure 1.1: Location of Mongla Port and surrounding area

In the year 2009-2010, the port handled 1.46 million ton of goods and 19,203 TEUs of containers. The handling of container increased more than two times in the year 2014 (43, 007 TEUs) compared with the year 2010. The Port provides facilities and services to the international shipping lines and other concerned agencies with shore based facilities like jetties, storage and stack yards, and cargo handling equipment. In Bangladesh, most of the industries are located in and around three major cities of Dhaka, Chittagong and Khulna. The business community in Dhaka and its surrounding areas are less interested to import and export their cargos through Mongla Port because of the present inadequate transportation system that does not guarantee the movement of the cargos in possible

quickest and shortest time. The present Government has given high emphasis for the development of Mongla Port by improving the infrastructures and surrounding road networks. As a courageous endeavor, the construction of Padma Bridge at Mawa point has already been started, which, once completed, will reduce the travel time and distance between Mongla and Dhaka from existing 273 km to 170 Km. Whereas, the distance between Dhaka and Chittagong port is about 260 km. So, the business community of Dhaka and its surroundings will be more interested to use Mongla Port for importing and exporting services of their cargos/ships.

Cargo handling congestion in Chittagong Port will be decreased if the cargo handling capacity of Mongla Port is utilized in full scale. At present, Jute and Jute goods, Frozen cargo and other general cargoes are generally exported from the Mongla port. After commissioning the Padma Bridge at Mawa point, there will create a bright prospect in exporting garments, tea and lather, etc. through Mongla Port. Moreover, import of heavy machinery & equipments, fertilizer, food grain, sugar, motor vehicles, raw materials for industrial operations will be increased significantly through Mongla Port as compared to the present scenario. Consequently, establishment of different industries, scope of enormous employments, expansion of trade and business in the south-western part of the country and overall activities of Mongla Port will be increased rapidly.

Mongla Port is providing services to international shipping lines and other concerned agencies. For the development of shore based facilities and enhancement of container handling capacity, the Mongla Port authority is willing to do the Feasibility Study for Dredging in Passur Channel of Mongla Port. This study has been undertaken to carry out the Environmental Impact Assessment (EIA) in connection with the proposed Feasibility Study for Dredging in Passur Channel of Mongla Port project.

Mongla Port, the second seaport of Bangladesh is located about 131 km upstream from the Bay of Bengal, in the south-western part of the country. The port is situated at the left bank of the Passur River. The navigability of Mongla Port is vital to the economy of the country. Further development of deep draft navigation facilities and application of the state of the art technology for their continuing maintenance are essential for future prosperity. The reduction in dry flows in the Ganges distributaries to the southwest region is the most serious threat to the region. It shows a continuous process of siltation progressing generally from the northwest (NW) toward the southeast (SE). The south-western coastal zone is in a state of transition from an active developing delta to a semi-moribund delta. Saline intrusion has been increased due to tidal penetration and reduction in freshwater flows.

In the last few years, the number of ships at Mongla Port has been increased tremendously. Due to huge congestion at the Chittagong Port, a portion of the ships are diverting to the Mongla Port. After completion of the Padma Bridge, Khulna-Mongla Rail Line, Rampal Power Plant and Khan Jahan Ali Airport, more loads are expected to come to this port. Considering the aforementioned issues, Mongla Port is planning to handle 10 m draft ship at Jetty and for this purpose, the channel should be dredged up to 8.5 mCD and Jetty front is to be dredged up to 10.5 m CD. Figure 1.2 represents the proposed dredging area in Passur Channel (Mongla Port to Harbaria).

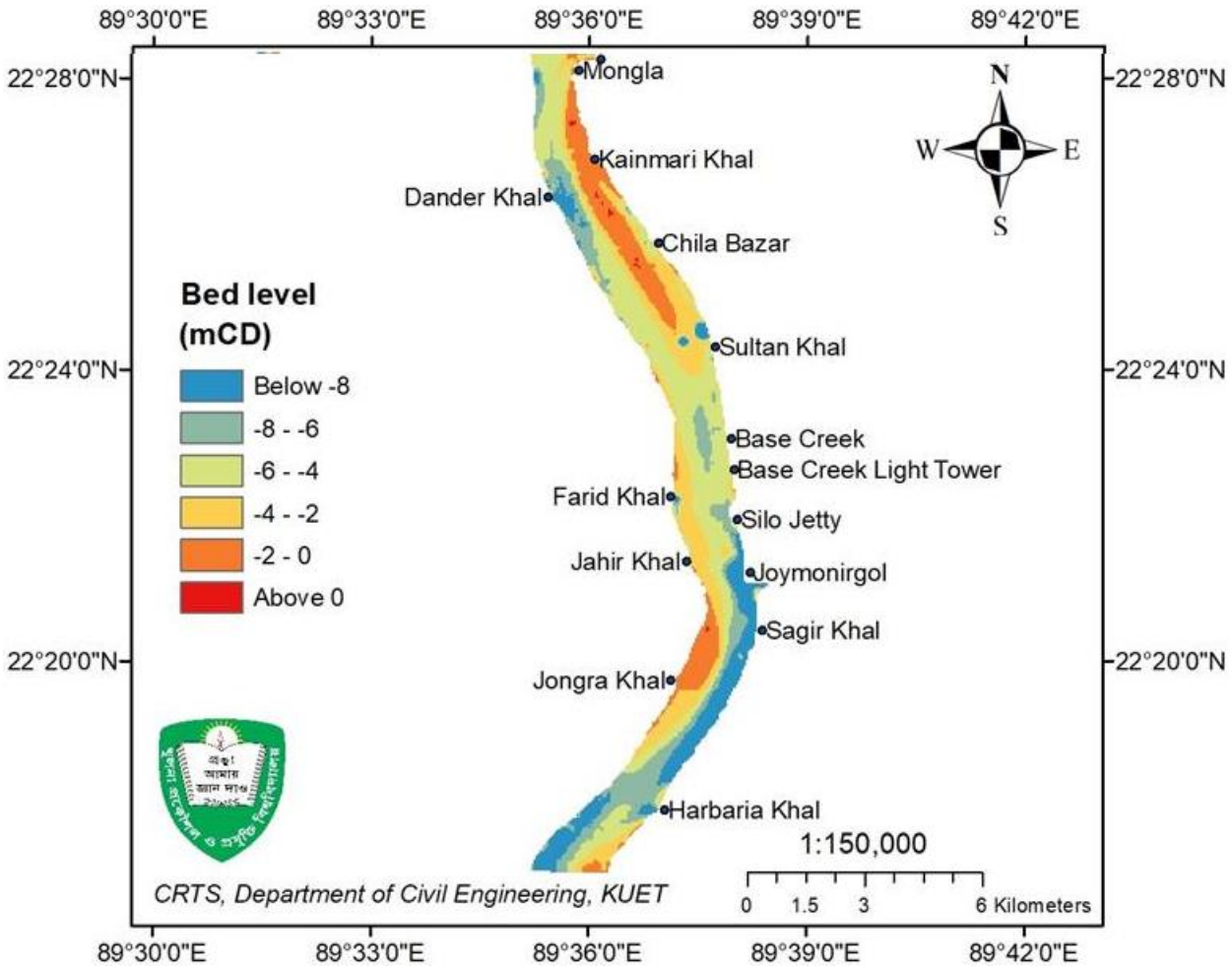



Figure 1.2: Proposed Dredging area in Passur Channel (Mongla Port to Harbaria)

## 1.3 Objectives of the EIA

The overall objective of this study is to conduct Environmental Impact Assessment (EIA) of the proposed Feasibility Study for Dredging in Passur Channel of Mongla Port project infrastructure with the purpose of implementation of activities in an environmentally sound and sustainable manner

ensuing that all negative effects are mitigated as best as practical and positive impacts are enhanced and finally obtaining the Environmental Clearance Certificate from the DoE. The specific objectives of this study are outlined as below:

- Identification of national and international legal environmental requirements
- Establishment of environmental and socio-economic baseline condition of the study area
- Prediction and evaluation of potential environmental and socio-economic impacts
- Identification of mitigation and abatement measures
- Development of Environmental Management Plan (EMP)

## 1.4 Scope of the EIA Study

The scope of the study includes identification of statutory requirements, prediction of potential environmental and socio-economic impacts and formulation of EMP. Detailed scope of this study are:

- Conduct field visit, reconnaissance survey and consultation with stakeholders;
- Assessment of Baseline Environmental Conditions (Human Settlement, Noise, Air Pollutants and Greenhouse Gases, Water Resources, Land use Pattern, Terrestrial and Marine Ecology, etc.);
- Socio-economic condition through focus group discussion (FGD), and questionnaire survey (QS) for the establishment of social baseline conditions;
- Identification of important environmental and social components (IESCs) likely to be impacted by the proposed development activities;
- Assessment of environmental and social impacts of the proposed interventions of port development following GoB guidelines;
- Preparation of environmental management plan (EMP) and social management plan (SMP) which include mitigation measures, enhancement measures, compensation measures, contingency measures and an environmental monitoring plan.

## 1.5 Methodology of EIA Study

The EIA of the proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project has been conducted following the identification of key impacts on natural and social environment and evaluation of the significant impacts along with recommendation of initiative measures as well as listing of unresolved environmental issues. The EIA includes collection of

baseline information, setting of boundaries, impact assessment, and suggestion of mitigation measures and providing an environmental management plan. Flow diagram of the process followed in the Environmental Impact Assessment (EIA) of the project is presented in Figure 1..

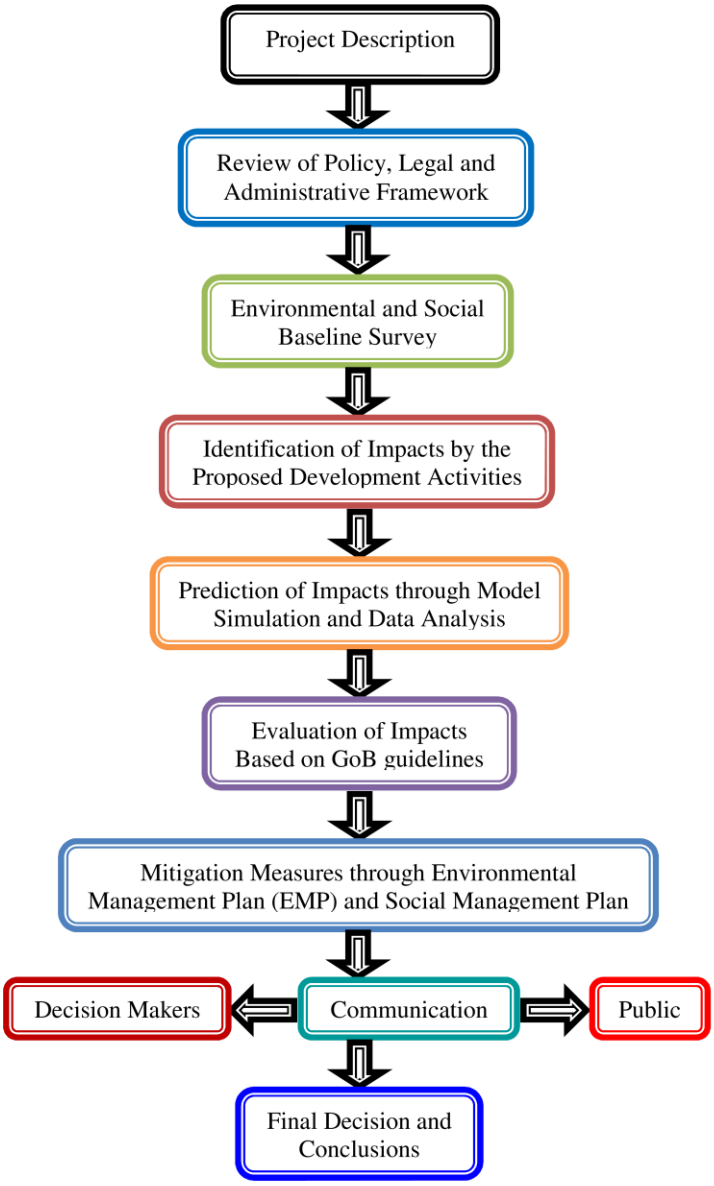



Figure 1.3: Flow Diagram of EIA Study

## 1.6 Environmental Classification of Project

Although the Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project project is not listed in any categories of Environmental Conservation Rules (ECR, 1997) of Department of Environment, this Project is classified as red category project in accordance with the requirements of the Department of Environment (DoE), Ministry of Environment and Forests,

Government of Bangladesh and requires a full EIA. The 69 types of projects listed as red category in the ECR (1997) includes engineering works where the capital investment is more than 1 million Taka. The Project investment is more than 1 million taka, and hence is a red category Project.

## 1.7 Limitations

This EIA is prepared based on past experience on similar types of activities as well as field investigations and public consultations carried out in connection with the project. However, attempts were made to identify most of the potential impacts both positive and negative due to the proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project and its O & M within the limited time periods.

## 1.8 EIA Team

The study team has been formed having their areas of expertise in the related field. The positions are assigned to each team members accordingly in order to accomplish the work smoothly and timely. The team composition is shown in Table 1.1.

Table 1.1: Name and Position of the EIA Study Team Members

| Sl. No. | Name of Study Team Members | Position |
|---|---|---|
| 1 | Prof. Dr. Dr. Quazi Hamidul Bari | Team Leader |
| 2 | Prof. Dr. Md. Shahjahan Ali | Coastal Morphologist |
| 3 | Prof. Dr. Md. Saiful Islam | Water Quality Specialist |
| 4 | Prof. Dr. Kh. Mahbub Hassan | Environmental Impact Assessment (EIA) Specialist |
| 5 | Prof. Dr. S. M. Moniruzzaman | Social Impact Specialist |
| 6 | Dr. Md. Khalekuzzaman | Data Analyst |

## 1.9 Organization of the Report

This EIA report describes the overall approach being followed in this study. The report contains eleven chapters. **Chapter 1** describes the background, objectives and scope of study and methodology adopted; **Chapter 2** presents the review of policy, legal and administrative framework;

**Chapter 3** depicts the project details with costing; **Chapter 4** represents the environmental baseline conditions; **Chapter 5** provides the social impact assessment, mitigation technique as well as social management plan for the proposed project; **Chapter 6** provides environmental impact evaluation; **Chapter 7** suggests the mitigation measures with regards to environmental sustainability **Chapter 8** provides description on outstanding value (OUV) of the Sundarbans; Finally, **Chapter 9** gives some concluding remarks based on overall features of the ongoing studies.

# Chapter 2
# POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

## 2.1 General

The proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project must comply with the relevant legislation and planning requirements of the Government of Bangladesh, as established and/or administered by the Ministry of Environment and Forest (MoEF) and Department of Environment (DoE) and other national and local jurisdictions. The policy, strategy and regulatory issues are particularly important for any project proponent or developer, before they physically go for the execution of any program or plan. The proponent is supposed to comply with the provisions as applicable and necessary for any development program. The subsequent sections provide the relevant national legislative, regulatory and policy instruments and bring out the concerned aspects of these to the notice of the proponent for their awareness, education, cognizance and compliance and also for any reviewer of the document for environmental clearance.

The Mongla Port Authority has proposed to establish the Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project with a view to providing safe and sound management for the imported/exported containers through this port. To do so the respective authority is required to conduct the Environmental Impact Assessment (EIA) as it is obligatory under the national law of Bangladesh. According to the Environment Conservation Act, 1995, no industrial unit or project will be established or undertaken without obtaining an Environmental Clearance Certificate from the Department of Environment. In respect of legal obligations and policy guidelines under the EIA study of the Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project the following activities have been carried out:

- Identification of national legal obligations in relation to the interventions which will be required to review under the EIA study of the proposed project;
- Exploration of the national legislative provisions and policy guidelines on environmental sectors;
- Identification of the international legal obligations and relevant provisions of multilateral environmental agreements related to the proposed project interventions;

## 2.2 National Environmental Legal Provisions

The Environment Conservation Act of 1995 is the key legislation in relation to environment protection in Bangladesh. This Act has been promulgated for environment conservation, standards, development, pollution control, and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. The Act has been subsequently amended in 2000, 2002, 2007 and latest amendments done up to year 2010. The main objectives of the Act are: (a) Conservation and improvement of the environment and (b) Control and mitigation of pollution of the environment.

The main strategies of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried/initiated in the ecologically critical areas;
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of the development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste and
- Formulation and declaration of environmental guidelines

According to the law before setting up any new project/interventions by the Government/ non-government agencies/public, the proponents are required to obtain respective clearance from the Department of Environment. Under the Environment Conservation Rules 1997, the project promoter must obtain site clearance from the Director General of Department of Environment. An appeal procedure does exist for those promoters who fail to obtain clearance. The Department of Environment executes the Act under the leadership of the Director General. Under the Environment Conservation Act (ECA, 1995), the first set of rules promulgated is the Environment Conservation Rules (ECR, 1997). The Rules have provided categorization of industries/ projects, hence identified types of environmental assessments needed against respective categories of industries/projects. The types of projects listed as red category in the ECR (1997) includes engineering works where the capital investment is more than 1 million Taka. The Feasibility Study for Dredging and River Training of in Passur Channel of Mongla Port investment is more than 1 million taka, and hence is a "Red" category Project.

### 2.2.1 Procedure to Obtain Environmental Clearance Certificate

According to the Section 12 of the Environment Conservation Act 1995 no industrial unit or project will be established or undertaken without obtaining, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industries which are specified under the Schedule – 1 of the Environment Conservation Rules 1997 require obtaining site and environmental clearance from the Department of Environment. For projects under "Red" category, it is mandatory to carry out Environmental Impact Assessment (EIA) including Environmental Management Plan (EMP) for getting environmental clearance from the Department of Environment. The Rules provide the application procedure for obtaining site and environmental clearance and the application procedure of Red category.

### 2.2.2 Protected Areas

Under the Environment Conservation Act 1995 and the Forest Act 1927 the territory (10km from the boundary of the Reserve Forest) of the Sundarbans has been declared as protected area and hereby been restricted certain activities in and around the Sundarbans. Under the Forest Act, the Sundarbans is declared as Reserve forest where no commercial activities and damage to forest and wildlife resources will be caused. Upon declaring Ecologically Critical Area, all activities except those permitted by the law are prohibited in the specified area. Setting up industries/ implement project which cause soil, water, air and noise pollution in the specified area are prohibited activity among others. The activities which cause damage/adversely impact on biodiversity, forest resources, wildlife, fisheries and other aquatic resources are also prohibited by the law.

### 2.2.3 Effluent Discharge

The proposed project might emit different types of gaseous pollutants, noise, liquid and solid waste to the surrounding environment. Schedule 2 to 11 of the Rule has been established to regulate uncontrolled emission. The specific standards that must be obliged in installing the proposed project are given in Table 2.1.

Table 2.1: Bangladesh Standard for Effluents in Commercial Areas ECR, 1997

| **Components/Parameter** | **Standard as in ECR, 1997** |
|---|---|
| **Standard to be maintained for Air Emission** | |
| Suspended Particulate Matters (SPM) | 400 µg /m3 |
| Sulfur dioxide ($SO_2$) | 100 µg /m3 |
| Nitric Oxide ($NO_2$) | 100 µg /m3 |
| Carbon Monoxide (CO) | 5000 µg /m3 |
| **Standard for Sewage Discharge** | |
| Biochemical Oxygen Demand ($BOD_5$) | 40 mg/l |
| Nitrate ($NO_3$) | 250 mg/l |
| Phosphate ($PO_4$) | 35 mg/l |
| Suspended Solids (SS) | 100 mg/l |
| Temperature | 30 $^0$C |
| Coliform | 1000 N/100ml |
| **Noise as stated in Schedule 4** | |
| Day time noise level | 70 dB (A) |
| Night time noise level | 60 dB (A) |

## 2.3 Compliance under the National Laws

### 2.3.1 The Forest Act, 1927 & Amendment Act 2000

The proposed location of the Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port projects situated within 6 km of the Sundarbans. Therefore, it is pertinent to review forest related laws and by-laws of the country to identify possible conflicts among the proposed project interventions and rule of law. The Forest Act, 1927 is the first and omnibus law of the land

on forestry. It provides for reserving forests over which the Government has an acquired property right. According to the Act the Government (Forest Department) can prohibit certain activities in the declared Reserved Forest area such as any intervention kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc. The proposed intervention should not carry out any such activities that may cause damage or adversely impact on the natural resources including wildlife of the Sundarbans Reserve Forest.

### 2.3.2 The Penal Code, 1860

The Penal Code of 1860 has some valid provisions related to pollution management, environment protection and protection of health and safety. Chapter XIV of the Penal Code provides offences affective public health, safety, convenience, decency and morals: Section277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; Section 284: Negligent Conduct with Respect to Poisonous Substance; Section285: Negligent Conduct with Respect to Fire or Combustible Matter; and Section 286: Negligent Conduct with Respect to Explosive Substance. According to the Section 277, whoever voluntarily corrupts or fouls the water of any public spring or reservoir, to render it less fit for the purpose for which it is ordinarily used will be punished under the law. According to the Section 278 whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the neighborhood or passing along a public way will get punishment.

### 2.3.3 The Acquisition and Requisition of Immovable Property Ordinance (1982)

This Ordinance has replaced the Land Acquisition Act of 1894 and the East Bengal (Emergency) Requisition of Property Act of 1948. The Ordinance governs acquisition and requisition by the government of immovable property for any public purpose or in the public interest. It may be noted that contrary to the previous Acts (i.e. Act XIII of 1948); this Ordinance deals only with immovable property. The Ordinance has well-defined procedures regarding payment of compensation for an acquired piece of land. If, for example, the land is used for rice growing, then an amount equivalent to approximately 1.5 times the market value of a given variety of rice (e.g., paddy) that is currently being (or could be) produced annually is fixed as a yearly lease value. In case of outright purchase (carried out on a 99-year lease), the compensation-value of acquired land varies widely according to the locality, soil fertility, and access to transportation and related infrastructure factors. The current compensation and resettlement provisions are however inadequate both in terms of timing of

payments and quantum. The procedures involved are cumbersome and time consuming and often causes hindrance to the smooth execution of the project. Legal provisions covering adequate compensation to the project affected persons, particularly disadvantaged groups such as women & squatters and such other vulnerable groups are yet to be framed.

### 2.3.4 The Protection and Conservation of Fish Act 1950

The Protection and Conservation of Fish 1950 was enacted to provide for the protection and conservation of fish. The law defines 'Fish' as all cartilaginous, bony fishes, prawn, shrimp, amphibians, tortoise, turtles, crustacean animals, mollusks, echinoderms and frogs at all stages in their life history. Under the Act the Protection and Conservation of Fish Rules was adopted in 1985. This is a set of rules in line with the overall objectives of the Act. The Rule 5 of the Rules provides that no person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters. During the project intervention, it should be noted that if waste effluent is not treated then it may cause significant damage to the local fishery and thus violate the provision of the law. Rule 6 states that no person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters. Therefore, the proposed intervention of Mongla Port Authority (MPA) will need to be carried in such a manner that the activities do not cause damage or adversely impact the inland waters or within coastal waters fisheries.

### 2.3.5 Civil Aviation Ordinance 1960 & Civil Aviation Rules, 1984

The Civil Aviation Ordinance 1960 was made to make better provisions for the control of manufacture, possessions, use, operation, sale, import and export of aircraft, the control and regulation of air transport services, and the control and development of aerodromes in the country. It repealed the Aircraft Act, 1934 (XXII of 1934). Present legal regulatory framework for civil aviation activities in Bangladesh is the Civil Aviation Rules, 1984 and the Air Navigation Orders issued by the Chairman under this rule. All civil aviation activities in Bangladesh are regulated by the Civil Aviation Rules, 1984 which was made and promulgated by the Government in exercise of the powers conferred by sections 4, 5, 7 and 8 of the Civil Aviation Ordinance, 1960 (XXXII of 1960), section 10 of the Aircraft (Removal of Danger to Safety) Ordinance, 1965 (Xll of 1965), section 4 of the Telegraph Act, 1885 (Xlll of 1885) and in suppression of the Aircraft Rules, 1937 and the Airport Obstruction Clearance Rules, 1981. This set of rules elaborately dealt with personnel (pilot, flight

engineer, air traffic controller, aircraft maintenance engineer etc.) licensing, airworthiness requirements, operation of aircraft, rules of the air, air transport services; construction height of the surrounding infrastructure, etc. Much of today's operational responsibilities and functions of CAAB are defined and formulated in these Rules. The proposed location of the Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project is more than 20 km from the proposed Khan Jahan Ali Airport location. However, the national civil aviation rules and regulations need to be reviewed to avoid any violation of rules of law. The civil aviation law demarcated two zones adjacent to airport runway and provided the specified height of infrastructures in the specified zones.

### 2.3.6 Ports Act, 1908

The Ports Act 1908 was adopted to consolidate the enactments relating to Ports and port charges. The administering authority is the Ministry of Shipping. Subject to this Act, a Conservator is appointed to each port. Now, the Mongla Port's Harbor Master is acting as Conservator of Mongla Port and administers the provisions of the Act for the Port. Specific environmental management provisions of the Act are given under s.21 (1) which prohibits the discharge of ballast, rubbish and oil into any port or adjacent areas. Under s.31 of the Act, the movement of vessels of 200 tons or more cannot enter, leave or be moved within any port without having a pilot on board. In addition, no vessel of more than 100 tones is to enter, leave or be moved within any port without having a pilot, unless authority to do so has been given in writing. The lawful use of infrastructure such as piers and moorings, and ensuring navigable waters are not obstructed is detailed under s.10, whereass.21 prohibits interference with buoys, beacons and moorings. Unless permission has been granted by the Conservator, any action that causes or may cause injury to the bank or shore is prohibited under s.30 (1).

### 2.3.7 Mongla Port Authority Ordinance, 1976

The Mongla Port Authority (MPA) Ordinance 1976, under the Ministry of Shipping, Government People's Republic of Bangladesh established the MPA. The Ordinance provides the MPA with the authority, function and jurisdiction over docks (wharves, warehouses, railways, piers, bridges, and other works) and vessels (including any ship, barge, boat, or raft designed or used for the transport by water of passengers or goods) within the port limits. The MPA also has authority to reclaim or excavate any part of the bank or bed of the river, to construct, maintain and operate dredgers and appliances for clearing, deepening and improving the bed of the river, and to construct, maintain and

operate all means and appliances for berthing, loading and discharging vessels. The MPA's authority also extends to improvements made to the land and riverbank of its existing Port at Khulna (Roosevelt Jetty). Under s.18 of the Act, the MPA may permit any person to make, erect or fix below high water-mark within the Port any dock, pier, erection or mooring. This provision may apply at Akram Point if moorings are established for securing barges or the floating transfer vessel (FTV). The MPA also has the authority to issue fines for the pollution of water or environment by throwing or allowing into the water, bank or land, any goods, ballast, ashes or any other material that leads to pollution.

### 2.3.8 Environment Conservation Act (1995, Amended in 2000 & 2002)

The Bangladesh Environment Conservation Act of 1995 (ECA '95) is currently the main legislation in relation to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. It has repealed the Environment Pollution Control Ordinance of 1977. Before any new project can go ahead, as stipulated under the rules, the project promoter must obtain Environmental Clearance from the Director General. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of 3 years' imprisonment or a maximum fine of Tk. 300,000 or both. The Department of Environment (DOE) executes the Act under the leadership of the Director General (DG).

Environmental Conservation Act (Amendment 2000): This amendment of the Act focuses on (1) ascertaining responsibility for compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.

Environmental Conservation Act (Amendment 2002): This amendment of the Act elaborates on (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.

Environmental Conservation Act (Amendment 2010): This amendment of the act introduces new rules & restriction on: a) Ensure proper management of hazardous wastes to prevent environmental pollution and Health Risk, b) No remarked water body cannot be filled up/changed; in case of national interest; it can be done after getting clearance from the respective department; and c)

Emitter of any activities/incident will be bound to control emission of environmental pollutants that exceeds the existing emission standards.

### 2.3.9 The Environment Conservation Rules, 1997

These are the first set of rules, promulgated under the Environment Conservation Act of 1995 (so far there have been three amendments to this set of rules - February and August 2002 and April 2003). The Environment Conservation Rules of 1997 has provided categorization of industries and projects and identified types of environmental assessments needed against respective categories of industries or projects. Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) the requirement for and procedures to obtain environmental clearance, and (iii) the requirement for IEE and EIA's according to categories of industrial and other development interventions.

### 2.3.10 The Environment Court Act, 2000

The Environment Court Act, 2000 provides for the establishment of environment courts and matters incidental thereto. This act also provides the jurisdictions of environment court, penalty for violating court's order, trial procedure in special magistrate's court, power of entry and search, procedure for investigation, procedure and power of environment court, authority of environment court to inspect, appeal procedure and formation of environment appeal court.

### 2.3.11 The Fatal Accidents Act, 1855

An Act to provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. It is mentioned in s.1, whenever the death of a person shall be caused by wrongful act, neglect or default, and the act, neglect or default is such as would (if death had not ensued) have entitled the party injured to maintain an action and recover damages in respect thereof, the party who would have been liable if death had not ensued shall be liable to an action or suit for damages, notwithstanding the death of the person injured, and although the death shall have been caused under such circumstances as amount in law to felony or other crime.

### 2.3.12 The Dock Laborers Act, 1934

An Act to give effect in Bangladesh to the Convention concerning the protection against accidents of workers employed in loading and unloading ships. It is stated in s.5(1), the Government may make

regulations providing for the safety of working places on shore and of any regular approaches over a dock, wharf, quay or similar premises which workers have to use for going to or from a working place at which the processes are carried on, and for the lighting and fencing of such places and approaches, prescribing the measures to be taken in order to prevent dangerous methods of working in the stacking, unshackling, stowing and unstaring of cargo, or handling in connection therewith, prescribing the precautions to be observed when the workers have to work where dangerous or noxious goods are, or have bee, stowed or have to deal with or work in proximity to such goods. It is mentioned in s.9, any person who unless duly authorized, or in case of necessity, removes any fencing, gangway, gear, ladder, life-saving means or appliance, light, mark, stage or other thing required to be provided by or under the regulations made under this Act; or having in case of necessity removed any such fencing, gangway, gear, ladder, lifesaving means or appliance, light, mark, stage or other thing, omits to restore it at the end of the period for which its removal was necessary; shall be punishable with fine which may extend to five hundred taka.

### 2.3.13 The Dangerous Cargoes Act, 1953

The Dangerous Cargoes Act, 1953 was enacted to provide provisions related to the safety of ports in respect of the transit, working and storage of dangerous cargoes. Relevant provisions include s.3 (which deals with explosives and fires on vessels), s.6 (safety of vessels imports) and s.9 (enforcement). The concerned authority is the Deputy Conservator of the Port, Board of Trade or the Ministry of Communication and the Chief of Naval Staff.

### 2.3.14 The Fire Services Ordinance 1959

The Fire Services Ordinance 1959 also states that the owner needs to obtain a license under the Ordinance before using premises as a warehouse. In addition, under this Ordinance the Government by order no. HSLG/SVII/1R-1/60/295 dated 3rd June 1960 declared that any stock of coal exceeding four tones shall be considered to be a fire risk.

### 2.3.15 The Bangladesh Petroleum Act, 1974

The Bangladesh Petroleum Act is enabling legislation that allows the Government of Bangladesh to enter into all aspects of petroleum exploration, development, exploitation, production, processing, refining and marketing. In addition, the Government is authorized to enter into Petroleum

Agreement(s) with any person(s) for the purpose of petroleum operations. The duties of such person(s) are:

- To ensure that petroleum operation is carried out in a proper and workman like manner and in accordance with good oil field practice.
- To carry out petroleum operation in any area in a manner that does not interfere with navigation, fishing and conservation of resources.
- To consider the factors connected with the ecology and environment.

Clause 6(2) of the Act sets out certain details related to environment and safety:

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

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

Apart from the above the law provides the following obligations:

a) Prescribing places where petroleum may be imported and prohibiting its import elsewhere; regulating the import of petroleum;

b) Prescribing the periods within which licenses for the import of [class I] petroleum shall be applied for, and providing for the disposal, by confiscation or otherwise, of any [class I] petroleum in respect of which a license has not been applied for within the prescribed period or has been refused and which has not been exported;

c) Regulating the transport of petroleum;

d) Specifying the nature and condition of all receptacles and pipe-lines in which petroleum may be transported;

e) Regulating the places at which and prescribing the conditions subject to which petroleum may be stored;

f) Specifying the nature, situation and condition of all receptacles in which petroleum may be stored;

g) Prescribing the form and conditions of licenses for the import of dangerous petroleum, and for the transport or storage of any petroleum, the manner in which applications for such licenses shall be made, the authorities which may grant such licenses and the fees which may be charged for such licenses; determining in any class of cases whether a license for the transport of petroleum shall be obtained by the consignor. consignee or carrier;

h) Providing for the granting of combined licenses for the import, transport, storage and distribution of petroleum, or for any two of such purposes;

1. Prescribing the proportion in which any specified poisonous substance may be added to petroleum, and prohibiting the import, transport or storage of petroleum in which the proportion of any specified poisonous substance exceeds the prescribed proportion;

2. Regulating the distribution of petroleum;

3. Prescribing the conditions for the appointment of, and the granting of the licenses to, agents, dealers and stockiest;

4. Prescribing the form and conditions of agreement between and agent, dealer or stockiest and an oil marketing company;

5. Prescribing the form and conditions of agreement between and agent, dealer or stockiest and an oil marketing company;

6. Providing for cancellation or restoration of licenses of an agent or a dealer and of agreement between an oil marketing company and an agent, dealer or stockiest; and

7. Generally, providing for any matter which in its opinion, in expedient for proper control over the import, transport, storage and distribution of petroleum.

### 2.3.16 The Explosives Act, 1884

The Government may for any part of Bangladesh, make rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale, transport and importation of explosives or any specified class of explosives. Any person manufacturing, possessing, using, selling, transporting or importing an explosive in contravention of a notification issued shall be punishable with

imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine which may extend to fifty thousand Taka, in default of which with a further imprisonment for a term which may extend to one year, and in the case of importation by water or land, the owner and master of the vessel or carriage in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine with a further imprisonment for a term which may extend to one year.

### 2.3.17 Wildlife Conservation (protection and safety) Act 2012

The government in 1973 framed a law for conservation of the forests. Since the independence, no effective measure had been taken for conservation of the wildlife. The existence of a number of animals is now under severe threat as no adequate measures were taken to protect wildlife in the pre-independence period. Bangladesh has expressed deep concern about the existing wildlife and a new wildlife law passed in parliament. The act has been formulated for the conservation and safety of wildlife to manage the protected areas. The act depicts 10 new types of protected areas. The bill with many other provisions proposed stern action for violation of the law. It proposed one-year imprisonment and Taka 50,000 fine for such a violation. The law also proposed at least two years and highest seven years' imprisonment and minimum Taka one lakh and maximum Taka 10 lakh fine for killing a tiger or elephant.

## 2.4 Policy Guidance

Under the study a number of sectoral national policies have been reviewed to identify the guiding principles which are relevant to the proposed construction of Mongla Custom House of Mongla Port and its operation and maintenance activities. The sectoral policies will include energy, environment, water, forest, transport, import; fisheries etc.

### 2.4.1 National Environment Policy, 1992

The National Environment Policy of 1992 sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. The Policy provides the broader framework of sustainable development in the country. It also stated all major undertakings, which will have a bearing on the environment; must undertake an IEE and EIA before they initiate the project. The Policy delineates DoE, as the approving agency for all such IEE and EIA's to be undertaken in the

country. The policy guidelines of fifteen sectors are stated in the Policy. Under the Environmental Action Plan, Section 3: 'Forest, wildlife and biodiversity' directs the followings:

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

### 2.4.2 National Environment Management Action Plan 1995

The National Environment Management Action Plan (NEMAP) is a wide ranging and multifaceted plan, which builds on and extends the statements set out in the National Environment Policy (NEP). NEMAP was developed to address issues and management requirements for a period between 1995 to 2005 and set out the framework within which the recommendations of the National Conservation Strategy (NCS) are to be implemented.

NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people.

### 2.4.3 The National Forest Policy (1994)

The National Forestry Policy of 1994 is the revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; bring about 20% of the country's land area under the afforestation program, and increase the reserve forestland by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people. The need of amendments of the existing forestry sector related laws and adoption of new laws for sect oral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

### 2.4.4 The National Energy Policy (1995)

The National Energy Policy provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources and environmentally sounds sustainable energy development programs. The Policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology. One (Section 1.2) of the seven objectives addresses the environment and states, "(vi) to ensure environmentally sound sustainable energy development programs causing minimum damage to the environment".

### 2.4.5 The National Water Policy (1999)

The National Water Policy of 1999 was adopted to ensure 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 has also addressed issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc. The Policy states that excessive water salinity in the southwest region is a major deterrent to industrial growth. In addition, pollution of both surface and groundwater around various industrial centers of the country by untreated effluent discharge into water bodies is a critical water management issue. The Policy suggests that the following matters should be considered:

(i) Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities;

(ii) Effluent disposal will be monitored by relevant Government agencies to prevent water pollution;

(iii) Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DoE;

(iv) Industrial polluters will be required under law to pay for the cleanup of water- body polluted by them.

### 2.4.6 National Water Management Plan 2001 (Approved in 2004)

The National Water Resources Council approved on March 31, 2004 a 25-year National Water Management Plan. The plan provides a framework within which all concerned with the development, management and use of water resources water services in Bangladesh can plan and implement their own activities in a coordinated and integrated manner. The planned activity programs have been presented in the eight sub-sectorial 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, with overall a total of 84 sub-sectorial programs identified and presented in the investment portfolio. It will be implemented in three phases. It was approved at the seventh meeting of the National Water Resources Council. It calls for a coordinated approach of concerned ministries and departments to stop water-logging and to incorporate the issues of arsenic mitigation, river administration, and dredging and fisheries resources. To mitigate the environmental risks of water sector project development, the plan suggested for a holistic view, which includes the environment itself as an important water sector stakeholder with anentire cluster of programs devoted to it. Furthermore, programs within the environment cluster are strategically timed in order that public awareness raising, the establishment and enforcement of regulatory mechanisms and long term planning are addressed as priority. Water Resources Planning Organization (WARPO) was assigned to monitor the national water management plan.

### 2.4.7 Coastal Zone Policy, 2005

Coastal zone policy initiated as a harmonized policy that transcends beyond sectorial perspectives. The policy provides general guidance so that the coastal people 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, marine fisheries, mangrove and other forests, land, livestock, salt, minerals, sources of renewable energy like tide, wind and solar energy. It also emphasis on conservation and enhancement of critical ecosystem- necessary measures will be taken to conserve and develop aquatic and terrestrial including all the ecosystems of importance identified by the Bangladesh National Conservation Strategy (Mangrove, coral reef, tidal wetland, sea grass bed, barrier island, estuary, closed water body, etc.).

### 2.4.8 Coastal Development Strategy, 2006

Coastal Development Strategy has been approved by the Inter-Ministerial Steering Committee on ICZMP on February 13, 2006. The strategy is based on the Coastal Zone Policy and takes into account the emerging trends: increasing urbanization, changing pattern of land use, declining land and water resources, unemployment and visible climate change impacts. The strategy has 9 strategic priorities and the following 3 are relevant priorities with proposed type of interventions:

- Safety from man-made and natural hazards - i) Strengthening and rehabilitation of sea dykes; and ii) reduction of severe vulnerability in the coastal zone through multipurpose cyclone shelters-including coping mechanism.
- Sustainable management of natural resources - i) environmentally and socially responsive shrimp farming; ii) introduction of renewable energy in coastal areas; and iii) development of marine fisheries and livelihood.
- Environmental conservation – i) Marine and coastal environmental development; ii) strengthening of Coast Guard for improvement of coastal safety and security in coordination with other law enforcing agencies.

## 2.5 International Legal Obligations

Bangladesh is signatory to a number of Multilateral Environmental Agreements (MEAs) and also some bilateral instruments. Some of them are very important in the context of environmental protection. The legal obligations and provisions of MEAs related to the proposed project interventions will be reviewed and the pertinent ones of these are highlighted below:

### 2.5.1 Rio Declaration

The 1992 United Nations Conference on Environment and Development (UNCED) adopted the global action program for sustainable development called ‘Rio Declaration’ and ‘Agenda 21’. Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, “In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it”.

### 2.5.2 Convention on Biological Diversity (1992)

The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 5 June 1992 and entered into force on 29 December, 1993. Bangladesh ratified the Convention on 20 March, 1994. The Contracting Parties of the Convention have committed to:

- Introducing appropriate procedures requiring environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and
- Introducing appropriate arrangements to ensure that environmental consequences of its programs and policies, which are likely to have significant adverse impacts on biodiversity are duly taken into account. Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity (art. 4)

### 2.5.3 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar (1971)

This convention is also known as the Ramsar Convention. It was adopted 2 February, 1971 and entered into force on 21 December, 1975. Bangladesh has ratified the Convention 20 April, 2002. This provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 127 Parties with 1085 wetland sites designated as Wetlands of International Importance'. This is an intergovernmental treaty, which provides the framework for international cooperation for the conservation of wetlands habitats. Obligations for Contracting Parties include the designation of wetlands to the "List of Wetlands of International Importance', the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves. Parts of the Sundarbans Reserved Forest (Southwest of Bangladesh) are one of the Ramsar sites.

### 2.5.4 United Nations Convention on the Law of the Sea, Montego Bay, (1982)

This Convention was adopted on 10 December 1982 at Montego Bay, Jamaica. Bangladesh has ratified this Convention. Main objectives of the convention are:

- To set up a comprehensive new legal regime for the sea and oceans, as far as environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment; and
- To establish basic environmental protection principals and rules on global and regional co-operation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to alt sources of marine pollution.

### 2.5.5 UNESCO World Heritage Convention

Convention concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972: This convection has been ratified by 175 states. This defines and conserves the world's heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. Of the 730 total sites, there are currently 144 natural, 23 mixed and 563 cultural sites that have been inscribed on the World Heritage List (distributed in 125 State parties). These are the 'Jewels in the Crown' of conservation. The Sundarbans is declared as the World Heritage Site. Therefore, the provisions of this convention regarding protection of World Heritage Site are very much relevant for the proposed intervention. The proposed project intervention should be carried out in such a manner that the above mentioned provisions of the multilateral environmental agreements are not violated and may not cause adverse impact on the natural resources.

### 2.5.6 Recommendations by Reactive Monitoring Mission to Protect OUV

There are sites within the project area that are part of the World Heritage sites within the Sundarbans. The three seaward sanctuaries within the Sundarbans form the World Heritage site. These sites are regarded as being of the highest importance for Biodiversity Protection within the Sundarbans Reserve Forest in spite of the concerns raised about their representativeness (Saunders, 2000).

In 2016, the Reactive Monitoring Mission visited Bangladesh and the Sundarbans to assess the current state of conservation of the property following a decision of the World Heritage Committee.

The Reactive Monitoring Mission (2016) identifies three major issues that are posing threats to the Outstanding Universal Value (OUV) of the Sundarbans which are: (1) increasing salinity and siltation following the construction of the Farakka Barrage and increased water extraction and threatening the overall balance of the ecosystem; (2) likely pollution from coal ash by air, pollution from wastewater and waste ash, increased shipping and dredging and the cumulative impact of

industrial and related development infrastructure related to the prospective construction and operation of the Rampal Power Plant; (3) lack of an integrated management system in the increasing port capacity and other coastal developments that are expected to result in increased shipping and dredging. The mission concluded that the property does not currently meet the requirements for inscription on the List of World Heritage in Danger. However, the mission made ten recommendations to prevent the OUV of the property from becoming irreversibly damaged. Among the recommendations, the following are related to the current project.

"**R4:** Considering the potential threats to the property from increased shipping and required dredging the planned expansion and increase in use of the Mongla Port requires urgent clarification. It is recommended that the State Party halt all expansion activities until an independent, comprehensive and scientifically sound EIA has been conducted and provided to the World Heritage Centre and IUCN for their review and evaluation."

"**R7.** Develop, finalize and submit for review by the World Heritage Centre and IUCN, a detailed assessment of potential impacts of current and planned dredging and associated activities on the OUV and integrity of the property."

"**R10.b:** Considering the multiple activities outside the property that are impacting on its OUV, it is recommended that the State Party puts in place a system that allows management of the property in a more integrated manner. Such a system should ensure decisions for further economic development and associated activities such as shipping and dredging are not taken in isolation but are subject to a Strategic Environmental Assessment (SEA) for the property and its surrounding areas upon which it is dependent."

# Chapter 3
# DESCRIPTION OF PROJECT ACTIVITIES

## 3.1 Introduction

Mongla Port, the second seaport of Bangladesh, is located about 131 km upstream from the Bay of Bengal, in the south-western part of the country. The port is situated at the bank of Passur River. The navigability of Mongla Port is vital to the economy of the country. Further development of deep draft navigation facilities and application of the state of the art technology for their continuing maintenance are essential for future prosperity. The reduction in dry flows in the Ganges distributaries to the southwest region is the most serious threat to this region. It shows a continuous process of siltation progressing generally from the northwest toward the southeast. The south-western coastal zone is in a state of transition from an active developing delta to a semi-moribund delta. Salinity intrusion has been increased due to tidal penetration and reduction in freshwater flows. In the last few years, the number of ships at Mongla Port has been increased tremendously. Due to huge congestion at the Chittagong Port, most of the ships are diverting to the Mongla Port. After completion of the Padma Bridge, Khulna-Mongla Rail Line, Rampal Power Plant and Khan Jahan Ali Airport, more loads are expected to come to this port. Considering the aforementioned issues, Mongla Port is planning to handle 10 m draft ship at Jetty and for this purpose, the channel should be dredged up to 8.5m CD and Jetty front is to be dredged up to 10.5 m CD. Based on recent bathymetric data of Passur Channel, it is evident that dredging is required for only 23.4 km from Mongla Port Jetty to Harbaria Khal (Figure 3.1, 3.2). From the long section of Passur River, it is seen that the downstream part of Harbaria Anchorage has sufficient draft to handle 10.0 m draft vessels. But about 13 km in the base creek area and Port Jetty area called inner bar is suffering for scarcity of sufficient water depth even for 7.0 m draft vessels. Based on the Hydrographic charts of Mongla Port Authority (MPA) and available information, it is observed that the width of the Passur River varies at different sections. The width and available minimum and maximum depth of those sections are described in Table 3.1.

Table 3.1: Width and depth of Passur River at different segments.

| Sl. No. | River Reach | Length of River Reach (km) | Width of Channel (m) | Min. Width of Navigation Channel (m) | Min. Depth | Max. Depth |
|---|---|---|---|---|---|---|
| | | | | | (mCD) | |
| 01 | Harbaria to Base Creek Area at Joymonirgol | 6 | 1,800-1,100 | 400 | 6.3 | 15.2 |
| 02 | Joymonirgol to Mongla Nulla | 14 | 1,750-950 | 250 | 5.2 | 9.0 |
| 03 | Mongla Nulla to Mongla Port Turning Ground | 3.4 | 1,150-900 | 250 | 5.0 | 7.5 |

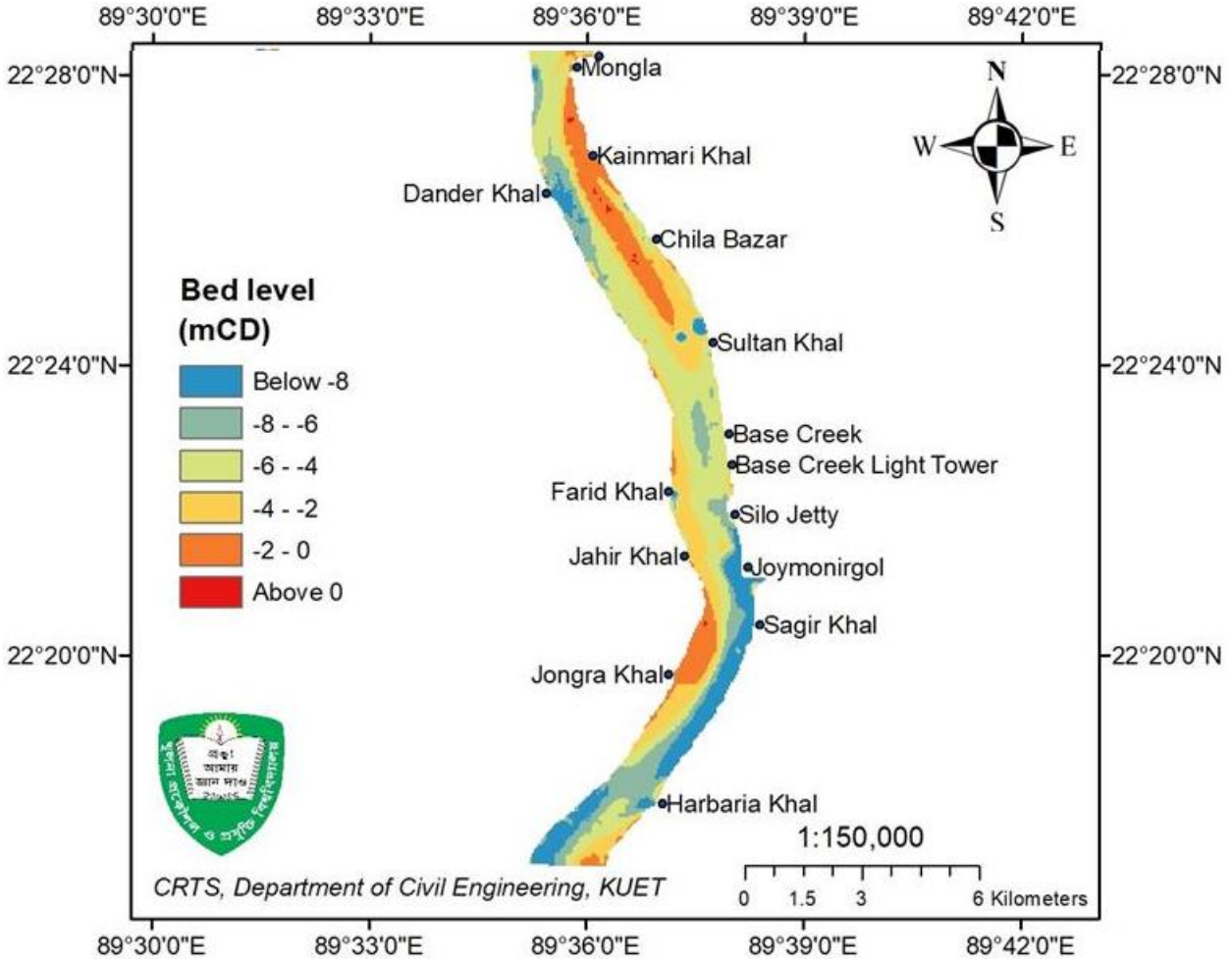



Figure 3.1: Proposed 23.4 km Dredging in Passur Channel (Mongla Port to Harbaria)

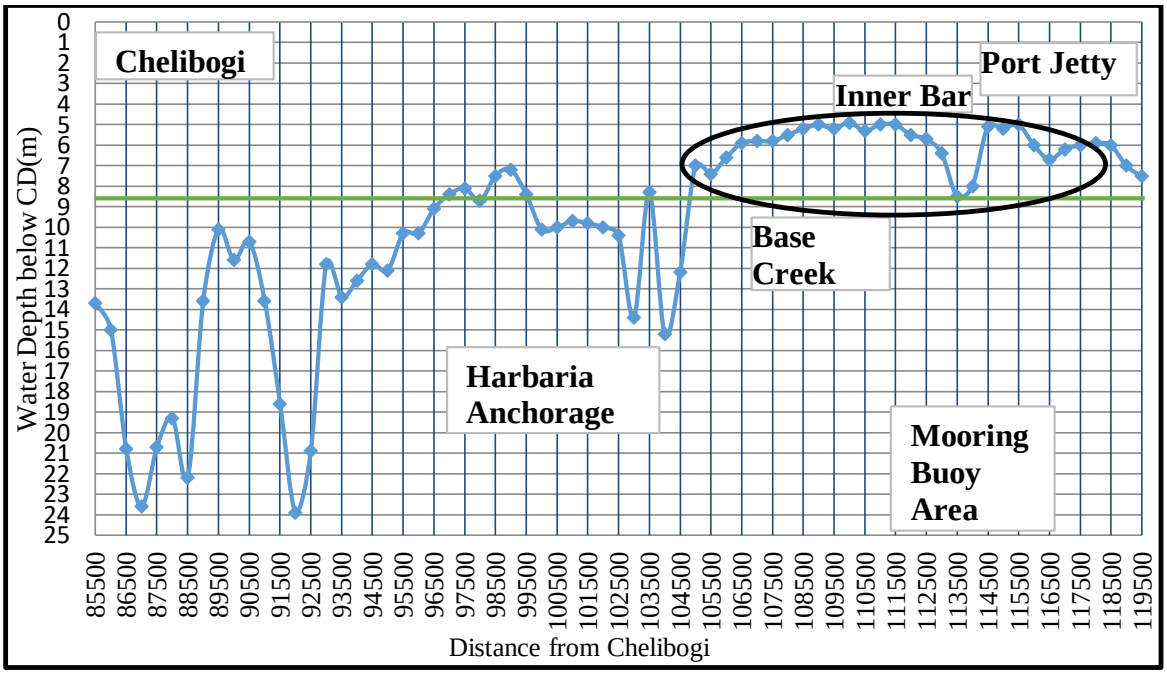



Figure 3.2: Longitudinal bed profile of Passur River from Chelibogi to Mongla Port along the navigation line

## 3.2 Dredging Plan

The depth profile of a river with its temporal change is the main function of navigation. It can be noted that the tidal riverine system already forms a navigation route. However, the model simulation results on velocity vectors have been used to finalize the navigation route. The main principal to maintain deep channel is concentrating tidal energy in the dredged channel to reduce the back filling rate. In order to obtain full benefit of ebb and flood tide energies, velocity field both in high and low tides were analyzed covering neap and spring period for dry and monsoon seasons using the simulation results of hydrodynamic model of the Passur river. The figures below show the simulated velocity vectors for high tide and ebb tide cases in different reaches of Passur river (a) from herbaria to Joymonirgol (b) from Joymonirgol to Confluence Channel and (c) Confluence channel to Mongla Port. The dominant flow path is clearly observed both in high tide and low tide cases. It is observed that the high velocity zone lies along the thalweg line. The simulation result presented below is for the 6000 cumec discharge and +2.5 mCD water depth. The velocity is found to be decreasing towards the downstream channel. Near the inner bar area two streams of flow are clearly observed at the two sides of the bar, where the maximum velocity is found as 0.7 m/sec that decreased to 0.6 m/sec in Joymonirgol and herbaria area.

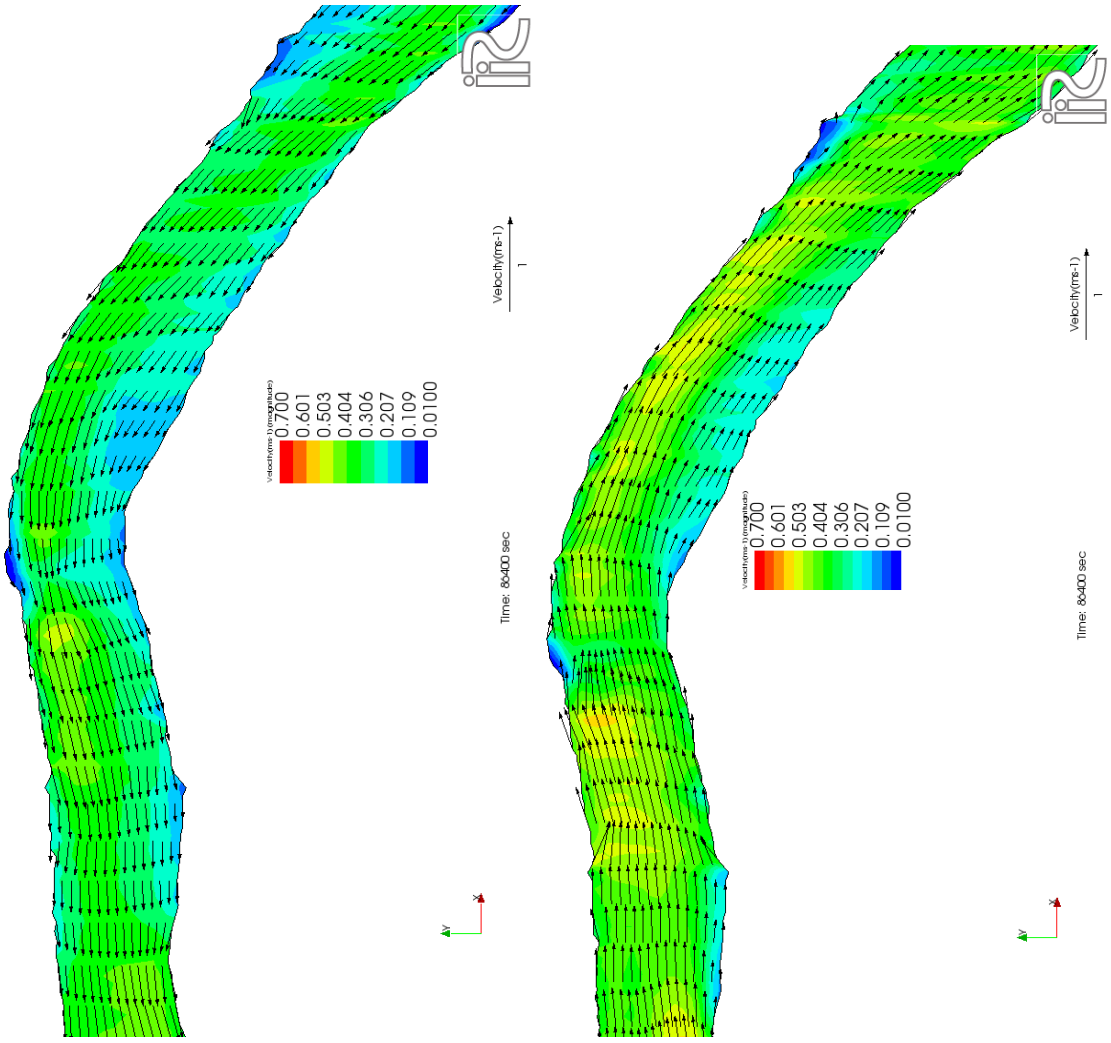



Figure 3.3: Simulated velocity flow field for ebb and high tide cases for the study reach harbaria to Joymonirgol.

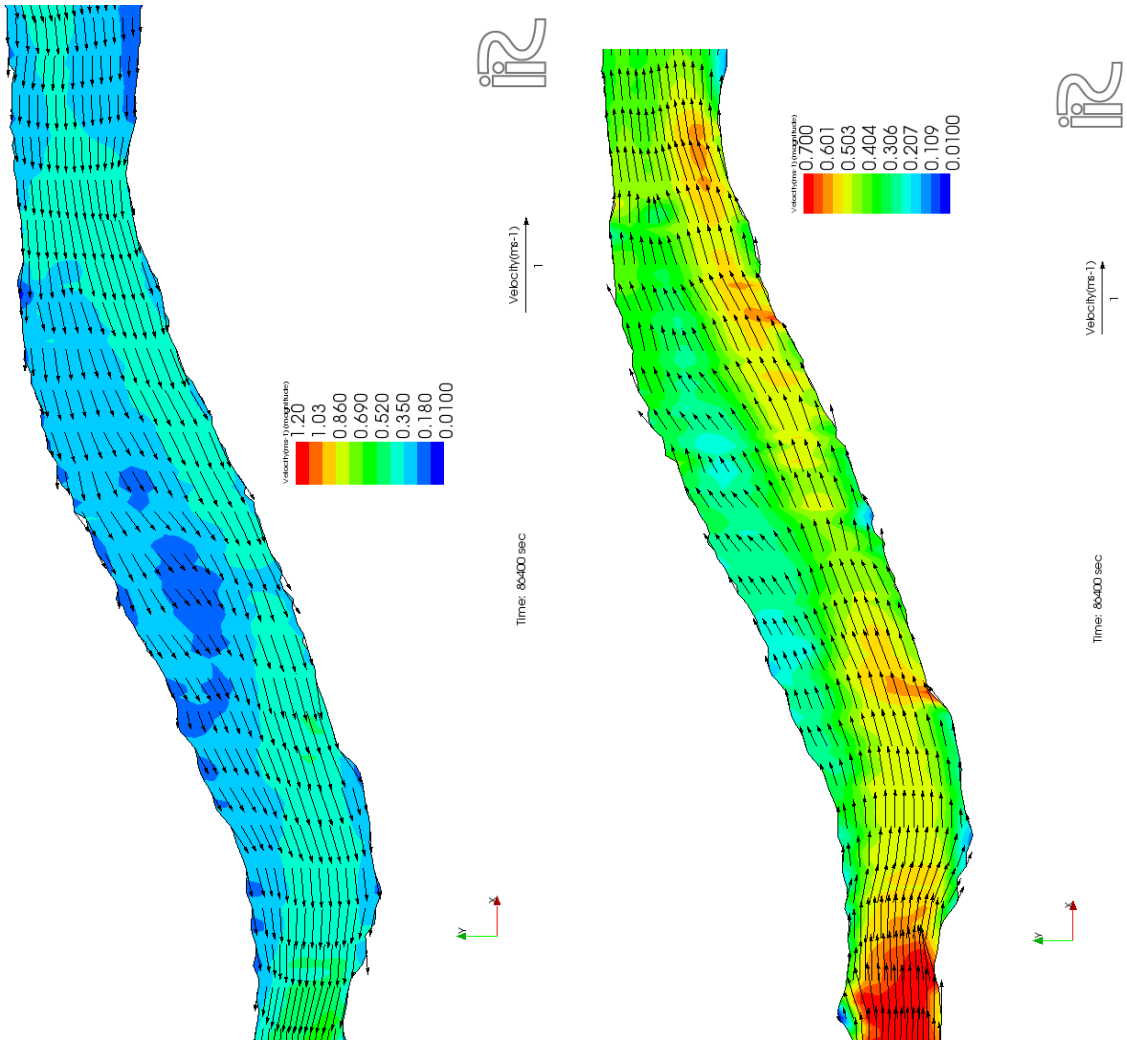



Figure 3.4: Simulated velocity flow field for ebb and high tide cases for the study reach Joymonirgol to confluence channel

The velocity flow field is also considered in finalizing the best suited alignment of dredging for the navigability of 10 m draft vessel. The dominant flow direction and available deeper channel are the basis of selecting the best suitable navigational route. If the tidal current is parallel to the dredged channel, then backfilling rate is less and the cross current accelerates the sedimentation rate in the dredged channel. To keep the navigational channel sustainable, effectiveness of various dredging alignment had been assessed. When a navigation channel has a bend, the intersection angle of centerlines of channel as the bend shall be made as small as possible. According to "Technical Standard and Commentaries for Port and Harbour Facilities" it is advisable that the intersection angle of channel centerlines at a bend will not exceed approximately 30 degrees. The width of the channel at such a bend should be equal to or larger than the required width. Considering all the issues the dredging alignment is proposed and given in Figures below.

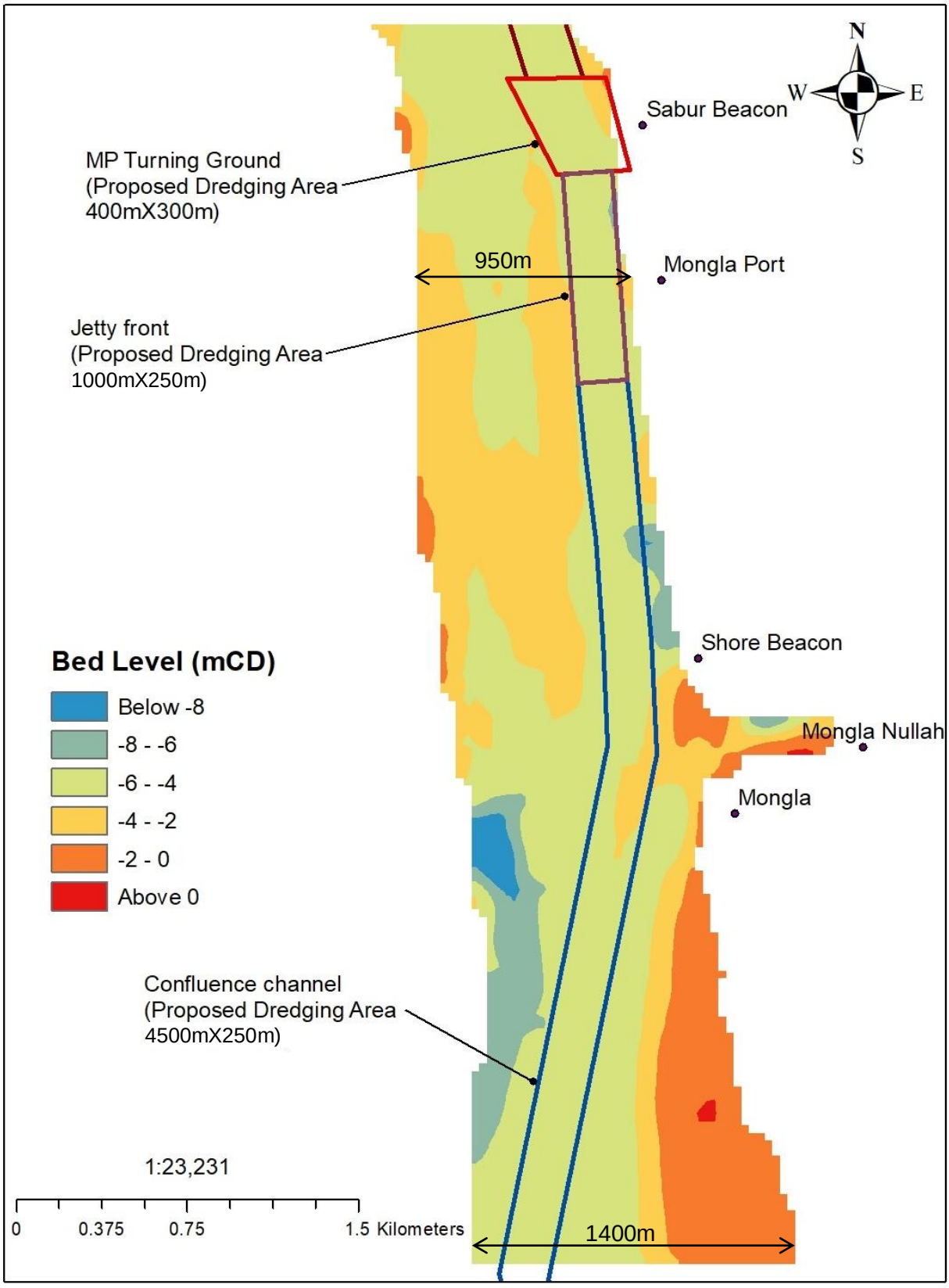



Figure 3.5: Layout of dredging area from Mongla Port Turning Ground to Confluence Channel

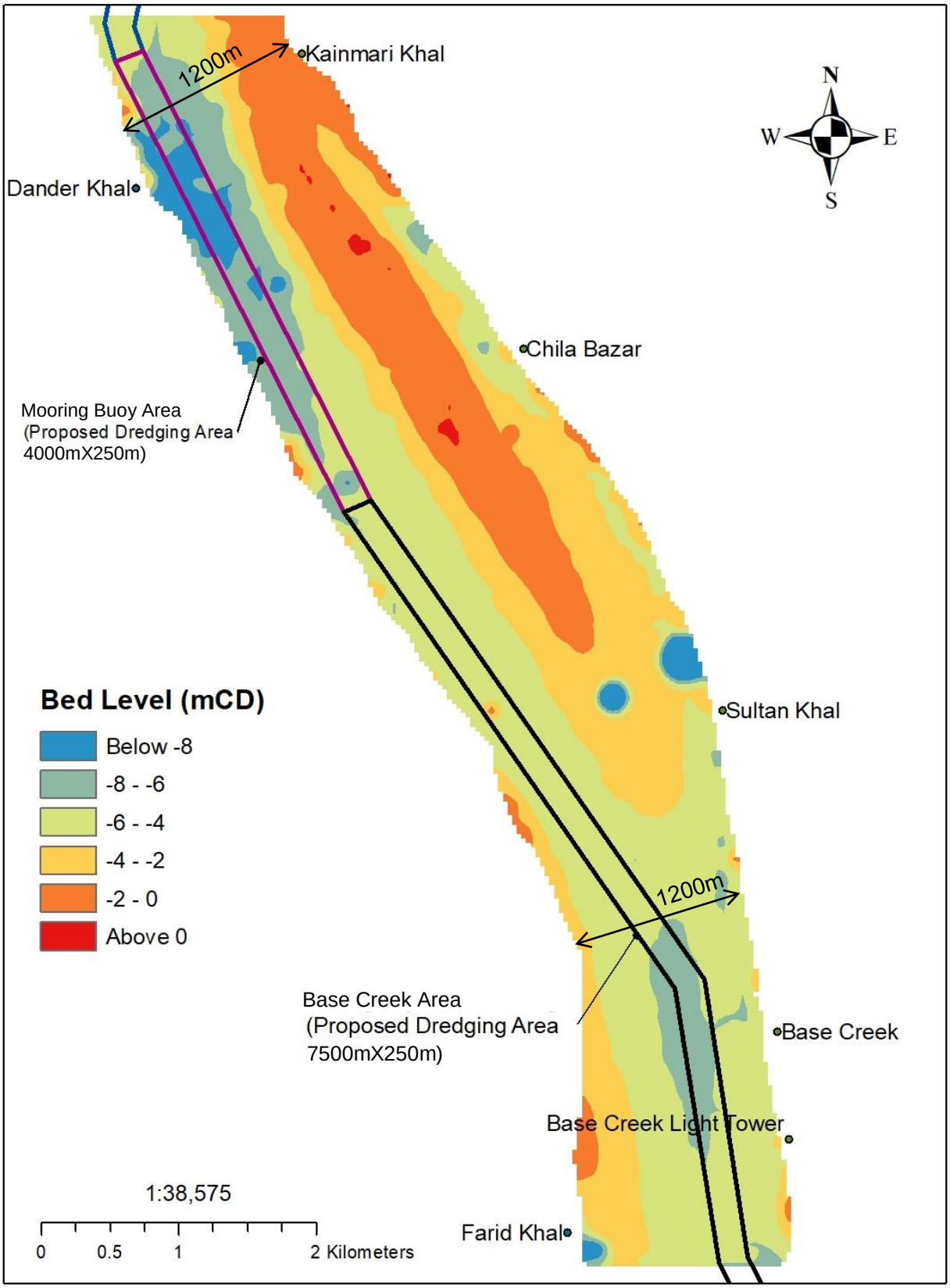



Figure 3.6: Layout of dredging area from Muring Boya to Base Creek

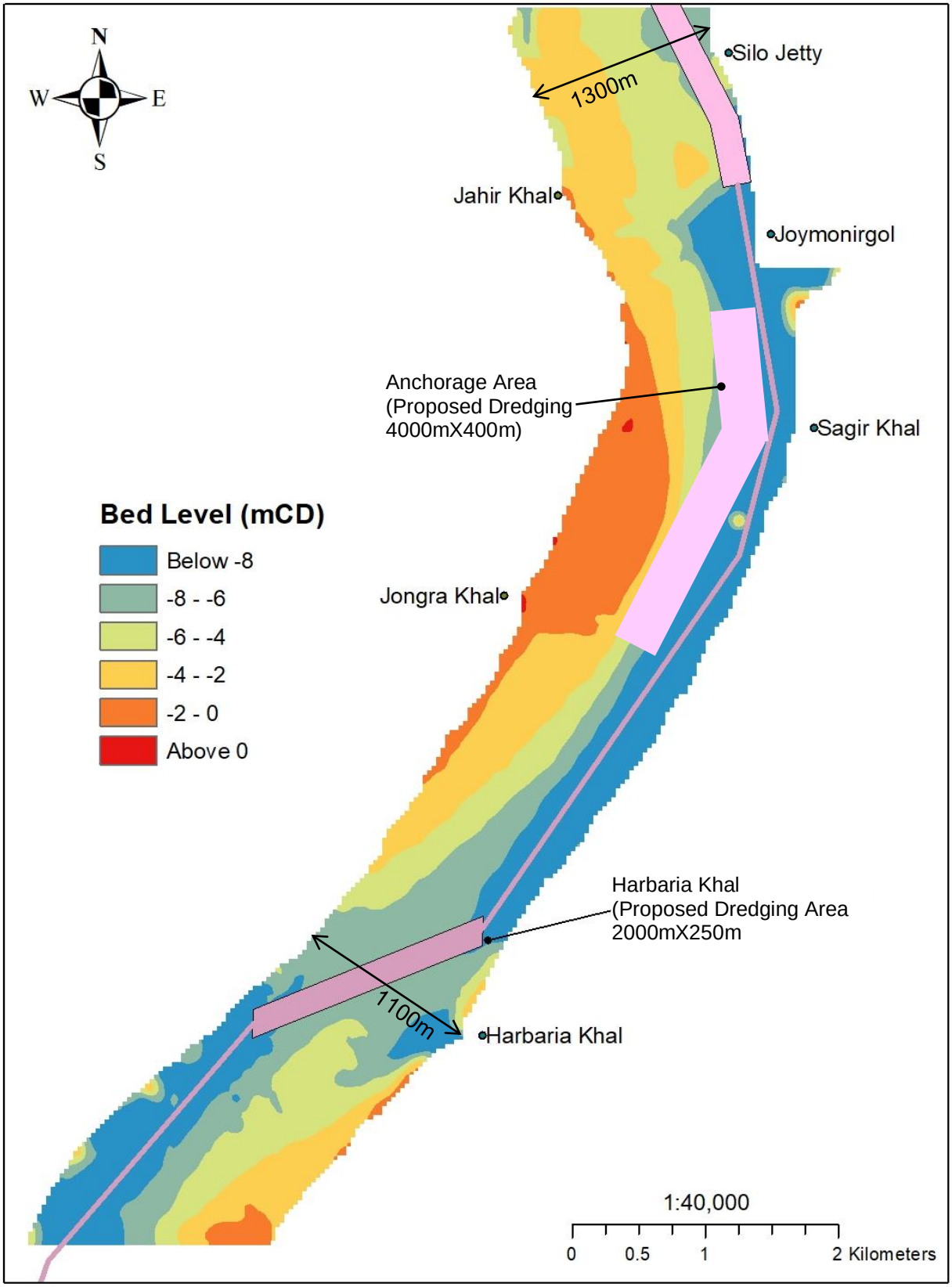



Figure 3.7: Layout of dredging area from Food Silo Jetty to Harbaria Khal

## 3.3 Dredging Volume

To maintain 8.5 mCD draft in the navigational channel, it is observed that the dredging will be required from Mongla Port to Harbaria area. Table 3.2 shows the estimated volume of dredging for a channel width of 250 m and depth 8.5 mCD in the channel and 10.5 mCD in the jetty front area. The total dredging volume has been estimated to be 21.61 $Mm^3$.

Table 3.2: Estimated Dredging Volume (Channel width 250m, Depth 8.5 mCD in channel & 10.5 mCD in jetty front area)

| Location | Size of dredge channel (m) | Present Avg. (m) | Design depth +Toler 0.5m (m) | Avg. Cutting (m) | Channel Volume ($Mm^3$) | Side Slope ($Mm^3$) | Total volume ($Mm^3$) |
|---|---|---|---|---|---|---|---|
| **Mongla Port Jetty to Harbaria Khal** | | | | | | | |
| Jetty Front (by CSD) | 1000×250 | 6.50 | 10.50 + 0.5 | 4.50 | 1.125 | 0.177 | 1.302 |
| Turning Ground (by CSD) | 400×300 | 5.00 | 8.50 + 0.5 | 4.00 | 0.480 | 0.078 | 0.558 |
| Confluence Channel (by CSD) | 4500×250 | 5.61 | 8.50 + 0.5 | 3.39 | 3.819 | 0.383 | 4.202 |
| Mooring Buoy (by CSD) | 4000×250 | 6.00 | 8.50 + 0.5 | 3.00 | 3.000 | 0.268 | 3.268 |
| Base Creek Area (by CSD) | 7500×250 | 5.50 | 8.50 + 0.5 | 3.15 | 5.906 | 0.538 | 6.445 |
| Anchorage Area (by TSHD) | 4000×400 | 6.5 | 8.50 + 0.5 | 2.50 | 4.000 | 0.193 | 4.193 |
| Harbaria Khal Area (by TSHD) | 2000×250 | 6.00 | 8.50 + 0.5 | 3.00 | 1.500 | 0.142 | 1.642 |
| **Total** | | | | | | | **21.61** |

## Selection of Dredging Method

In this dredging project, considering the availability of dumping sites, type of dredging material, "Cutter Suction Dredger (CSD)" may be chosen for Mongla Port Jetty to Base Creek area and "Trailer Suction Hooper Dredger (TSHD)" is considered for Harbaria Anchorage area. A brief description of these dredgers is shown below:

### (a) Cutter Suction Dredger (CSD)

The cutter suction dredger may be self-propelled but is more commonly non-self-propelled. Dredging only takes place with the dredger moored in some way and it involves an initial

powerful cutting action with suction and pump discharge to barges or, more commonly, via a pipeline to a remote onshore area for disposal or land reclamation. The main advantages of the cutter suction dredger are as follows:

- An ability to dredge a very wide range of material, including weak rocks, and to convey by pumping the dredged material, with water, directly to the disposal or reclamation area;

- An ability to operate in shallow water to produce a fairly uniform level bottom and a relatively high rate of production.

The disadvantages of the cutter suction dredger include a pronounced sensitivity to sea conditions among all but the largest dredgers, a fairly limited distance through which dredged materials can be economically conveyed, fairly severe dilution of the dredged material, a fairly limited dredging depth and high mobilization costs. The cutter suction dredger is normally rated according to either the diameter of the discharge pipe, or by the cutter head driving horsepower, or in the case of very large dredgers by the total installed horsepower. The positioning and control of the dredger is usually by means of a combination of spuds and winches. Occasionally only winches may be employed. Even more rarely, only spuds may be employed. The discharge from the dredge pump passes over the stern of the pontoon to a heavy hose or flexible coupling, to which is connected a floating pipeline. Sometimes an intermediate seabed pipeline may be used. The disadvantages of the backhoe dredger mainly relate to a low rate of production when compared with those dredgers in which the dredging process is relatively continuous (i.e. cutter suction and bucket dredgers) and its considerable dependence on the skill of the operator.

### (b) Trailing Suction Hopper Dredger (TSHD)

The trailing suction hopper dredger is a ship which has an ability to load its own hold, called a hopper, by means of a centrifugal pump and dredges while moving freely. Discharge is normally by means of a bottom dumping arrangement or occasionally by pump discharge, which is usually to the shore.

The main advantages of the trailing suction hopper dredger are a relative immunity to adverse weather and sea conditions, an independence of operation, a minimal effect on other shipping when working in areas of shipping movement, an ability to transport spoil over long distances, a relatively high rate of production and usually a simple and hence inexpensive mobilization procedure.

The main disadvantages are an inability to dredge materials with significant inherent strength, an inability to work in areas of very restricted navigation, sensitivity to significant concentrations of foreign matter or debris and a tendency to significantly dilute the dredged

materials during the loading process particularly when it is composed of fine particles. The trailing suction hopper dredger is usually rated according to its maximum hopper capacity. When the objective of the work is to reclaim land, it may be preferable to pump discharge the dredged materials directly from the hopper into the reclamation area. Some trailing suction dredgers are specially constructed to permit this operation. Since the dredge pumps of the normal trailing suction hopper dredger are usually low head pumps, the trailing suction hopper dredger cannot normally pump discharge through long pipelines unless intermediate booster pumps are employed.

**Selected Dredger for this Project:**

Cutter Suction Dredger (CSD) => Mongla Port Turning Ground to Base Creek (17.4 km)

- *2 Nos. of Dredger will be Operated at Distance 10 km Apart.*
- *Dredging Capacity 30000~35000 $m^3$/day and Operational Time 20 hours/day.*
- *Dredging Area Covered at Passur Channel will be approximately 10000 $m^2$/day.*

Trailing Suction Hopper Dredger (TSHD) => Anchorage Area to Harbaria (6 km)

- *2 Nos. of Dredger will be Operated at Distance 4 km Apart.*
- *Dredging Capacity 20000~25000 $m^3$/day and Operational Time 24 hours/day.*
- *Dredging Area Covered at Passur Channel will be approximately 8000 $m^2$/day.*

## 3.4 Disposal Location

Consideration of suitable site selection for dredging as well as safe disposal of dredged spoils is essential to arrive at feasible and environmentally sound option. One of the main challenges of dredging program is disposal of dredged spoil, which requires technical, environmental and social considerations. The dredged spoil is, in principle, disposed on the locations where natural sedimentation may not be expected and there is no scope of re-suspension of dredged spoil into the dredged channel. These locations are the inner bends, abandoned channels, deeper channel with strong currents, along the shoals and on slope of swatch of no ground. One of the objectives of this study is to identify the potential dumping sites for the dredged materials. For the dumping of dredged materials, potential locations of the Dumping sites from Mongla Port Jetty to Harbaria have been demarcated as in figure below:


Figure 3.8: Potential Dumping sites from Mongla Port Jetty to Harbaria Khal

Table 3.2: Area of the proposed disposal sites

| Location ID | Area (Acre) |
|---|---|
| C2 | 45 |
| C3 | 34 |
| C4 | 270 |
| C5 | 90 |
| C6 | 239 |
| C7 | 130 |
| C8 | 93 |
| C9 | 95 |
| C11 | 550 |
| C12 | 114 |
| C13 | 34 |
| Total Area | 1694 |

The proposed disposal sites bounded areas are mostly used as fish farming "Gher" activities by leasing from different landowners with yearly lump sum money. In case of dredged materials dumping in those selected sites, the land owners/people involved will be compensated @ Tk 20000/Acre/yr for 10 years and then potential agriculture by the land owner. Furthermore (if required), provision for Geo-tube Dyke (Mongla River to Chilla Bazar) has been kept for approximately 500 Acres of land (Length 5 km, Width 500 m) at river front.

**Recent Dredging History of Passur River**

***Capital Dredging***

Three capital dredging projects have been implemented in the year 1991 - 1992, 2000 - 2004 & 2013-2014. The most recent capital Dredging project entitled "Harbour Area Dredging" has been completed in the year 2014. After completion of this project, ships having draft of 7.50 m can easily take berth at Mongla Port. The details of recent Capital Dredging Projects are described in Table 3.3.

Table 3.3: Details of Recent Capital Dredging in Passur Channel

| Dredging period | Dredging Company | Dredging Area | Dredging Quantity ($Mm^3$) | Dredger Type |
|---|---|---|---|---|
| 1991-1992 | China Harbour Engineering Company | Harbour | 3.551 | CSD |
| 2000-2004 | PT. Rukindo- Basic Dredging Partnership | Harbour | 2.79 | CSD & TSHD |
| 2013-2014 | China Harbour Engineering Company | Harbour | 3.406 | CSD |
| **Total** | | | **9.747** | |

***Maintenance Dredging***

Mongla Port was originally designed for berthing ships having 8.50 m draft. Until 1980, there was limited siltation problem in Jetty front or Channel areas. However, after 1980, siltation started in Jetty front area and from that time regular maintenance dredging had been performed. Then, further siltation was noticed in Harbour Area (About 13 km downstream from Port Jetty). The total volume dredged over the period 1979 to 2016 is about 12.9 $Mm^3$, which is equivalent to an average 0.35$Mm^3$ per year. Out of 37 years record, around 3.0 $Mm^3$ dredging was done in the Jetty Front to maintain the berthing pocket alongside the jetty. This is a localized dredging requirement and for maintenance dredging the practice has been using Cutter suction dredger.

**Bangladesh Delta Plan (BDP) 2100:**

Bangladesh Delta Plan -2100 recommends the improvement of navigation and flow in the Sundarbans Rivers by regular dredging operation.

## 3.5 Project Schedule

Table 3.4: Project Schedule

| Sl. No. | Activity | Years/Months | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | | | | | | | 2021 | | | | | | | | | | | | 2022 | | | | |
| | | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M |
| 1.0 | Mobilization | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.0 | Reconnaissance Site Visit | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.0 | Collection and Review of Data, Maps and Charts | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.0 | Dredging Plan and Operation at Site | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1 | Preparation of dredging Plan | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2 | Dredging Operation | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.0 | Completion of Dredging Operation and Demobilization | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.0 | Joint Pre, Interim & Post Survey and Monitoring Survey | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.0 | Reporting | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Continuous | | | | | | | | | | | | Intermittent | | | | | | | | | | | |

# Chapter 4
# DESCRIPTION OF THE ENVIRONMENT

## 4.1 General

Baseline environmental condition around the proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port (Figure 4.1) has been investigated to depict the state of the environment before the onset of the proposed development. For projects with long lead-in times however, need to consider what the future state of environment will be at the time that the project comes to fruition. This will be an important consideration for aspects of the environment which exhibit trends over time, such as levels of air pollutants, noise, greenhouse gases, water resources, land use pattern, etc. For the proposed project, the consequent future state of environmental quality will be assessed in comparison with statutory standards set by the government. Moreover, during Dredging and River Training work, major assessment will be required for any inevitable situation leading to some negative impacts on the ecology of the route corridor.


Figure 4.1: Passur River course with important locations

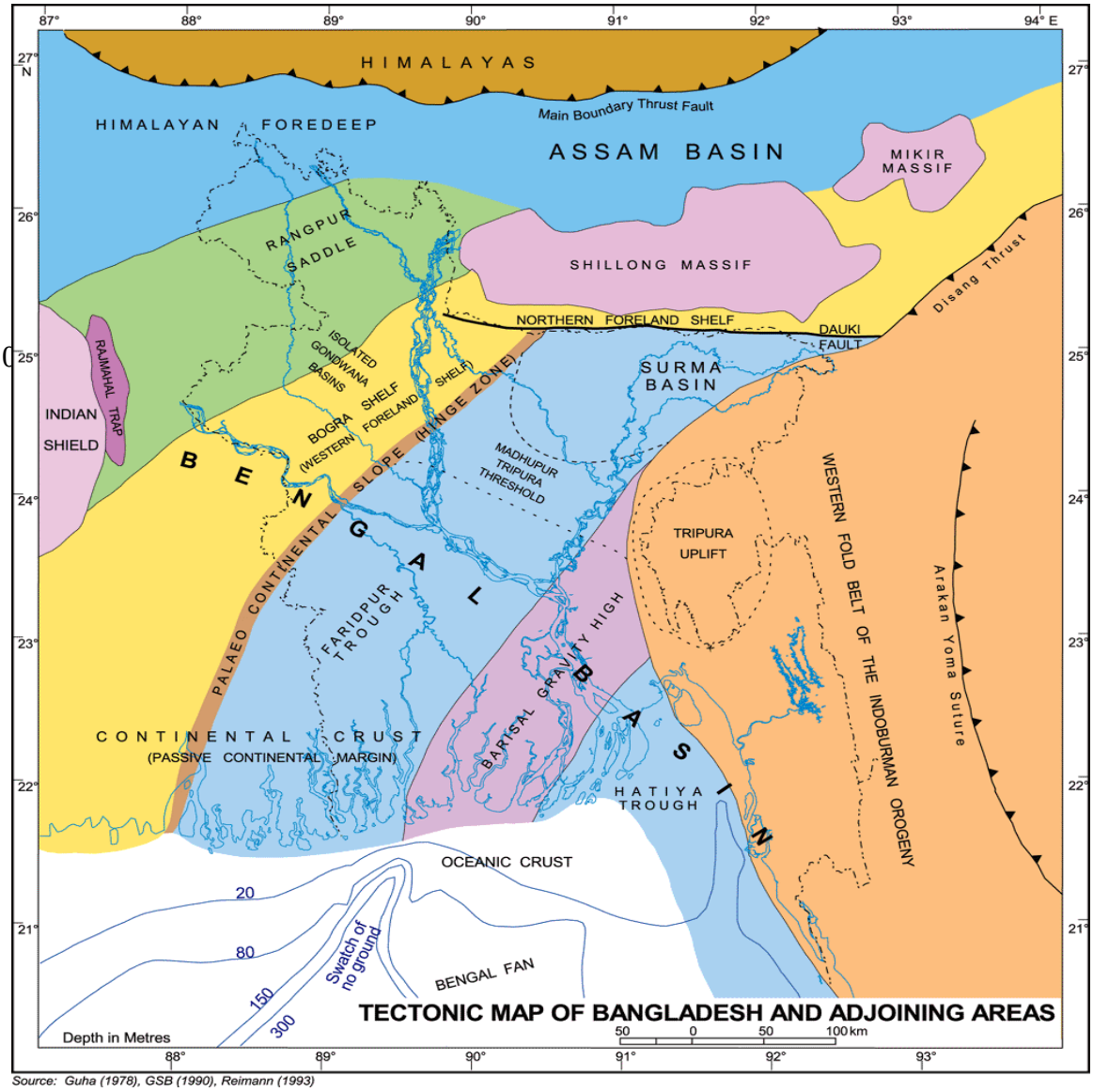
## 4.2 Physical Environment

### 4.2.1 Land Use Pattern

The proposed study area is located in the Southwestern region of Bangladesh, which is a part of alluvial delta formed by major rivers originating from the Himalayas in the North. The landscape of the site is characterized by coastal land and tidal creeks. The Sundarbans mangrove forest along the Passur River is the major landscape features. Some shrimp farming land nearby Passur River are also available. Tidal action is dominant in the Passur River. Except Mongla port area and Hiron Point the human settlement is negligible in the study area. The Passur River is navigable throughout the year and ships can approach with the maximum allowable draught of 6 to 6.5 m easily up to Mongla Port. The Passur is an important river route through which Indian vessels under transit agreement, clinker carrying vessels, LPG carrying vessels, fuel carrying vessels, maritime transportation vessels of approaching and departing Mongla Port, barges, Khulna-Barisal steamboats and other vessels ply round the year. The Passur and its distributaries are tidal channels and is the main river to control drainage system of the total study and project area. The nearest location of the Sundarbans is around 7 km from Mongla Port. The Mongla Port Authority (MPA) together with Mongla EPZ and other industrial setups are substantial with regards to overall economic development as well as job opportunities for the entire southwestern region of the country.

### 4.2.2 Geographic Location and Seismicity

The proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port located in the Bengal basin –an extensive alluvial plain of the Quaternary sediments laid down by Ganges-Brahmaputra-Meghna river system. Physiographically, this area is tidal delta and saline enriched shallow aquifer. As per tectonic classification, the area falls under Faridpur trough of Western platform flank which is adjacent to the hinge line (Figure 4.2). Tectonically, this area is inactive and no apparent major structure like fault or fold exists in the region that might be geologically significant. Seismically, it is in the quiet zone and the only historic high magnitude earthquake occurred in this zone was centered in the Sundarbans. Bangladesh National Building Codes (BNBC) suggested Seismic co-efficient for this zone is shown in Figure 4.2.



Source: Guha (1978), GSB (1990), Reimann (1993)

Figure 4.2: Generalized tectonic map of Bangladesh (*Source: GSB, 1990*)

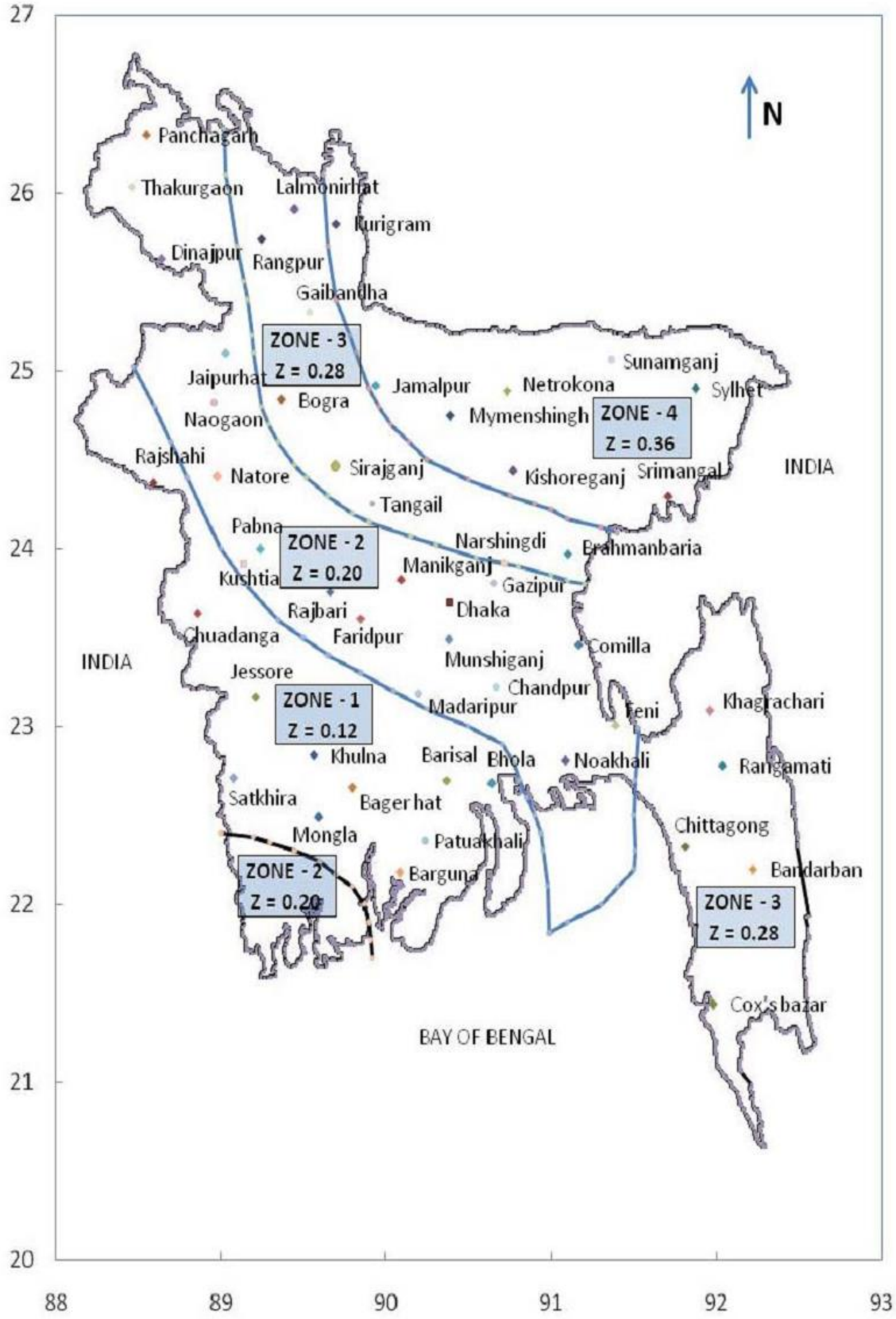



Figure 4.3: Tectonic map of Bangladesh *(Source: BNBC, 2011)*

### 4.2.3 Transportation System

**Road communication system**

The proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port site is located in Mongla and Hiron Point Upazila of Bagerhat district. The Khulna-Mongla highway (Figure 4.4) is 42 km long and nearby towns include Bagerhat District Town, Gopalganj District Town and Old Mongla Port Town (1 & 2). The Khulna-Mongla highway is the main mode of road communication with Districts, Divisions and the Capital city from Mongla Port.


Figure 4.4: Existing Road Communication System (Khulna-Mongla Highway)

**Water communication**

Passur River is the main water communication system (Figure 4.5) in the proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port site. There are two ports in the study area. These are Mongla port as a seaport and Chalna port as a river port. The depth of Passur River varies from 8 to 11 meter during high tide. The river is deep and navigable throughout the year and large marine ships can easily enter the Mongla seaport

through Akram point. A few local boat points exist in Dighraj, Biddarbaon and Kaigar Dashkati in the study area.

Figure 4.5: Existing Water Communication System (Passur River and Mongla Nala)

**Railway communication system**

Since the termination of the Khulna-Bagerhat rail route in 1980s, there is no railway communication system in the study area. However, in Khulna division, the broad gauge line has been established that connects Khulna with other areas of Bangladesh. Recently, Bangladesh Railway has planned to establish the rail traffic between Khulna and Mongla. A railway bridge on Rupsa River is under construction to connect Mongla with rail network through Fultala station in Khulna.

### 4.2.4 Climatic Condition and Cyclones

The Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port site lies in the South-central climate zone of the country (Figure 4.6) and shows tropical monsoon climate with three prominent seasons - Summer/Pre-monsoon - March to May; Rainy season/monsoon - June to October; and Winter season - November to February. The rainy season is humid, and characterized by heavy rainfall, tropical depression and cyclones. The winter is predominately cool and dry. The summer is hot and dry interrupted by occasional heavy rainfall. Gentle north/north-westerly winds with occasional thunderstorms during summer and southerly wind with occasional cyclones during monsoon are prominent wind characteristics of the region.

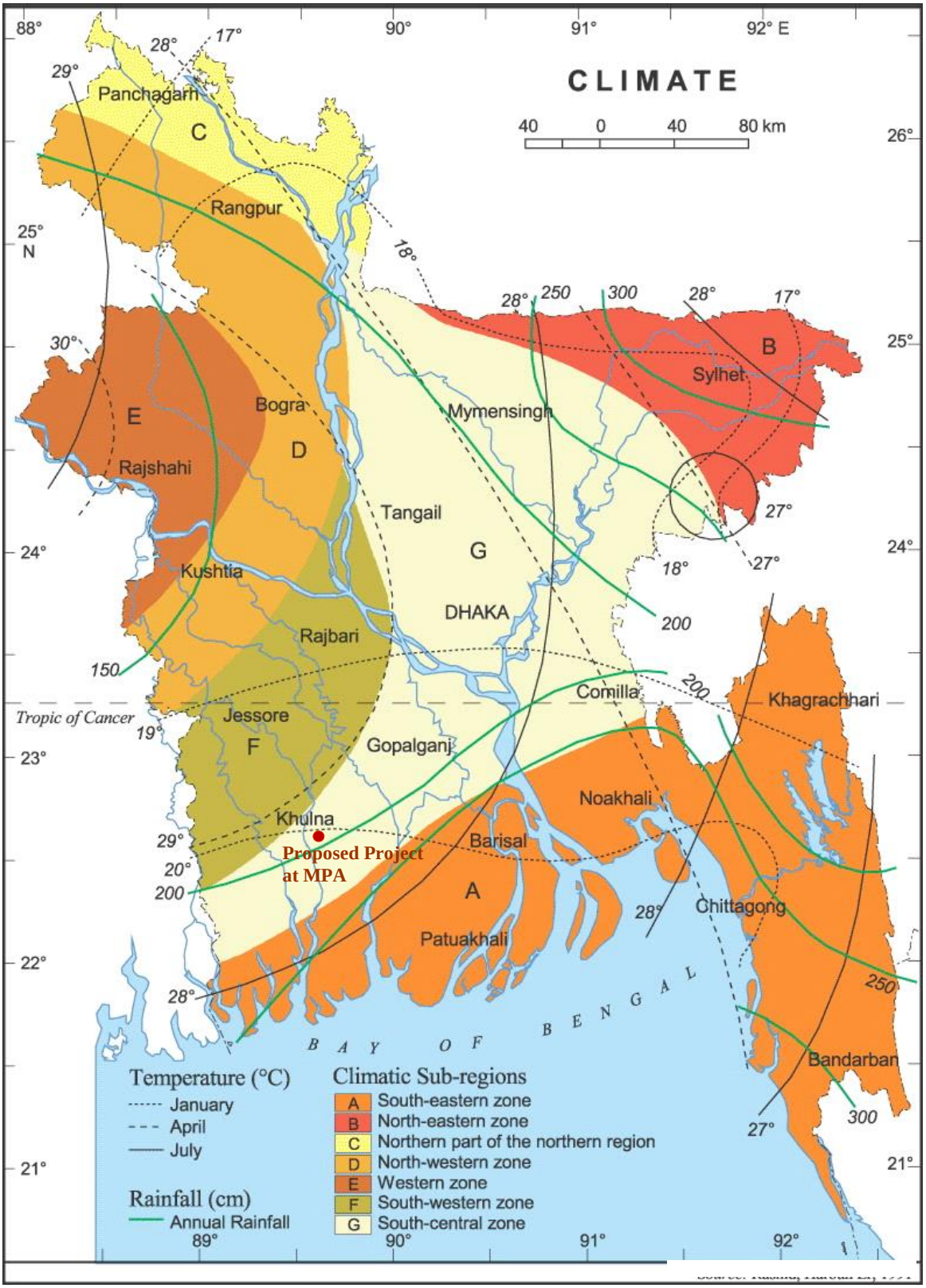



Figure 4.6: Climatic Sub-region of Bangladesh *(Source: Asiatic Society of Bangladesh, 2006)*

### 4.2.5 Temperature

In the project area, the seasonal variation of temperature is distinct but does not vary largely. Data of last 27 years (1989-2015) shows that monthly average maximum temperature varies from 25.30$^0$C to 34.62$^0$C (Figure 4.7) while April is the warmest month and January is the coldest month. The highest maximum temperature ever recorded within the last 25 years is 36.57$^0$C during May 1995 and the lowest ever recorded minimum temperature is 12.21$^0$C during January, 2003.

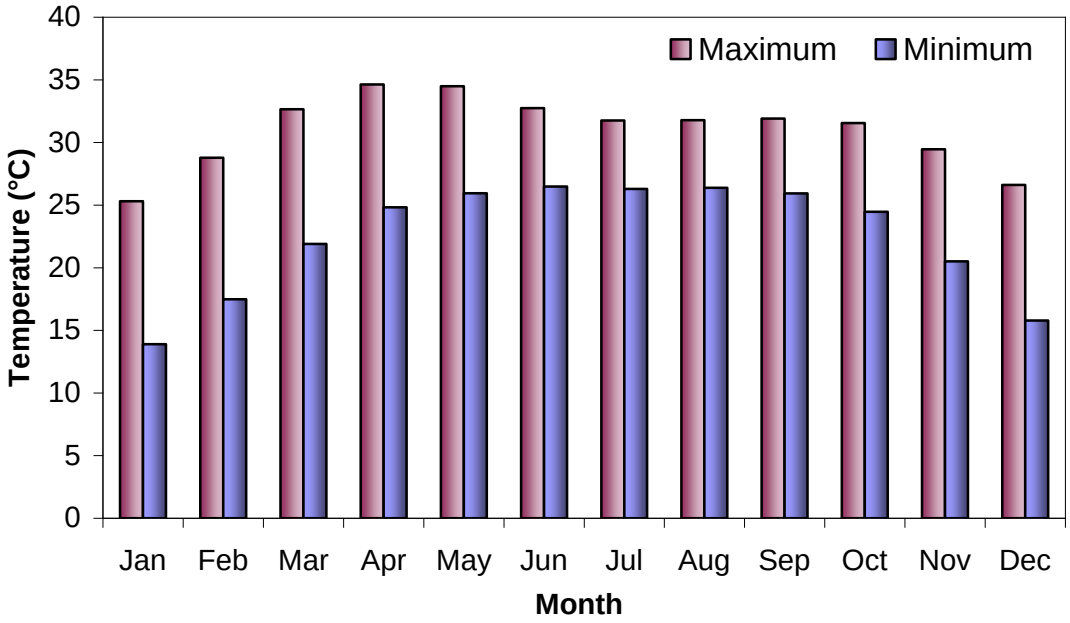



Figure 4.7: Average of last 27 years (1989-2015) monthly temperature in Mongla *(Data Source: Mongla Weather Station, Bangladesh Meteorological Department)*

### 4.2.6 Humidity

The monthly average relative humidity in the nearby Mongla Station of project area varies seasonally from 70% to 90%. June, July and August are the most humid months (80 % to 90 %) while January to March humidity remains the lowest (20% to 30%). Figure 4.8 shows the average monthly humidity of last 27 years (1989 to 2015).

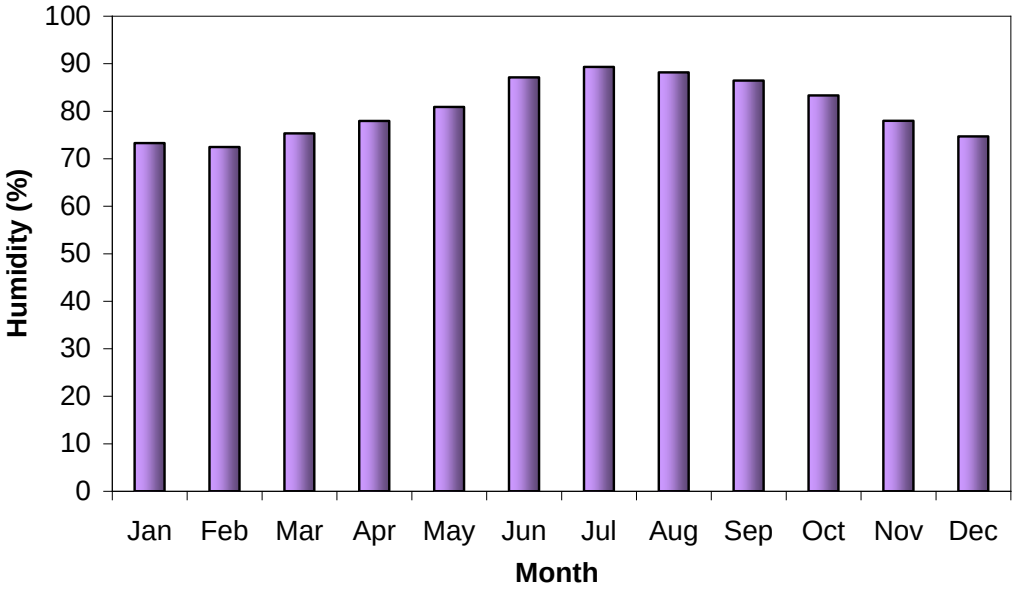



Figure 4.8: Average of last 27 years (1989-2015) monthly humidity in Mongla *(Data Source: Mongla Weather Station, Bangladesh Meteorological Department)*

### 4.2.7 Rainfall

The project area lies in the South-central climate zone of the country and shows tropical monsoon climate and hence rainy season is very prominent in this region. The annual average rainfall is 1946 mm/yr as per last 27 years recorded data of Mongla weather station. Eighteen years average of monthly rainfall is presented in Figure 4.9. June to September has maximum rainfall of the year and it varies in the range of 300 mm to 350 mm. Nevertheless, winter season shows no rain or very little.

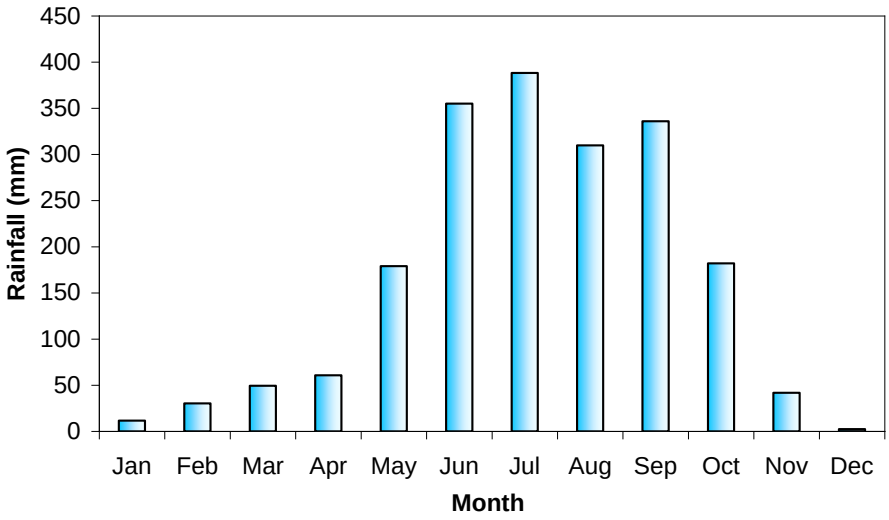



Figure 4.9: Average of last 27 years (1989-2015) monthly rainfall in Mongla (*Data Source: Mongla Weather Station, Bangladesh Meteorological Department)*

### 4.2.8 Wind Speed and Direction

The project area is characterized by Southerly wind from the Bay of Bengal during monsoon and Northwesterly wind from Himalayas during winter. The wind roses for Khulna show average wind direction and speed for different period of a year (Figure 4.10-4.13). The yearly average wind rose suggests that wind prevails flowing from south to north direction in most of the time in a year (Figure 4.10). During November to February, maximum prevailing wind flows from north and north-west to south and southeast direction (Figure 4.11). During March to April wind mostly flows from south and southwest to north and northeast, (Figure 4.12) and during May to October it flows from south to north and southeast to northwest direction (Figure 4.13).

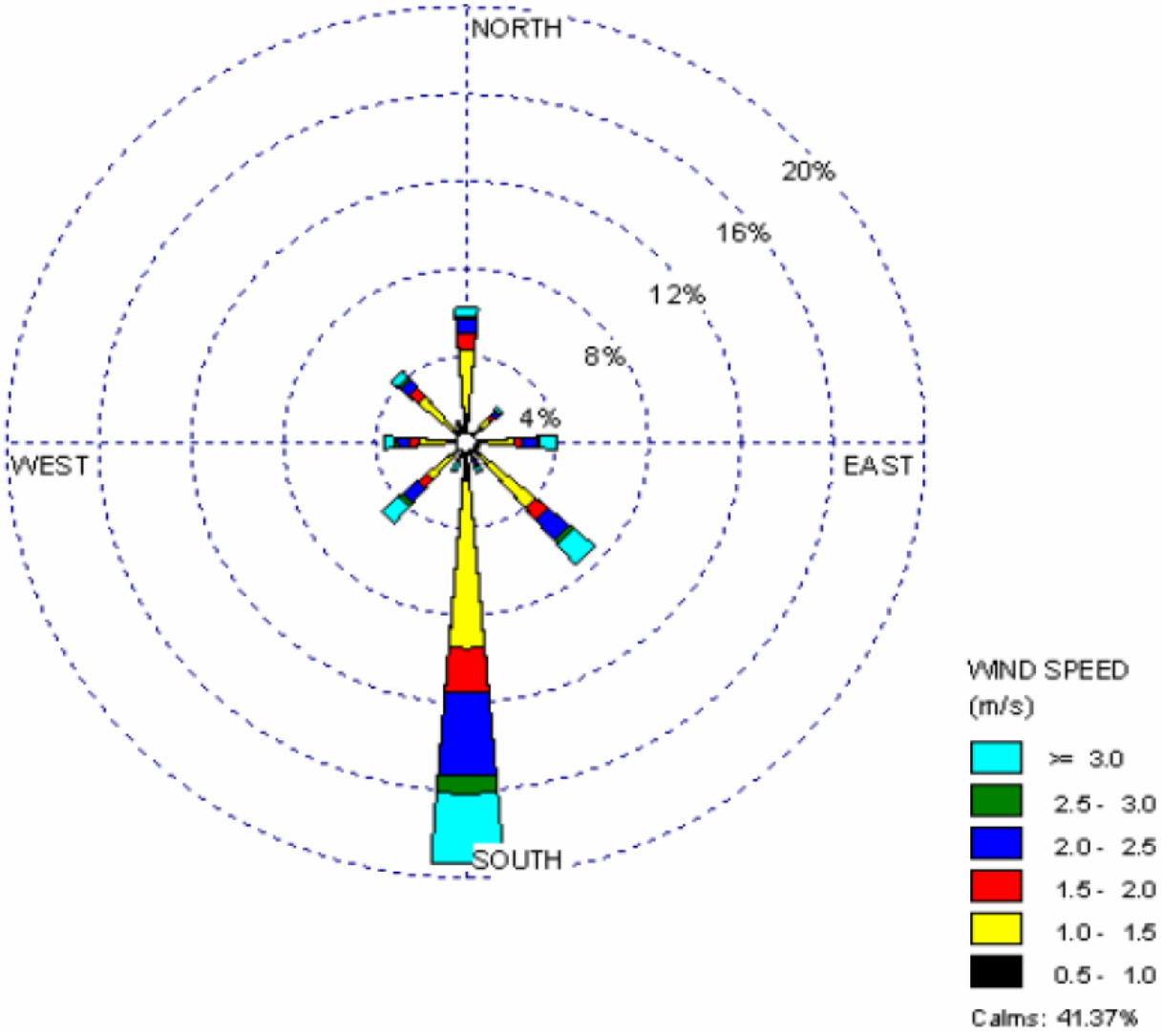



Figure 4.10: Wind rose for Khulna for a year (SMEC, 2006)

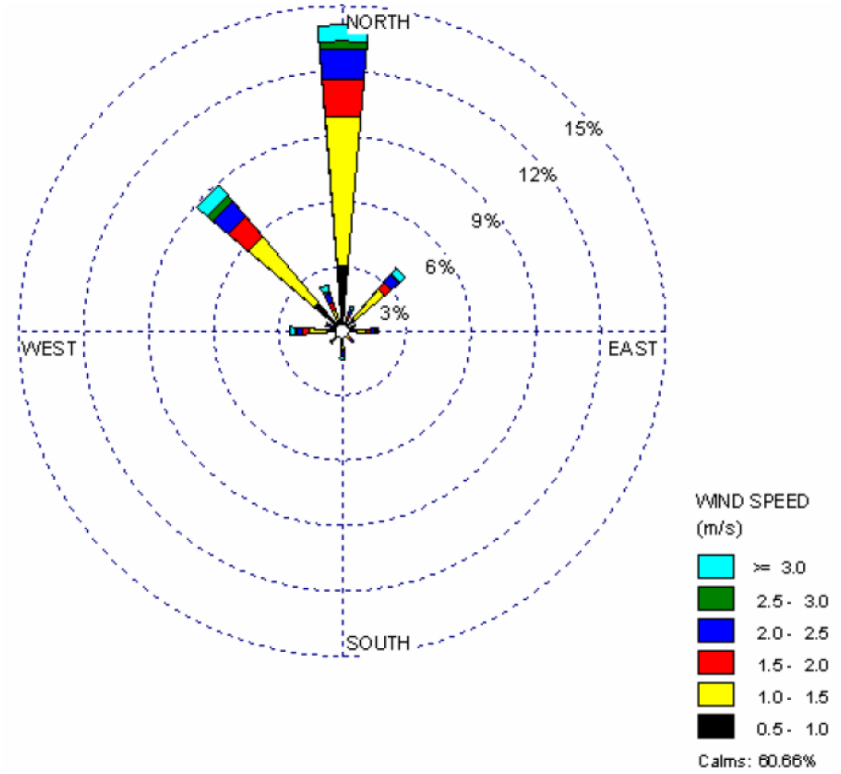



Figure 4.11: Wind rose for Khulna for the period of November to February (SMEC, 2006)

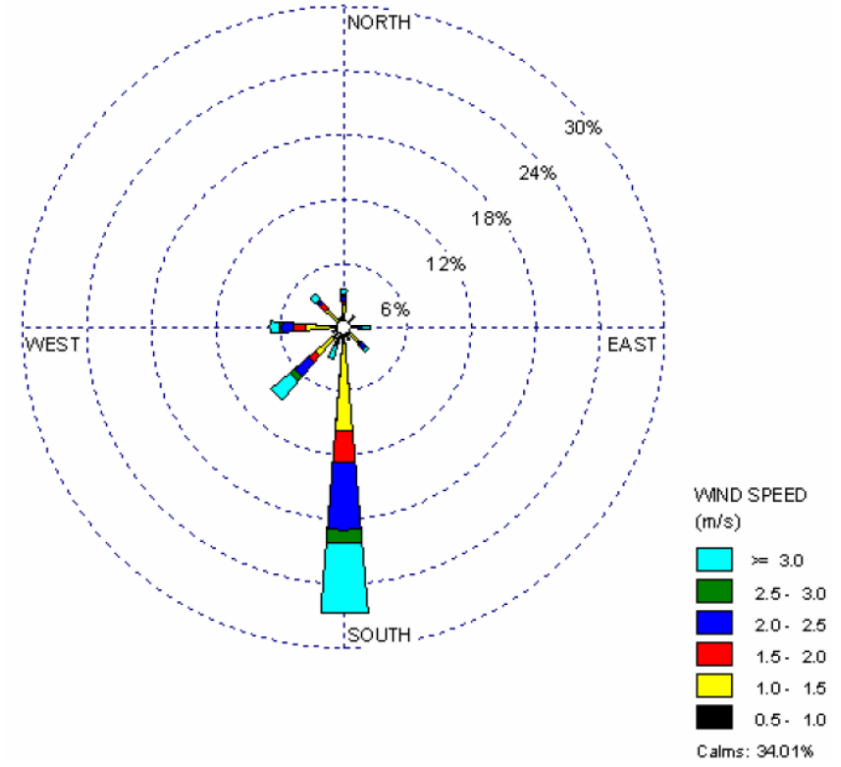



Figure 4.12: Wind rose for Khulna for the period of March to April (SMEC, 2006)

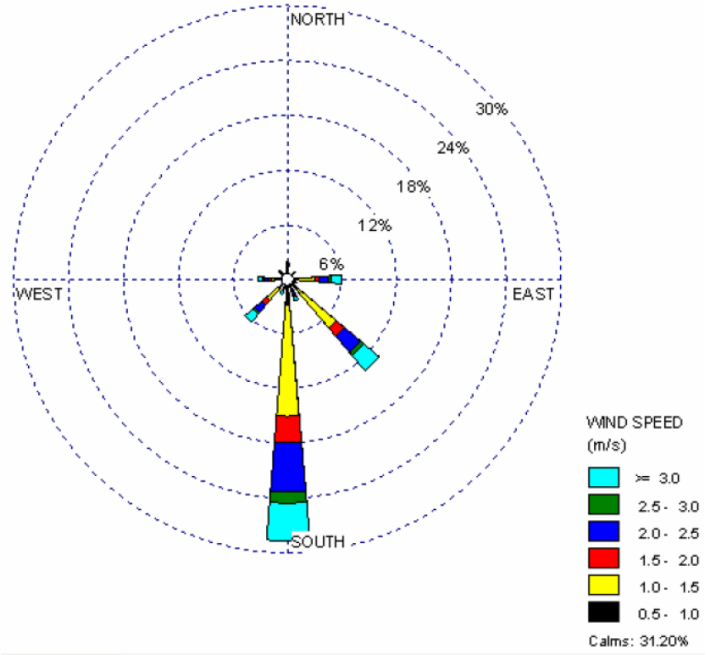



Figure 4.13: Wind rose for Khulna for the period of May to October (SMEC, 2006)

### 4.2.9 Meteorological Conditions

To define meteorological conditions in and around the proposed dredging area of the project, temperature, humidity, wind data as well as noise level were collected from nine different locations during March 2018. Table 4.1 shows the summery of the meteorological data.

Table 4.1: Meteorological data at Different Locations of Passur Channel (Collected on March 2018)

| Locations | GPS Co-ordinates | Date & Time | Air Temp. (°C) | Humidity (%) | Noise Level (dB) | Wind Velocity (m/Sec) | Tidal Condition |
|---|---|---|---|---|---|---|---|
| Monkey Point | $22^0 14' 03'' N$ $89^0 34' 51'' E$ | 24/03/18 12:00 | 30.8 | 76 | 47 | 1.0 | High Tide |
| Sundary Kota | $22^0 7.8' 13'' N$ $89^0 35' 45'' E$ | 24/03/18 13:50 | 36 | 61 | 54 | 4.3 | High Tide |
| Akram Point | $22^0 00' 40'' N$ $89^0 32' 9.8'' E$ | 24/03/18 15:40 | 32.9 | 69 | 78 | 4.8 | High Tide |
| Hiron Point | $21^0 48' 00'' N$ $89^0 30' 00'' E$ | 25/03/18 14:50 | 39.8 | 49 | 62 | 4.2 | High Tide |
| Hiron Point | $21^0 48' 96'' N$ $89^0 30' 00'' E$ | 25/03/18 15:22 | 36.5 | 55 | 62 | 4.6 | High Tide |
| Hiron Point | $21^0 47' 24'' N$ $89^0 29' 34'' E$ | 25/03/18 14:00 | 35 | 66 | 54 | 3.6 | High Tide |
| Outer Bar | $21^0 36' 00'' N$ $89^0 27' 37'' E$ | 25/03/18 10:25 | 37 | 59 | 48 | 0.8 | Low Tide |
| Outer Bar | $21^0 34' 48'' N$ $89^0 27' 37'' E$ | 25/03/18 9:27 | 33 | 64 | 56 | 1.6 | Low Tide |
| Outer Bar | $21^0 36' 47'' N$ $89^0 27' 19'' E$ | 25/03/18 11:50 | 37 | 59 | 49 | 2.5 | High Tide |

### 4.2.10 Tropical Cyclones

In the coastal areas, tropical cyclones and surges are the major threats, causing loss of human lives and livestock and severe damage to crops and properties. Major 16 cyclones have occurred in the last 25 years (Table 4.2) and more than 42 cyclones had hit the coastal areas, during last 125 years (Figure 4.14) and. Last devastating cyclone 'Aila' hit the study area on 25$^{th}$ may 2009. The project area is located in the wind risk zone of Bangladesh (Figure 4.15).

Table 4.2: Major cyclones hitting the Bangladesh coast

| Date | | Maximum Wind speed (km/hr) | Storm Surge height (Meter) |
|---|---|---|---|
| 30 October | 1960 | 211 | 4.6-6.1 |
| 30 May | 1961 | 160 | 6.1-8.8 |
| 28 May | 1963 | 203 | 4.2-5.2 |
| 11 May | 1965 | 160 | 6.1-7.6 |
| 15 December | 1965 | 211 | 4.6-6.1 |
| 1 November | 1966 | 146 | 4.6-9.1 |
| 23 October | 1970 | 163 | 3.0-4.9 |
| 12 November | 1970 | 224 | 6.1-9.1 |
| 25 May | 1985 | 154 | 3.0-4.9 |
| 29 November | 1988 | 160 | 3.0-4.0 |
| 29 April | 1991 | 225 | 6.0-7.5 |
| 2 May | 1994 | 210 | 2.0-3.0 |
| 25 November | 1995 | 140 | 2.0-3.0 |
| 19 May | 1997 | 220 | 3.1-4.2 |
| 15 November (Sidr) | 2007 | 240 | up to 10 |
| 25 May (Aila) | 2009 | 120 | 3.0 |

*(Source: Bangladesh Meteorological Department, 2010)*

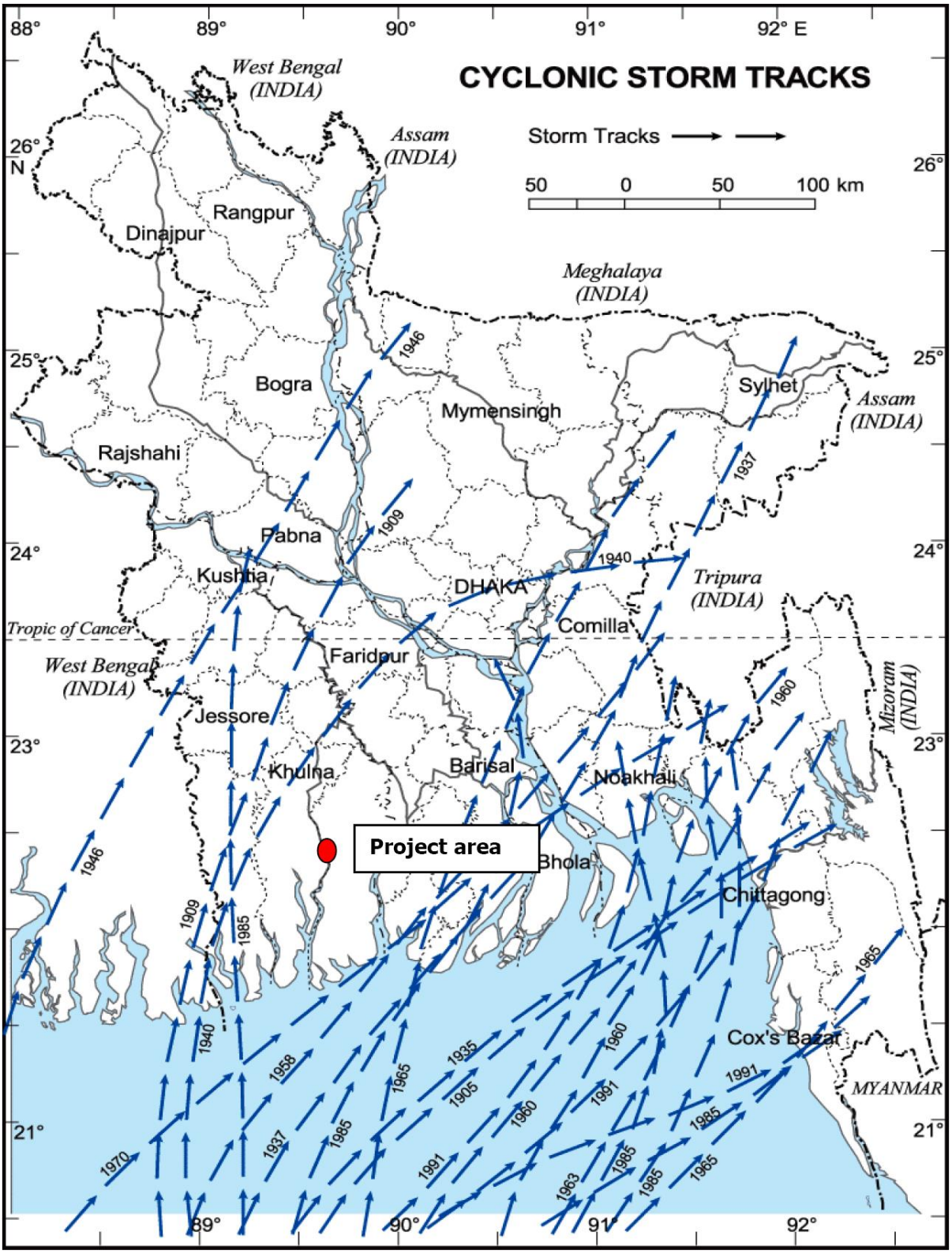



Figure 4.14: Map of previous cyclonic storm tracks (Source: MCSP, 1993)

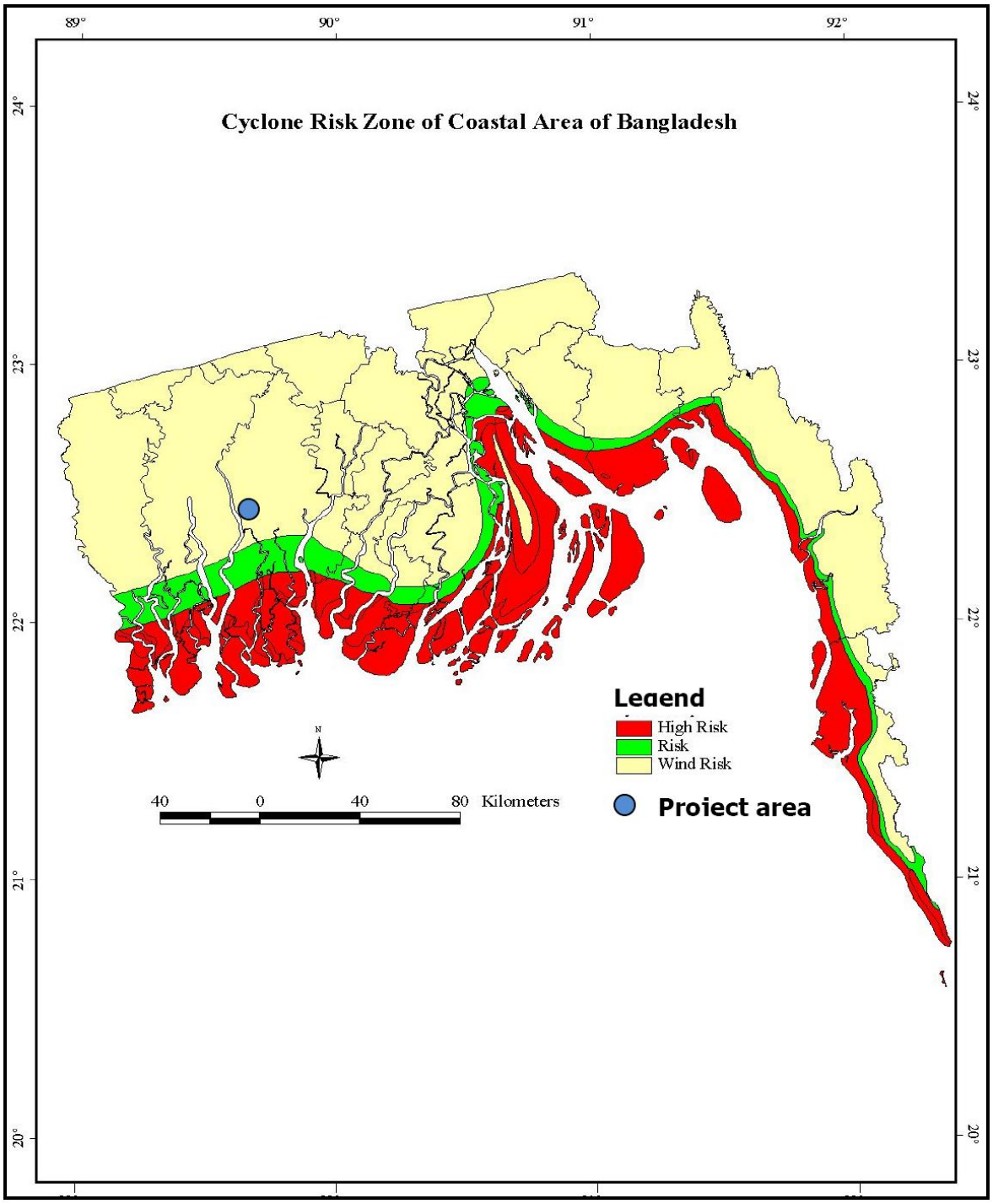



Figure 4.15: Cyclone prone areas of Bangladesh (Source: WARPO)

### 4.2.11 Water Resources

#### Surface Water Quality

Passur River is the major river in the study area as an extension of the Rupsha River. The general characteristics of the Passur River are shown Art. 4.2.12. The Mongla canal joins the

river at about 32 km south from Chalna. Flowing further south, the river meets the Sibsha at about 32 km from north from its mouth and debouches into the sea keeping its original name Passur.

Table 4.3: General characteristics of the Passur River

| **Sl.** | **Characteristics** | **Description** |
|---|---|---|
| 1. | Off take | From Gorai River |
| 2. | Outfall | Bay of Bengal |
| 3 | Physical settings of river: | |
| | Length | 131 km (Mongla Port to Fairway Buoy) |
| | Width | 700~3000 m |
| | Depth | Min. 1.4~11.7m, and Max. 7.5~29.6m below CD |
| 4. | Discharge at Mongla: | |
| | Spring tide on 03-7-2015 | 5227 ~6272 cumec |
| | Neap Tide on 25-7-2015 | 2434~3771 cumec |

*Source: Mongla Port Authority*

The river is navigable throughout the year and ships can approach with the maximum allowable draught of 6 to 6.5 m easily up to Mongla Port. The Passur is an important river route through which Indian vessels under transit agreement, clinker carrying vessels, LPG carrying vessels, fuel carrying vessels, maritime transportation vessels of approaching and departing Mongla Port, barges, Khulna-Barisal steamboats and other vessels ply round the year. The Passur and its distributaries are tidal channels and is the main river to control drainage system of the total study and project area. The general features of Passur River are presented in Table 4.3. The seasonal water quality of Passur River at Mongla port station is shown in Table 4.4. Water quality of Passur Channel during the study period of March 2018 near surface and bed at different locations are shown in Table 4.5 and Table 4.6, respectively.

Table 4.4: Seasonal water quality of Passur River at Mongla port station

| Parameter | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | 7.7 | 7.6 | 7.5 | 7.6 | 7.5 | 7.7 | 7.7 | 7.7 | 7.7 | 7.8 | 7.8 | 7.7 |
| EC (µS/cm) | 3020 | 4380 | 11780 | 25300 | 29200 | 18000 | 440 | 275 | 270 | 290 | 340 | 520 |
| $Cl^-$ (mg/L) | 880 | 1260 | 2950 | 8270 | 9470 | 5810 | 32 | 16 | 16 | 26 | 38 | 62 |
| Turbidity (NTU) | 70 | 178 | 176 | 185 | 200 | 112 | 76 | 68 | 65 | 62 | 56 | 72 |
| TDS (mg/L) | 1510 | 2180 | 5890 | 12700 | 14600 | 9000 | 220 | 160 | 135 | 145 | 170 | 260 |
| DO (mg/L) | 5.1 | 4.7 | 4.7 | 4.6 | 4.5 | 4.7 | 5.2 | 5.3 | 5.5 | 5.6 | 5.6 | 5.1 |
| BOD (mg/L) | 0.8 | 1.0 | 1.2 | 0.7 | 1.2 | 1.1 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.9 |
| COD (mg/L) | 55 | 76 | 76 | 136 | 177 | 97 | 26 | 22 | 22 | 22 | 22 | 25 |

*(Data Source: KUET; DoE 2015)*

Table 4.5: Water Quality of Passur Channel near Water Surface at Different Locations
(Field data collected on March 2018)

| Locations of Water Sample | GPS Co-ordinates | pH | EC (ms/cm) | Turbidity (NTU) | $Cl^-$ (mg/L) | TS (mg/L) | TDS (mg/L) | SS (mg/L) | $SO_4$ (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| Monkey Point | $22^0 14' 03''$N<br>$89^0 34' 51''$E | 7.58 | 10.03 | 38.5 | 11500 | 16170 | 15260 | 910 | 3100 |
| Sundary Kota | $22^0 7.8' 13''$N<br>$89^0 35' 45''$E | 7.50 | 11.46 | 93.7 | 11500 | 22940 | 21550 | 1390 | 3000 |
| Akram Point | $22^0 00' 40''$N<br>$89^0 32' 9.8''$E | 7.68 | 12.60 | 114 | 14000 | 48380 | 42100 | 6280 | 6500 |
| Hiron Point | $21^0 48' 00''$N<br>$89^0 30' 00''$E | 7.72 | 11.74 | 4.17 | 14000 | 56620 | 40690 | 15930 | 5100 |
| Hiron Point | $21^0 48' 96''$N<br>$89^0 30' 00''$E | 7.81 | 11.75 | 6.14 | 17000 | 33600 | 24840 | 8760 | 5900 |
| Hiron Point | $21^0 47' 24''$N<br>$89^0 29' 34''$E | 7.78 | 12.74 | 3.55 | 16000 | 47380 | 35560 | 11820 | 5900 |
| Outer Bar | $21^0 36' 00''$N<br>$89^0 27' 37''$E | 7.74 | 12.95 | 4.8 | 19000 | 68840 | 53190 | 15650 | 4600 |
| Outer Bar | $21^0 34' 48''$N<br>$89^0 27' 37''$E | 7.85 | 13.18 | 18.0 | 19000 | 74280 | 48290 | 25990 | 3400 |
| Outer Bar | $21^0 36' 47''$N<br>$89^0 27' 19''$E | 7.91 | 13.61 | 11.4 | 19000 | 76110 | 57330 | 18780 | 4300 |

Table 4.6: Water Quality of Passur Channel near Bed at Different Locations
(Field data collected on March 2018)

| **Locations of Water Sample** | GPS Co-ordinates | pH | EC (ms/cm) | Turbidity (NTU) | $Cl^-$ (mg/L) | TS (mg/L) | TDS (mg/L) | SS (mg/L) | $SO_4$ (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| Monkey Point | $22^0 14' 03'' N$ $89^0 34' 51'' E$ | 7.88 | 10.25 | 952 | 25500 | 47380 | 41360 | 6020 | 800 |
| Sundary Kota | $22^0 7.8' 13'' N$ $89^0 35' 45'' E$ | 7.74 | 11.38 | 452 | 13000 | 32970 | 20050 | 12910 | 4500 |
| Akram Point | $22^0 00' 40'' N$ $89^0 32' 9.8'' E$ | 7.69 | 11.84 | 155 | 31000 | 40460 | 34160 | 6300 | 3900 |
| Hiron Point | $21^0 48' 00'' N$ $89^0 30' 00'' E$ | 7.76 | 13.01 | 98 | 45500 | 50210 | 30100 | 20110 | 4600 |
| Hiron Point | $21^0 48' 96'' N$ $89^0 30' 00'' E$ | 7.82 | 13.10 | 67 | 19000 | 56710 | 49540 | 7370 | 5900 |
| Hiron Point | $21^0 47' 24'' N$ $89^0 29' 34'' E$ | 7.81 | 11.84 | 250 | 20000 | 51650 | 47350 | 4300 | 5900 |
| Outer Bar | $21^0 36' 00'' N$ $89^0 27' 37'' E$ | 7.83 | 13.56 | 189 | 20500 | 71840 | 52890 | 18950 | 6100 |
| Outer Bar | $21^0 34' 48'' N$ $89^0 27' 37'' E$ | 7.85 | 13.44 | 102 | 19000 | 53130 | 23680 | 29450 | 2300 |
| Outer Bar | $21^0 36' 47'' N$ $89^0 27' 19'' E$ | 7.88 | 13.52 | 61.6 | 21500 | 67800 | 43750 | 24050 | 2500 |

## 4.2.12 Hydrological Characteristics of Passur River

### 4.2.12.1 Water Level

**Upstream reach (at Chalna)**: Water level near Mongla Port has been observed by installing staff gauges for cross checking in 2015. The gauge readings have been taken by the consultant. The gauges have been calibrated from the nearest TBM which have been connected again form the existing SOB Benchmark. Observation were taken for a week during the field survey. One staff gauge is installed at locations 22°28′43″N and 89°35′30″E for cross checking the automatic recorded water level data by MPA. Figure 4.16 shows the measured water level variation for the study area from August 18 to 21, 2015. It is observed that data collected by the client (observed data) are found in good agreement with the automatic recorded water level data by MPA. The water level fluctuates between 0.48 to 4.51 mCD for the recorded period.

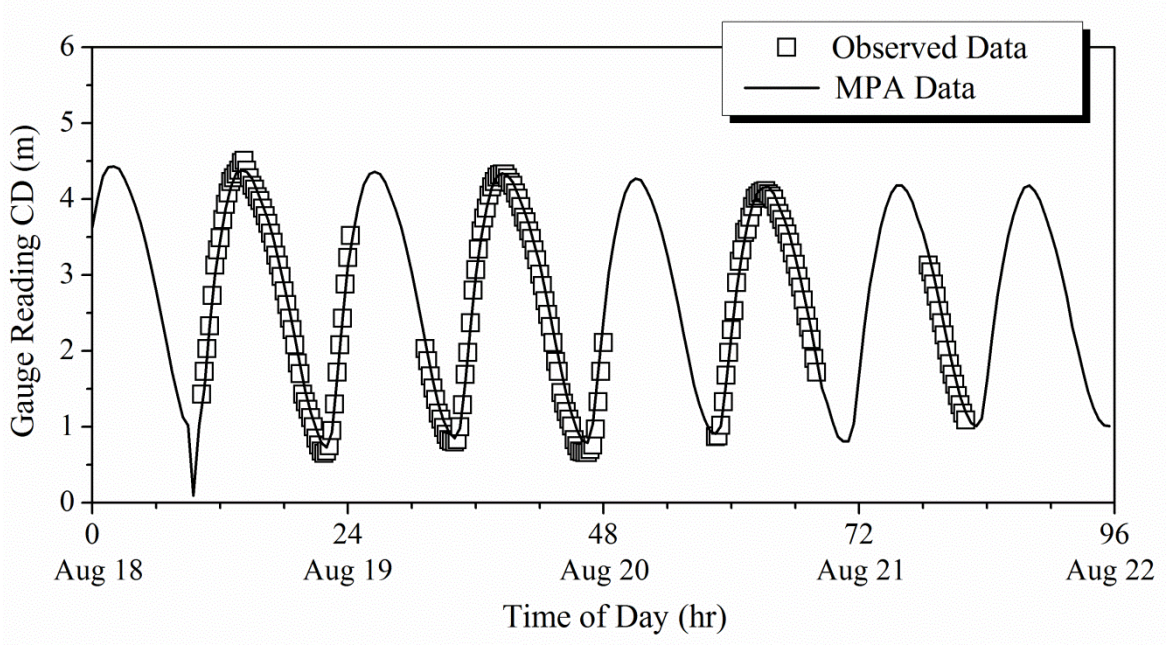



Figure 4.16: Water/tidal level variations for the river (KUET, 2015)

The variation of water depth and tidal characteristics in the study area over the years is studied by water level. The water level data analysis shows that the maximum tidal ranges at Mongla during the dry and monsoon period at spring tide in 2015 are about 3.75 m and 3.4 m, respectively. In neap tide, the maximum tidal ranges for the dry and monsoon period are 2.0 m and 1.9 m. The seasonal variation at Mongla Port between March and September is obtained about 0.9 m.

Table 4.7: Maximum, Minimum and Mean water level and Maximum Tidal range (Source: Feasibility study report, IWM 2015)

| **Location** | **Duration** | **Max WL (mPWD)** | **Min WL (mPWD)** | **Mean WL (mPWD)** | **Max Tidal Range (m)** |
|---|---|---|---|---|---|
| Chalna | 07/01/2015 to 07/07/2015 | 4.518 | 0.314 | 2.410 | 4.204 |

**Downstream reach (at Hiron Point):** The tidal range was calculated by the algebraic difference of two consecutive high tide and low tide. It is about 4.204 m Near the Rampal Power Plant at Dacop. Semi-diurnal tides with a tidal period of about 12 hours 25 minutes are predominant in the Bay of Bengal. According to the Bangladesh Tide Tables 2015, the mean tide levels at Mongla, and Hiron Point along Passur River are 2.31 m and 1.7 m in CD, respectively (Table 4.8). The tidal regime is larger at Mongla than at Hiron Point.

Table 4.8: Tidal levels (mPWD) at Mongla and Hiron Point (Tide Table, 2015)

| Stations | Tidal Level (mPWD) | | |
|---|---|---|---|
| | Lowest | Mean | Highest |
| Mongla (Bangladesh Tide Tables, 2015) | -0.261 | 2.310 | 4.882 |
| Hiron Point (Bangladesh Tide Tables, 2015) | -0.256 | 1.700 | 3.656 |

Tidal waves approaching the coastal areas of Bangladesh are affected at least by four factors causing amplification and deformation of the wave: i) Coriolis acceleration ii) the width of the transitional continental shelf iii) the coastal geometry and iv) the frictional effects due to freshwater flow and bottom topography. Tide arrives from the deep sea and approaches at Hiron Point and Cox's Bazar at about the same time. Tidal range is different in different locations. Tidal range at Hiron Point near outer bar area varies from 3.22 m to 1.0 m in spring and neap tide respectively (IWM, 2004). According to the Bangladesh Tide Tables 2016, the mean tide level at Hiron Point along Passur River is 1.7 mCD.

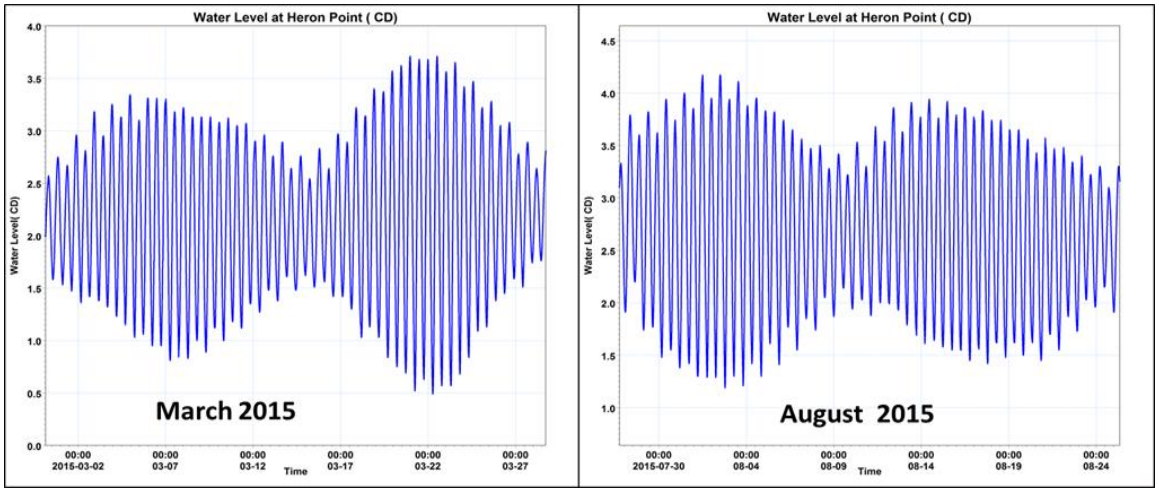



Figure 4.17: Tidal variation of at Hiron Point during spring and neap tide (IWM, 2015)

The variations of water depth and tidal characteristics in the study area over the years are identifying by water level. The water level data analysis shows that the maximum tidal ranges at outer bar area during the dry and monsoon period at spring tide in 2015 are about 3.22 m in March 2015 and 3.02 m in August 2015 respectively (IWM, 2016). In neap tide, the tidal ranges for the dry and monsoon period are 1.03 m in March 2015 and 1.28 m in August 2015. Water level characteristics of Hiron Point is presented in Figure 3.10. The seasonal variation

at Hiron Point between March and September as obtained is about 0.79 m (Figure 4.18). Tidal characteristics of Hiron Point according to 2016 tide tables are presented in Table 4.9.

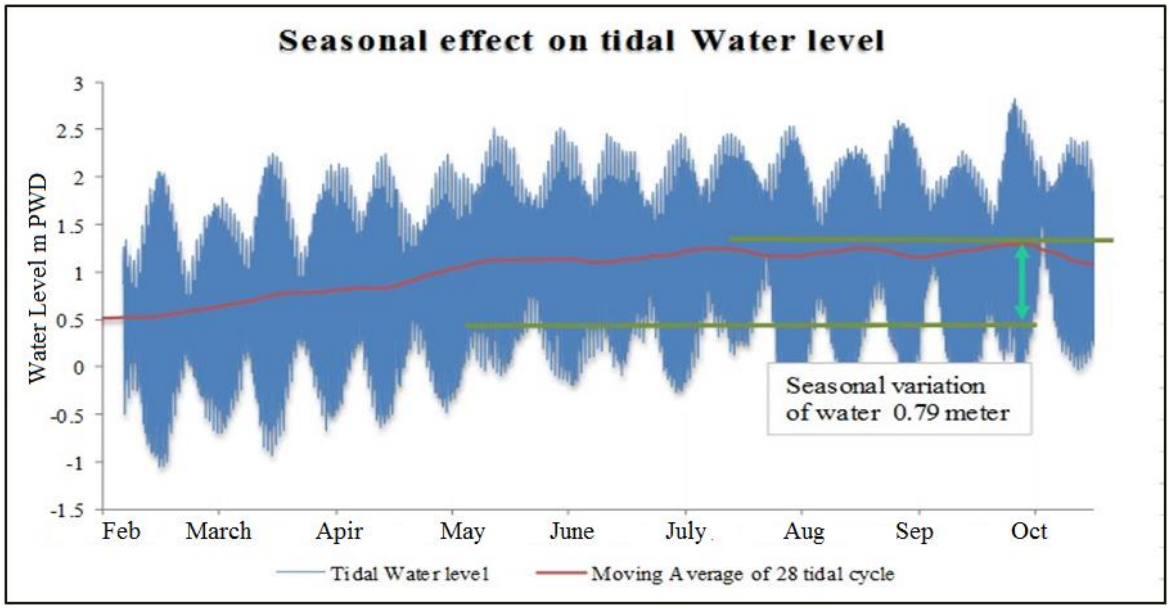



Figure 4.18: Water level characteristics of Hiron Point in 2010 (IWM 2016)

Table 4.9: Tidal Characteristics at Hiron Point (Tide Table 2016)

| Station | LAT | MLWS | MLWN | ML | MHWN | MHWS | HAT |
|---|---|---|---|---|---|---|---|
| Hiron Point | -0.256 | 0.225 | 0.905 | 1.7 | 2.495 | 3.175 | 3.656 |

#### 4.2.12.2 Discharge

Discharge is an important key factor for the navigability of Passur Channel. Siltation or scouring of river bed is directly related with the discharge. To understand the discharge behavior of the Passur Channel, the discharge reported in the feasibility study (IWM, 2015) was used, where discharge data was measured during spring and neap covering both flood tide and ebb tide. The observed data has been plotted in Figure 4.19 and 4.20 for the spring and neap tide, respectively. The summarized observed data has given in Table 4.10, which shows that the flow in the ebb tide is always higher than that in the flood tide at Mongla.

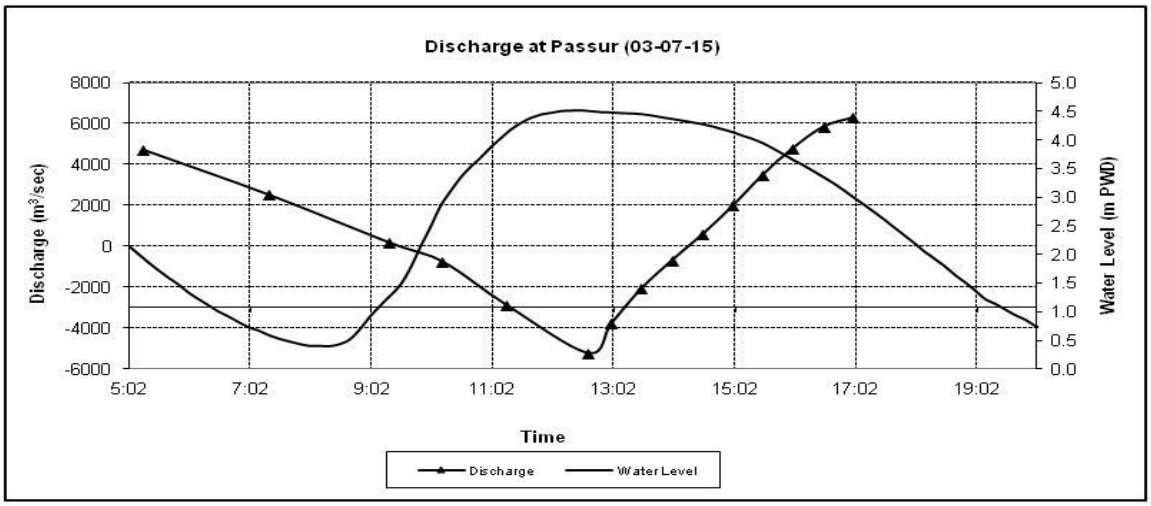



Figure 4.19: Discharge and water level during spring tide at Mongla (IWM 2015)

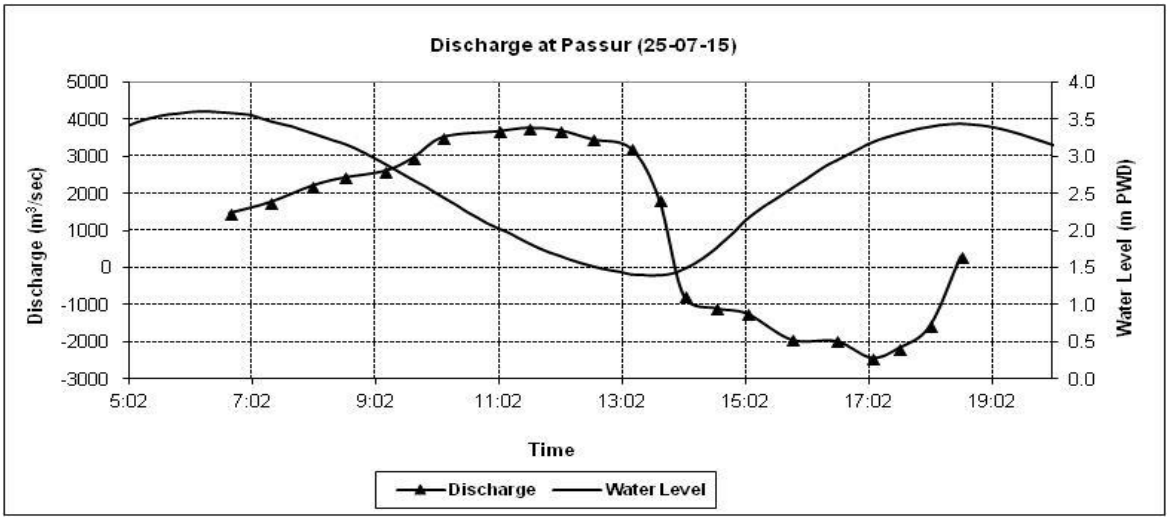



Figure 4.20: Discharge and water level during neap tide at Mongla (IWM 2015)

Table 4.10: Maximum discharge during flood tide and ebb tide (IWM 2015).

| **Location** | **Measurement Period** | **Type of tide** | **Max flow during flood tide ($m^3$/sec)** | **Max flow during ebb tide ($m^3$/sec)** |
|---|---|---|---|---|
| Mongla | 03-07-2015 (half hourly) | Spring | 5227 | 6272 |
| Mongla | 25-07-2015 (half hourly) | Neap | 2434 | 3771 |

#### 4.2.12.3 Bed Profile

Mongla Port (MP) is located along the left bank of Passur River and 130 km upstream from Hiron Point. Available bathymetric charts/maps have been collected from MPA and analyzed. Figure 4.21 shows the bed topography with respect to chart datum of the Passur River connecting to MPA and Bay of Bengal. The port was designed for an average 8.5 m draft ship but after the construction of Mongla Port Jetty, the depth in several areas of Passur channel reduced significantly and regular maintenance dredging is required to provide adequate depth alongside the berths, in the approaches to the berths and in the southern anchorage areas. The main causes of this siltation is empolderment schemes between the Sibsa and Passur rivers carried out between 1966 and 1974, resulting in reduction of tidal storage and redistribution of flow, mostly between the Sibsa and Passur river, starting in 1959. The navigation channel at the Passur river entrance crosses a wide bar known as outer bar. The bar is relatively stable with sea bed elevation of -6.5 m CD (Chart Datum). With the existing depth in the outer bar, maximum 8.5 m draft vessel can cross the outer bar and enter the port at normal high tide. But the depths over the anchorage area of the channel permit anchoring of more than 9 m draft vessels. Outer bar area is the only obstacle for ships of 9 m and above to enter into the anchorage area of Mongla Port.

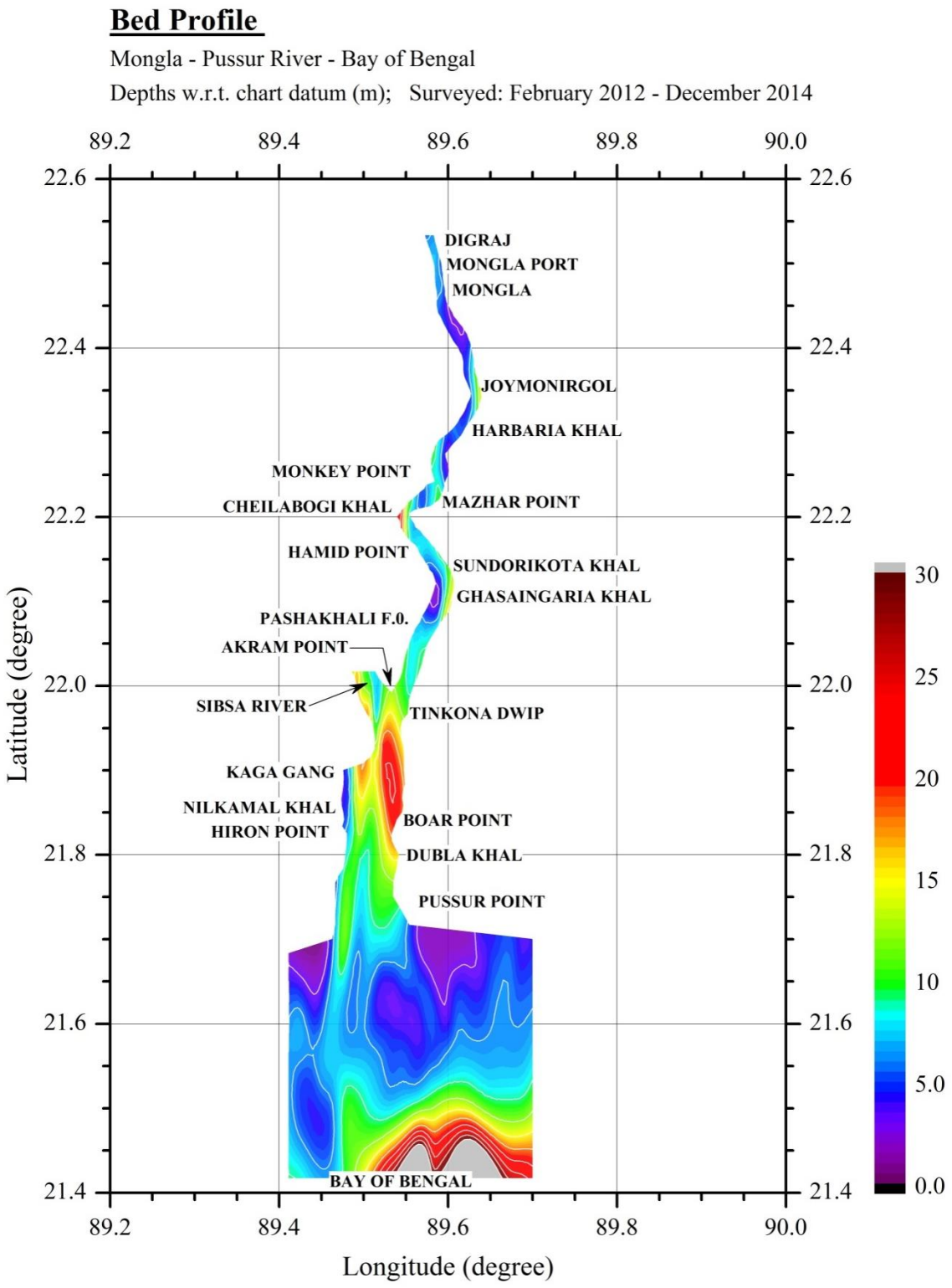



Figure 4.21(a): Bed Profile of Mongla - Passur River - Bay of Bengal (Source: MPA 2015)

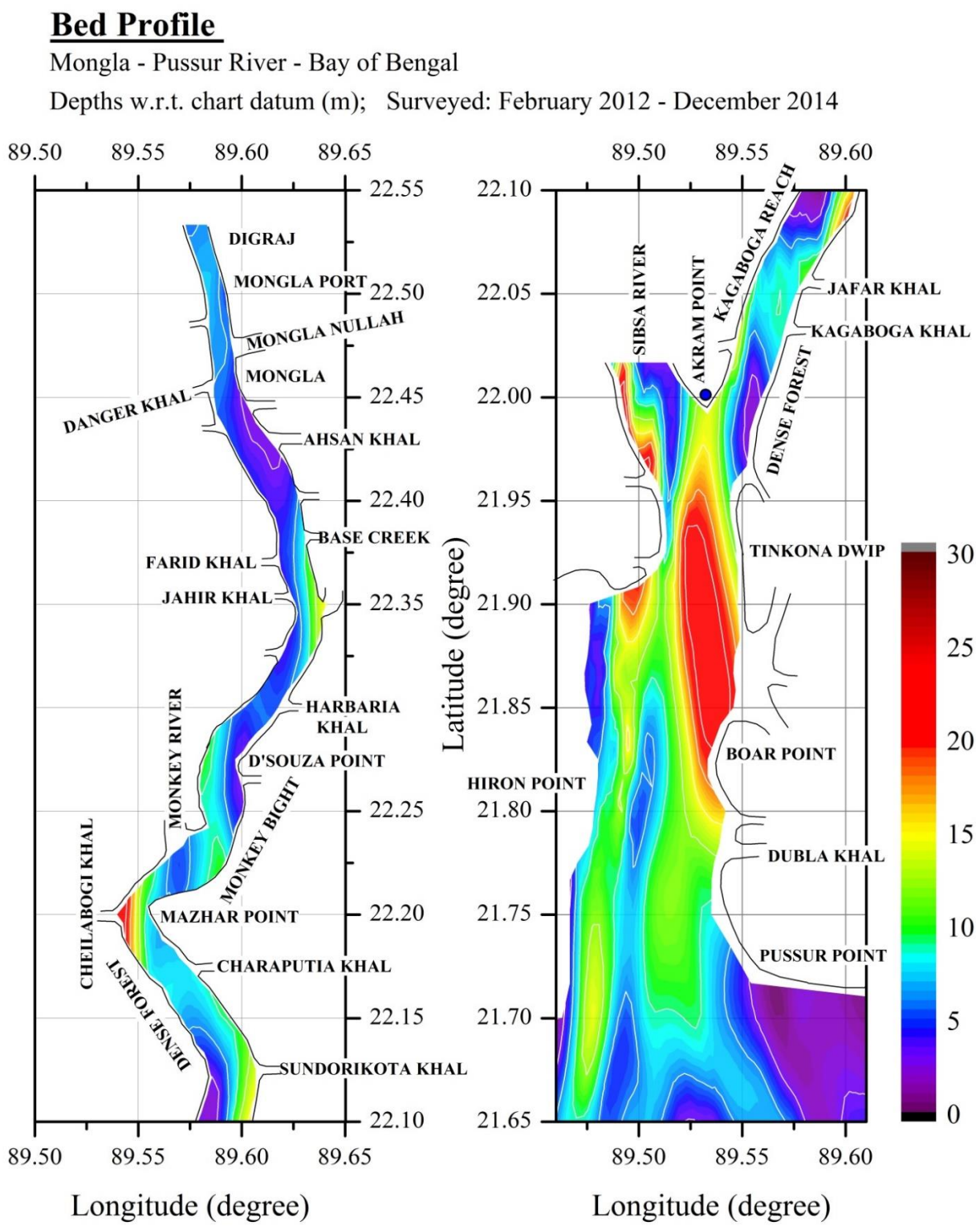



Figure 4.21 (b): Bed Profile of Mongla - Passur River - Bay of Bengal (Larger Scale)

(Source: MPA, 2015)

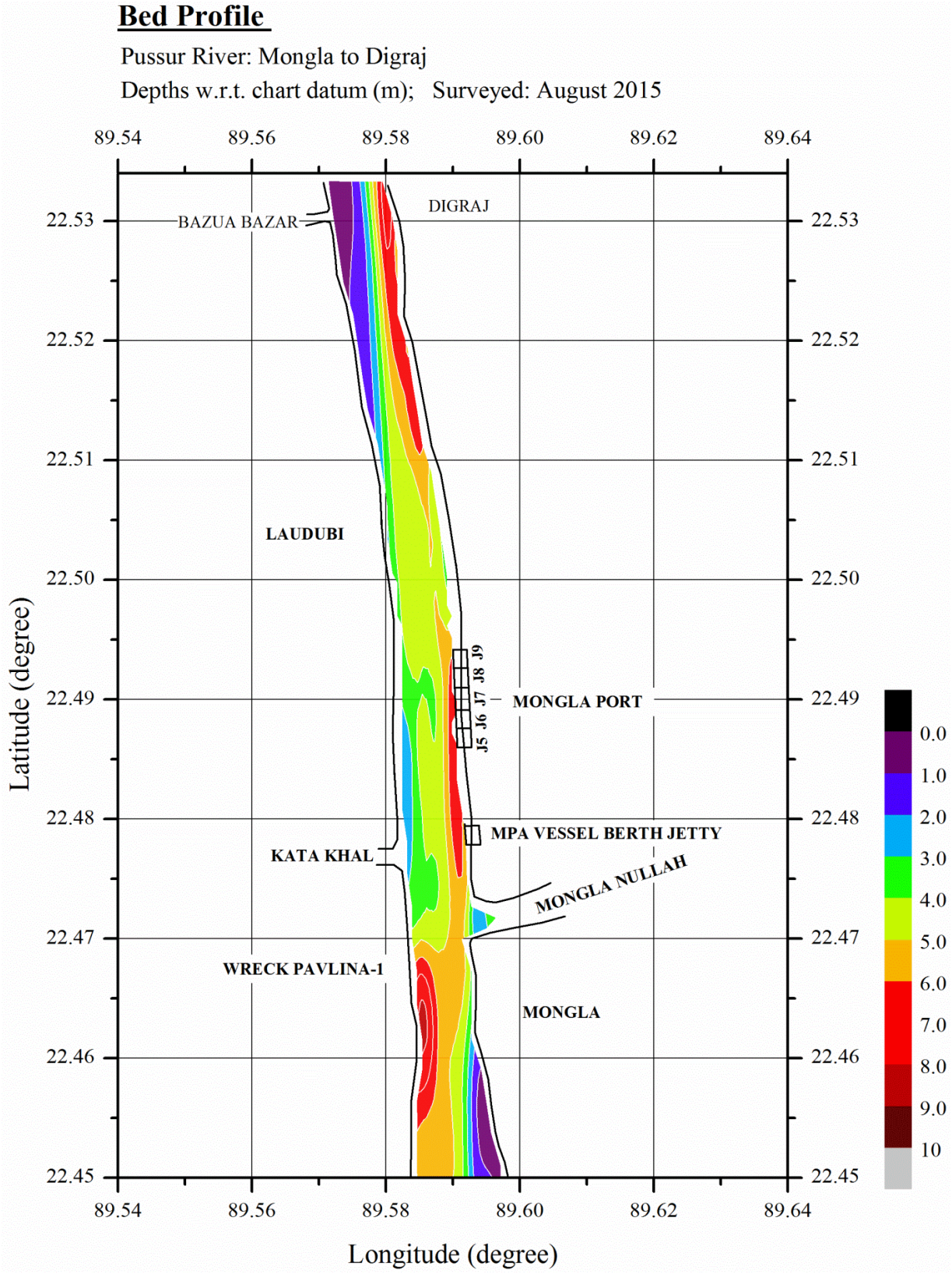



Figure 4.21 (c): Bed Profile of Mongla - Passur River – Digraj (MPA 2015)

### 4.2.13 Groundwater

All households in the Mongla Port area are using deep tubewell water ( Mongla Port Water Supply) to fulfill their daily requirement. To establish a base line situation groundwater samples from deep tube wells (DTW) as well as shallow tube wells (STW) have been collected by KUET and analyzed to identify its quality (Table 4.11). The Bangladesh Standard for drinking water quality (ECR' 1997) was also provided for comparison.

Table 4.11(a): Groundwater quality from deep tube well of Mongla Port Water Supply (KUET, May- 2019)

| Sl. | Parameters | Units | Test Results | Bangladesh Standard |
|---|---|---|---|---|
| 1. | Color | Pt.Co. Unit | 45 | 15 |
| 2. | Turbidity | NTU | 4 | 10 |
| 3. | pH | -- | 7.4 | 6.5 ~ 8.5 |
| 4. | Chloride ($Cl^-$) ion concentration | mg/l | 480 | 150 ~ 600 |
| 5. | Total Hardness, EDTA as $CaCO_3$ | mg/l | 148 | 200~500 |
| 6. | Total Dissolved Solids (TDS) | mg/l | 1150 | 1000 |
| 7. | $CO_2$ Concentration | mg/l | 10 | -- |
| 8. | Total Iron (Fe) | mg/l | 0.4 | 0.3 ~ 1.0 |
| 9. | Manganese (Mn) | mg/l | 0.1 | 0.1 |
| 10. | Arsenic (As) | mg/l | 0 | 0.05 |
| 11. | Total Coliform (TC) | N/100ml | 3 | 0 |
| 12. | Faecal Coliform (FC) | N/100ml | 0 | 0 |

Table 4.11 (b): Groundwater quality from shallow tubewell at Digraj Bazar (KUET, May- 2019)

| Sl. | Parameters | Units | Value | Bangladesh Standard |
|---|---|---|---|---|
| 1. | Color | Pt.Co. Unit | 146 | 15 |
| 2. | Turbidity | NTU | 590 | 10 |
| 3. | pH | -- | 7.1 | 6.5 ~ 8.5 |
| 4. | Chloride ($Cl^-$) ion concentration | mg/l | 3500 | 150 ~ 600 |
| 5. | Total Hardness, EDTA as $CaCO_3$ | mg/l | 1787 | 200~500 |
| 6. | Total Dissolved Solids (TDS) | mg/l | 6690 | 1000 |
| 7. | $CO_2$ Concentration | mg/l | 20 | -- |
| 8. | Total Iron (Fe) | mg/l | 4.3 | 0.3 ~ 1.0 |
| 9. | Manganese (Mn) | mg/l | 6.1 | 0.1 |
| 10. | Arsenic (As) | mg/l | 0 | 0.05 |

| Sl. | Parameters | Units | Value | Bangladesh Standard |
|---|---|---|---|---|
| 11. | Total Coliform (TC) | N/100ml | 0 | 0 |
| 12. | Faecal Coliform (FC) | N/100ml | 0 | 0 |

Table 4.11 (c): Kumarkhali Water Supply for Old Mongla Port Area
(KUET, May- 2019)

| Sl. | Parameters | Units | Value | Bangladesh Standard |
|---|---|---|---|---|
| 1. | Color | Pt.Co. Unit | 35 | 15 |
| 2. | Turbidity | NTU | 5 | 10 |
| 3. | pH | -- | 7.30 | 6.5 ~ 8.5 |
| 4. | Chloride ($Cl^-$) ion concentration | mg/l | 290 | 150 ~ 600 |
| 5. | Total Hardness, EDTA as $CaCO_3$ | mg/l | 556 | 200~500 |
| 6. | Total Dissolved Solids (TDS) | mg/l | 400 | 1000 |
| 7. | $CO_2$ Concentration | mg/l | 5 | -- |
| 8. | Total Iron (Fe) | mg/l | 0.04 | 0.3 ~ 1.0 |
| 9. | Manganese (Mn) | mg/l | 0.2 | 0.1 |
| 10. | Arsenic (As) | mg/l | 0 | 0.05 |
| 11. | Total Coliform (TC) | N/100ml | 12 | 0 |
| 12. | Faecal Coliform (FC) | N/100ml | 5 | 0 |

### 4.2.14 Riverbed Soil Quality

Analyses of Riverbed soil of Passur Channel are very important. This has implication on the safe disposal of dredged material on land and its use as filling material. Riverbed materials (mainly sand) in a significant quantity will be required to be dredged. Some of the dredged material will be used for filling of low land areas around the project site. Samples of bed materials were collected from six different locations of Passur Channel and three locations of outer bar area during March 2018 to identify heavy metals presents in the bed materials and determine their concentration. Test results are given in Table 4.12. The test results were compared with European Union guideline for Agricultural soil. All the parameters of heavy metals were found to be within allowable limit.

Table 4.12: Toxic Properties of Bed Soil at Different Locations of Passur Channel (Field data collected by KUET on March 2018)

| Locations | GPS Co-ordinates | Arsenic (mg/Kg) | Copper (mg/Kg) | Zinc (mg/Kg) | Lead (mg/Kg) | Cadmium (mg/Kg) | Chromium (mg/Kg) |
|---|---|---|---|---|---|---|---|
| Monkey Point | $22^0 14' 03'' N$ $89^0 34' 51'' E$ | 1.89 | 0.00 | 22.03 | 13.08 | < 0.004 | 7.38 |
| Sundary Kota | $22^0 7.8' 13'' N$ $89^0 35' 45'' E$ | 2.69 | 0.00 | 24.51 | 13.43 | < 0.004 | 10.46 |
| Akram Point | $22^0 00' 40'' N$ $89^0 32' 9.8'' E$ | 1.77 | 0.00 | 20.32 | 12.36 | < 0.004 | 7.30 |
| Hiron Point | $21^0 48' 00'' N$ $89^0 30' 00'' E$ | 2.69 | 0.00 | 28.34 | 11.72 | < 0.004 | 11.12 |
| Hiron Point | $21^0 48' 96'' N$ $89^0 30' 00'' E$ | 2.40 | 0.00 | 68.10 | 13.12 | < 0.004 | 10.68 |
| Hiron Point | $21^0 47' 24'' N$ $89^0 29' 34'' E$ | 1.57 | 0.00 | 15.70 | 11.74 | < 0.004 | 7.60 |
| Outer Bar | $21^0 36' 00'' N$ $89^0 27' 37'' E$ | 8.35 | 36.81 | 72.05 | 30.49 | < 0.004 | 48.56 |
| Outer Bar | $21^0 34' 48'' N$ $89^0 27' 37'' E$ | 2.17 | 0.00 | 19.58 | 12.94 | < 0.004 | 11.50 |
| Outer Bar | $21^0 36' 47'' N$ $89^0 27' 19'' E$ | 8.49 | 26.65 | 66.85 | 26.49 | < 0.004 | 45.07 |
| European Union Guideline for Agricultural Soil | | 20 | 200 | 300 | 100 | 3 | 100 |

### 4.2.15 Mongla Port Facilities

With the capacity of handling 6.5 million tons in a year, at present, Mongla Port handles 1.6 million tons of cargo yearly. The average turnaround time (in day) for a bulk cargo is 5.5 and 2.5 for a container cargo. At present, Mongla port operates five general cargo/container berths, seven river mooring berths, and fourteen anchorage berths. In addition, there are seven specialized private berths. The port has cargo-handling equipments of different capacity including dockside, mobile crawler, truck mounted forklift truck, prime mover, trailer cargo handling, etc. At present, there are four transit sheds having an area of 19628 sq m, two warehouse of 19,630 sq m, and open dumps of 3,00,000 sq. m available for cargo storage. Moreover, three container yards of 35,754 sq. m are also available. Maintenance of draught is the main challenge for Mongla port. Presently, maximum allowable draught at jetty is 6.5 m. Vessels having 6.0 m. to 6.5 m. draught can take berth at port jetty. The navigational information provided by Mongla Port Authority including allowable draught, fleet size, and capacity is given in the following Table 4.13. The port has a master plan of upgrading its capacity of ship handling up to 450 ships per year within 10 years. Accordingly, the channel will be improved for maintaining 7.5 m draught at jetty site.

Table 4.13: Navigational information of Mongla Port

| Sl. | Location | Maximum Allowable | Allowable Fleet Size | Berthing Capacity |
|---|---|---|---|---|
| 1. | Fairway buoy | Nov to Mar => 20 m<br>Apr to Oct => 16 m | -- | -- |
| 2. | Akram point | 9 m | 200 m | 7 Nos. Ship |
| 3. | Harbaria (A) | 7.5 m | 180 m | 2 Nos. Ship |
| 4. | Harbaria (B) | 8.5 m | 180 m | 4 Nos. Ship |
| 5. | Jetty area | 6.5 m | 165 m | 5 Nos. Ship |

*Source: Mongla Port Authority*

## 4.3 Biological Resources

### 4.3.1 Fish Species Diversity

The fisheries resources of the study area are rich and diversified. The network of river systems of this region connects the fresh water fish habitats with the brackish water habitats and maintains biological balance of the major fish groups. A list of indicative fish species of the study area is given in Table 4.14. Culture fish habitats of the study area are classified as closed shrimp gher.

Table 4.14: Indicative fish species diversity of the study area (MPA Report, 2015)

| Sl. No. | Scientific Name | Local Name | Common English Name |
|---|---|---|---|
| 1. | *Acanthopagrus latus* | Datina | Sea Bream |
| 2. | *Acentrogobius caninus* | Baila | Tropical Sand Goby |
| 3. | *Apocryptes bato* | Chingri | Prawn |
| 4. | *Catla catla* | Catla | Katla |
| 5. | *Cirrhinus mrigela* | Mirka | Mrigel |
| 6. | *Ctenopharyngodon idellus* | Grass carp | Grass carp |
| 7. | *Cyprinus carpio* | Carpio | Common carp |
| 8. | *Hypopthlmichthes molitrix* | Silver carp | Silver carp |
| 9. | *Labeo boga* | Bhangon | Boga Labio |
| 10. | *Labeo calbasu* | Calbaus | Black Rui |
| 11. | *Labeo rohita* | Rui | Rohu |
| 12. | *Lates calcarifer* | Koral | Sea Bass |
| 13. | *Liza parsia* | Parse | Gold Spot Mullet |
| 14. | *Macrognathus aculatus* | Bain | Tire-track Spinyeel |

| Sl. No. | Scientific Name | Local Name | Common English Name |
|---|---|---|---|
| 15. | *Monopterus cuchia* | Kuicha | Cuchia |
| 16. | *Mystus tengara* | Tengra | Tengra Mystus |
| 17. | *Oreochromis niloticus* | Tilapia | Tilapia |
| 18. | *Penaeus monodon* | Bagda | Prawn |
| 19. | *Plotosus canius* | Magur | Catfish |
| 20. | *Pama pama* | Poa | Jew fish |
| 21. | *Rhinomugil corsula* | Mullet | Bata |
| 22. | *Rita rita* | Rita | Rita |
| 23. | *Sillaginopsis panijus* | Tular dati | Flathead Silage |
| 24. | *Pangasius sutchi* | Pangus | Pangus |

### 4.3.2 Dolphin in Passure River

The Passur River is a home for Dolphin (Platanistagangetica). It is to be noted that freshwater dolphins are globally endangered and are protected under the Bangladesh Wildlife Conservation Act 2012. The Passur River is the habitat of good number of fish, Irrawaddy Dolphin and Estuarine Crocodile. The existing navigation route for approaching Mongla Port is also important for the critically endangered mammalian species, freshwater dolphins and Irrawaddy dolphins and saltwater crocodiles. The Sundarbans is the last resort for the saltwater crocodiles and hence it is important that utmost care and stringent conditions be laid down for the safety and sustenance of this unique ecosystem and ecological services and natural/biological resources it is providing to support the biodiversity and livelihood of hundreds of thousands of people.

Figure 4.22: Habitats of Culture Fishery in the Study Area: a) Shrimp Gher and b) Crab Pond

Figure 4.23: Ecological niches in the Sundarbans ecosystem

About 32,400 hectares of the Sundarbans have been declared as three wildlife sanctuaries, and came under the UNESCO World Heritage Site in 1997. These wildlife sanctuaries were established in 1977 under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. These are Sundarbans West (9,069 ha), Sundarbans South (17,878 ha), and Sundarbans East (5,439 ha). Figure 4.24 also shows the three Dolphin Sanctuary area in the Sundarbans.

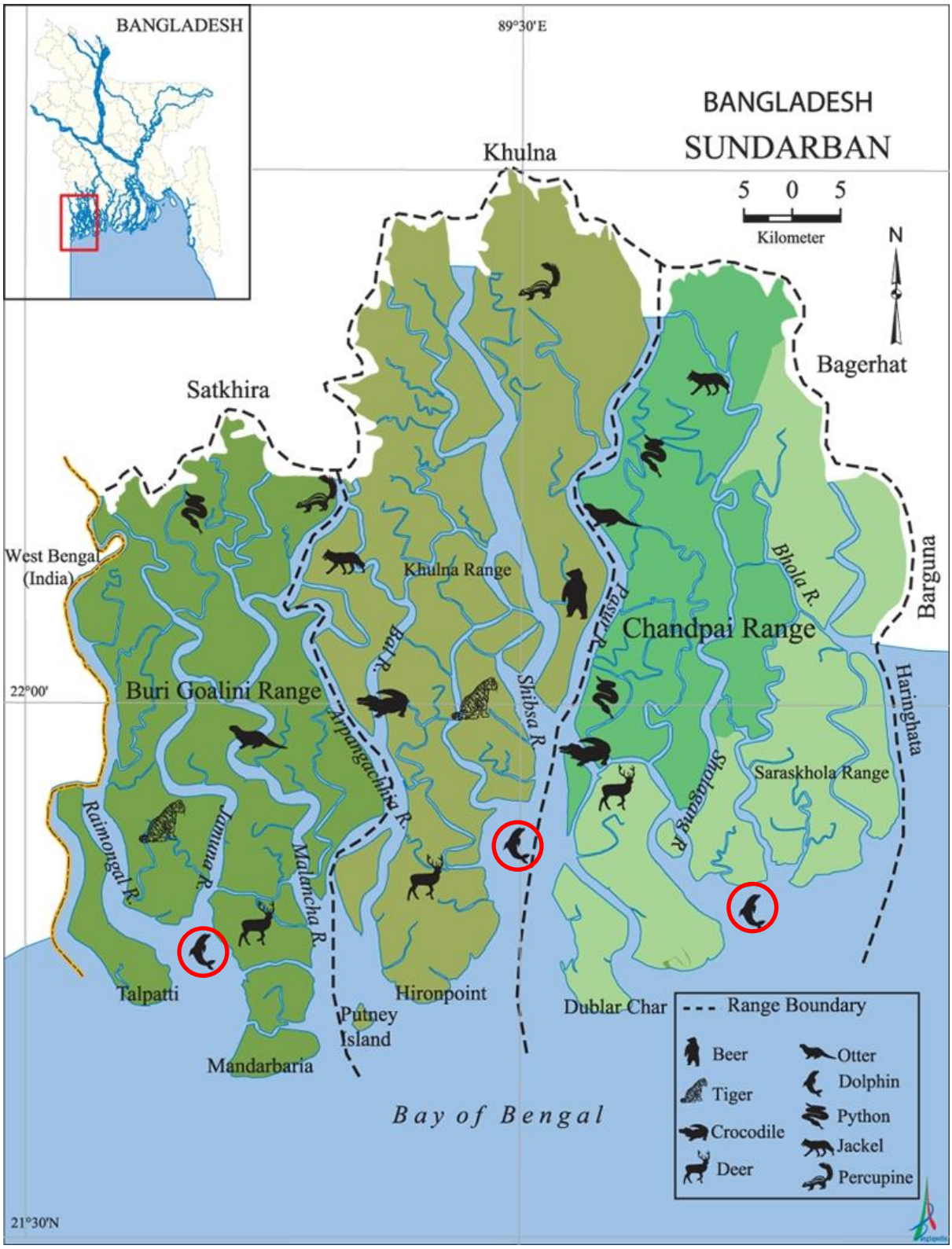



Figure 4.24: Dolphin Sanctuary Area in the Sundarbans (Source: http://en.banglapedia.org/index.php?title=File:Sundarbans.jpg, accessed on Jan. 2020)

### 4.3.3 Bio-ecological zone "the Sundarbans"

The Sundarbans mangrove forest is situated in the southwest part of Bangladesh. The Sundarbans is the world's largest Mangrove forest consist of about 330 species of plants, 42 species of mammals, 35 species of reptiles, 400 species of fishes and 270 species of birds (MoEF, 2010). The Bangladesh part of the Sundarbans now covers an area of about 5,770 $km^2$, of which 4,016 $km^2$ are land and the remaining 1,761 $km^2$ is under water, in the form of rivers, canals and creeks. The mangrove tract constitutes 44% of the total forest area in Bangladesh and contributes about 50% of the total revenue derived from the forestry sector. However, the most important value of the Sundarbans stems from the protection it affords to millions of people against the ravages of cyclonic storms, surges and tidal waves, which frequently generate from the Bay of Bengal. The Sundarbans can be divided into the following ecological niches (Figure 4.21): a) Mudflats (sloping) b) Ridges or levees c) Back-swamps or basins d) Main river channel e) Tidal creeks f) Bays of sandy shores.

***Ecosystem of the Sundarbans***

The Sundarbans lie across the outer deltas of the Ganges, Brahmaputra and Meghna rivers. The forest is composed of small forested islands and mudflats intersected by an intricate network of tidal waterways. The area has a wide range of rare fauna, including the Bengal tiger, estuarine crocodile and many reptiles and birds. These mangroves are slightly elevated, isolated landmasses (like islands) under strong tidal influence. Mangrove plants are specially adapted to survive in saline conditions using pneumatophores. The mangrove root system, along with its buttress, helps to support the trees in the salty clay loam soil under strong water flow. Due to the variation in physical factors, such as topography, salinity, soil condition and tidal variation, vegetation composition within the Sundarbans varies widely.

Mudflats or slopes can be defined as the areas exposed during low tides but going underwater during high tide. These are formed on the banks of rivers, canals and creeks. Crabs of various species inhabit the mudflat. These crabs play an important role in maintaining ecosystem functions and consumed by shore birds. Mudflats are also a favorite habitat for estuarine crocodiles. Snakes prefer mudflats of creeks, as they feed on trapper fishes here during low tide. Germination of many plant species takes place in the mudflat. Hoda (Acrostichumaureum), nol-khagra (Phragmtieskarka), dhanshi (Myriostachyawightiana), golpata and hargoza (Acanthus ilicifolius) all grow in the mudflats.

In this mudflat, the difference between the low tide water level and the upper ridge of the mudflat was nearly 4 meter.

A ridge or levee is the area just behind the mudflat. Most plant succession takes place in these ecological niches. These are the highest elevated lands of the Sundarbans acting as a natural dike to protect the next niche (back swamp). The area's tallest trees (sundari or keora) are found in these ecological niches. Most of the area's terrestrial insects and snails take refuge in these niches during high tide. The levees support primarily marginal vegetations which include: hargoza, golpata, hantal (Phoenix paludosa), baen (Avicenniaofficinalis), kakra (Bruguieragymnorrhiza), kewakatta (Pandonusfoetides), keora (Sonneratiaapetala) and dhundul (Xylocarpusmekongensis). Back swamps or basins are the areas behind the ridges or levees. This ecosystem represents the major area of the Sundarbans and plays a vital role in trapping rainwater in its characteristic saucer-shaped basins. These are the most common and safe grazing lands for spotted deer (Axis axis), rhesus macaque (Macacamulata) and wild boar (Susscrofa).

The main river channel is long with either an eroded bank line or a mudflat margined with golpata. These ecological niches occur mainly along the Baleswar, Bhola, Passur, Marjata, Arpangasia, Shibsa, Jamuna and Raimangol rivers. Main channels are popular for hilsa and shrimp fishing and, as such, are the main routes for navigation. Gangetic dolphin (Platanistagangetica) is common in the upper stream of the major rivers. Tidal creeks are the most dynamic ecological niches of the Sundarbans ecosystem. These can be defined as water channels filled with water during high tide and almost dry during low tide. Most of the climbers of the Sundarbans are seen in these areas. These climbers include chanda lota (Dalbergia spinosa), gila (Derris trifoliata), abeta (Flagellaria indica) and bowali lata (Sarcolobus globisus). Bay or sandy shore is found along the southern face of the Sundarbans. These are mainly gentle slopes of sand deposition from the sea. Logs of various plants are seen scattered along these areas, offering breeding sites for terns (Sterna spp) and pratincle (Glareolalactea).

***Biodiversity of the Sundarbans***

The Sundarbans mangroves are habitats of many rare and endangered animals, especially it is the unique natural habitat of the world famous Royal Bengal Tiger. Ecologically, the forest is particularly important as a barrier to cyclones, tidal upsurges, etc. It is also acting as a huge

sink of unlimited capacity for absorbing $CO_2$ and other pollutants from air and water that makes the surrounding environment free from pollution.

***Distribution of Fauna***

The Sundarbans is the only remaining habitat in the lower Bengal Basin with a great variety of fauna. Besides the spectacular Royal Bengal Tiger (Pantheratigristigris), the other notable mammalian fauna are Spotted deer (Cervus axis), Barking deer (Muntiacusmuntjak), Rhesus macaque (Macacamulatta), Jungle cat (Felischaus), Leopard cat (Prionailurusbengalensis), Indian porcupine (Hystrixindica), Otter (Lutraperspicillata), and wild boar (Susscrofa). Aquatic mammals include various species of dolphin. The ecological diversity of the Sundarbans supports a large variety of birds. Among the total number of species recorded, most are resident. The egrets, storks, herons, bitterns, sandpipers, curlew, and numerous other waders are seen along the muddy banks. There are many species of gulls and terns, especially along the seacoast and the larger waterways. The bird-life of the Sundarbans waterways is varied and colorful which include: Asian open-bill stork (Anastomusoscitans), collared and black-capped kingfishers (Todiramphuschloris and Halcyon pileata), brown-winged and stork-billed kingfishers (Pelargopsisamauroptera and P. capensis). Raptors include osprey (Pandionhaliaetus), white-bellied sea-eagle (H. leucogaster), the grey-headed fishing eagle (Ichthyophagaichthyaetus), short-toed snakeeagle (Circaetusgallicus), peregrine falcon (Falco peregrines), oriential hobby (F. severus), northern eagle owl (Bubo bubo) and brown fish owl (Ketupazeylonensis). There are many species of gulls and terns along the coast and larger waterways. There is also a considerable variety of forest birds such as woodpeckers, barbets, shrikes, drongos, mynahs, minivets and babblers. The eighteen recorded species of snake include king cobra (Ophiophagus Hannah) and spectacled cobra (Najanaja), Asiatic rock python (Python molurus), Russell's Viper (Viperarussellii), Banded Krait (Bungarusfasciatus) and several species of sea snakes. Estuarine crocodile (Crocodylusporosus) still survives, its numbers greatly depleted by hunting and trapping for skins. Green turtle (Cheloniamydas) is rare due to excessive fishing. The green frog (Euphlyctishexadactylus) is mostly observed in Chandpai area of the mangrove forest. The other forest amphibians include the Skipper frog (E. cyanophlyctis), Cricket frog (Limnonecteslimnocharis), Tree frog (Polypedatesmaculatus), and the common toad. A rare species of shark, the Ganges river shark (Glyphisgangeticus) swims the estuaries. There are 48 species of crabs and a large

variety of molluscs. The area supports a varied insect population including 300 species of spider and large numbers of honey-bees.

***Distribution of Flora***

The dominant species are sundari (Heritierafomes), gewa (Exoecariaagallocha), goran (Ceriopsdecandra) and keora (Sonneratiaapetala). Excoecariaagallocha dominates the zone of moderately saline soils; and Ceriopsdecandra, the saline soils. Other mangrove species include garjan or red mangrove Rhizophora mangle, R. mucronata and R. apiculata, kankra (Bruguieragymnorhiza), and baen or (Avicenniaofficinalis). Wild rice (Oryzacoarctata), Nypa and speargrass (Imperatacylindrica) are prevalent on mud flats. The Nypafruticans palm growing along the creeks on wet mud-banks is widespread along drainage lines. There is an understory of shingra (Cynometraramiflora) where soils are drier, amur (Amooracucullata) in wetter areas and Ceriops in saline soils. Sundari (Heritierafomes) trees dominate the Chandpai range at its northern end. The remaining area is a mixture of sundari and gewa (Excoecariaagallocha). Virtually, the entire Sarankhola range is covered by mixed sundari and gewa. Gewa grows at the peripheral region and the sundari in the inner part of each forest cluster. Sundari trees dominate most of these areas from north to south of the Khulna range. Lower part of these ranges (Khulna) is composed of sundari and gewa. The northeastern part of the Burigoalini range, under Satkhira district is mainly dominated by gewa, but goran (Ceriopsdecandra) dominates the remaining area. There are trees of different species in the area surrounding of the Sarankhola range and the northernmost part of the Khulna range. The natural vegetation of the Sundarbans is composed mainly of halophytic tree species. The trees of the Sundarbans exhibit hydro-phytic and halophytic adaptations, which facilitate survival in waterlogged and saline conditions. Three ecological zones within the Sundarbans, differentiated according to salinity and species composition are: (1) the freshwater zone, (2) the moderately saltwater zone and (3) the saltwater zone. Although the boundaries of these zones are not static, in general, Heritierafomes is characteristic of the freshwater zone, Excoecariaagallocha of the moderately saltwater zone, and Ceriopsdecandra of the saltwater zone. The forest is dominated by H. fomes and E. agallocha, and there are about 25 other tree species, which are common but considerably less frequent in their occurrence. Five other families are also representing in the Sundarbans. These are the Combretaceae, Euphorbiaceae, Meliaceae, Myrsinaceae and Plumbaginaceae. Certain tree species such as Ficus spp., Eugenia fruticosa and Diospyrosperegrina occur in places of lower salinity,

usually on raised areas and are more commonly found as components of dry-land forest and are only marginally salt-tolerant.

***Fisheries Resources of the Sundarbans***

The fish habitats in the Sundarbans area are mostly brackish in nature. The fisheries resources in this area are rich and diversified. The fishes use the Sundarbans as a nursery, breeding and feeding ground and return to the sea or freshwater. Fishes like Khorsula (Mugilcorsula), GulshaTengra, Rui, Catla, Shol, Taki, PungusTengra, Shing, Magur, Koi, Puti, Datina (Pomadasys spp.), Bagda (Penaeusmonodon) etc are very common in these areas. A number of fish species spend most of their life stages outside the Sundarbans but come to breed here. These types of fishes are GulshaTengra, Poma, Phesa (Setipinna spp.), Pungus, Golda, Topshi (Polynemusparadiseus), Parsha, ChamuaChingri, etc. depending on ichthyoplankton concentration due to reduced salinity. Marine fishes like Ghagot (Tachysurusjella), Apula (Osteogeneisusmilitaris), Lakhya (Polynemusindicus) and Tailla (PolynemusTetradactylus) are also present in this area. Many marine fishes come to the Sundarbans only for feeding as this area is rich in food organisms. This type of fishes are Chaka Chingri, ChaliChingri, MotkaChingri, Tiger Chingri, GuraChingri (Leander stylifera), BegiIlish (Tenualosailisha), Rupchanda, Gang Thurina, Boiragi, Potka, ShaplaPata, Kamot, Tulardati (Silago domina), Pokki, Pankha, Baim, Churi (Lepturacunthassavale), Lottya (Harpadonneherius), Kaldi, Korina, etc. The juveniles of many marine species of prawns and fishes e.g. Chaka Chingri (Penaeusindicus), GuraChingri (Leander stylifera) and various sciaenid and ribbon fish (Churi Mach) migrate into the lower zone of the estuary during the winter and summer months to feed and then return to the sea with the onset of the monsoon. Some other fishes like Koral (Latescalcarifer), Jaba, Kawn, Chitra, Chapli Chela, Tarial, Borial, Crab, Renua (musskeeper- Boleophthalmusspp), etc. spend most of their life stages in the Sundarbans. In addition, crabs, mussels, snails, and turtles are also found in the Sundarbans area. Topshachewa etc. are available during high tide. During low tide loittay, bata, poa, chewa, chingri, pangus are abundant. In the mudflats icha, poa, gulla, juvenile and small fishes are available.

## 4.4 Air Quality at Mongla Port Area

The purpose of this assessment is to identify and analyze any air quality impacts by examining existing air quality, determining air quality criteria, discussing sources of

emissions to air from the future construction and operation of the different MP project and proposing safeguard measures to mitigate potential air quality impacts.

The objective of the air quality study was to review the existing air quality in the Mongla port area for importing car and to provide an assessment of the likely impacts on air quality during the construction and future operation of the Mongla Port. Table 4.15 shows the ambient air quality results in Mongla Port area.

Table 4.15: Ambient air quality analysis in Mongla port (KUET, May-2017)

| Parameters | Results | Air quality standards for residential and rural areas in Bangladesh (ECR'97) | Impact assessment criteria for the MP upgradation project (Maximum increasing threshold) |
|---|---|---|---|
| Suspended particulate matter (SPM), µg/$m^3$ | 125 | 200 (24 hr ave) | 60 (24 hr ave) |
| NOx, µg/$m^3$ | 45 | 100 (annual ave) | 55 (8 hr ave) |
| $SO_2$, µg/$m^3$ | 35 | 365 (24 hr ave) | 80 (8hr ave) |
| Maximum particle deposition in the sensitive receiver | -- | -- | 2.0 g/$m^2$/month |
| *Sampling location: Lat $22^0 29' 25''$, Long $89^0 35' 29''$* | | | |

***Air emission inventory throughout at Mongla port: Existing scenario***

The inventory focuses on the sources of air emissions from maritime MP vessel at berth and car transporting from container vessel to car parking space for storage and delivery purposes. The emission estimation from ships at berth and imported car movement in the Mongla port area was performed using emission factor method. Auxiliary engines of maritime container vessels were used to generate electricity for the on-board ship when ships at berth in Mongla port. In addition, most maritime vessels have boilers used to heat residual oil to make it fluid enough to use in diesel in diesel engines and to produce hot water. Emission from auxiliary engines and boilers of ships at berth was calculated using input parameters collected from primary and secondary data sources.

Emissions from container handling equipment were calculated using emission factors method based on the equipment type, equipment horsepower rating, and the selected emission standard of the equipment. The calculations of the exhaust emissions from container handling equipment were performed using emission factor method.

Various types of pollutants are produced in the combustion process. Oxides of nitrogen (NOx) result from the oxidation of nitrogen at high temperature and pressure in the combustion chamber. Carbon monoxide (CO) occurs when carbon in the fuel is partially oxidized rather than fully oxidized to carbon dioxide. Sulphurdioxide ($SO_2$) and lead are derived from the sulphur and lead in fuels. Particulate matter is produced from the incomplete combustion of fuels, additives in fuels and lubricants, and worn material that accumulates in the engine lubricant. These additives and worn materials also contain trace amounts of various metals and their compounds which may be released as exhaust emissions. Motor vehicle emissions are estimated for a grid cell from data on spatial Vehicle Kilometers Travelled (VKT) by road type and fleet composition, and the relevant emission factors using emission factor method. Table 4.16 shows the existing air pollutants emission from Mongla port.

Table 4.16: Emission of air pollutants at Mongla port in 2017 (Present scenario)

| | Air pollutants emission, kg/yr | | | |
|---|---|---|---|---|
| | $PM_{10}$ | NOx | $SO_2$ | CO |
| ***A. Container vessels at berth*** | | | | |
| Auxiliary engine | 432 | 62640 | 41904 | 4752 |
| Auxiliary boiler | 58 | 554 | 2434 | 209 |
| a) Sub-Total | 490 | 63194 | 44338 | 4961 |
| ***B. Container handling equipment*** | | | | |
| Mobile Crane | 162 | 3402 | 65 | 972 |
| Straddle Carrier | 378 | 7943 | 151 | 2269 |
| Fork Lift Truck (H. Duty) | 289 | 6078 | 115 | 1736 |
| Terminal Tractor | 320 | 6736 | 128 | 2165 |
| Fork Lift Truck | 818 | 9437 | 205 | 3979 |
| b) Sub-Total | 1967 | 33596 | 664 | 11121 |
| ***C. Heavy duty trucks*** | | | | |
| Heavy duty trucks | 36 | 524 | 44 | 472 |
| c) Sub-Total | 36 | 524 | 44 | 472 |
| Total [a+b+c] | 2494 | 97313 | 45046 | 16555 |

# Chapter 5
# SOCIAL IMPACT ASSESSMENT

## 5.1 Introduction

Social Impact Assessment (SIA) is a study of how the proposed "Dredging at the Inner Bar of Mongla Port Channel" project at Mongla Port (MP) affects the community of Mongla and its surroundings, determines, characterizes and assesses potential impacts therein, as well as develop and propose appropriate mitigation measures. It is a process that provides a framework for prioritizing, gathering, analyzing, and incorporating social information and participation into the decision support system. Therefore, it became a very important part of feasibility study of any project or development intervention. It ensures that development interventions: (i) are informed and take into account the relevant key issues, and (ii) incorporate a participation strategy for involving a wide range of stakeholders. The task requires identifying and working with all potentially affected groups. Groups affected by proposed project include those who live nearby; those who will be affected by the intervention; those who are forced to relocate because of the project; and those who might normally use the land on which the project is located. Once identified, representatives from each group are systematically interviewed to determine potential areas/issues of concern/impact, and ways each representative might be involved in the planning decision process. This chapter provides a brief description of the historical context of the study area, data collection sources, socio-economic status, SIA methodology, each potential impact, social management plan (SMP) and mitigation measures for the SIA of the proposed "Dredging at the Inner Bar of Mongla Port Channel " project at Mongla port, Mongla.

## 5.2 Location of Project Site

The site is located at Mongla port, Mongla Upazila of Bagerhat District in the Division of Khulna, Bangladesh. The Mongla Upazila comprises an area of 1461.20 sq. km including 1083.00 sq. km of forest. It is located between $22^0 33^/$ N and $21^0 49^/$ N latitudes and between $89^0 32^/$ E and $89^0 44^/$ E longitudes. Mongla is surrounded by Rampal upazila (North), Morrelgonj and Saronkhola upazila (East), Bay of Bengal (South), and Dacop upazila (West) as shown in Figure 5.1.

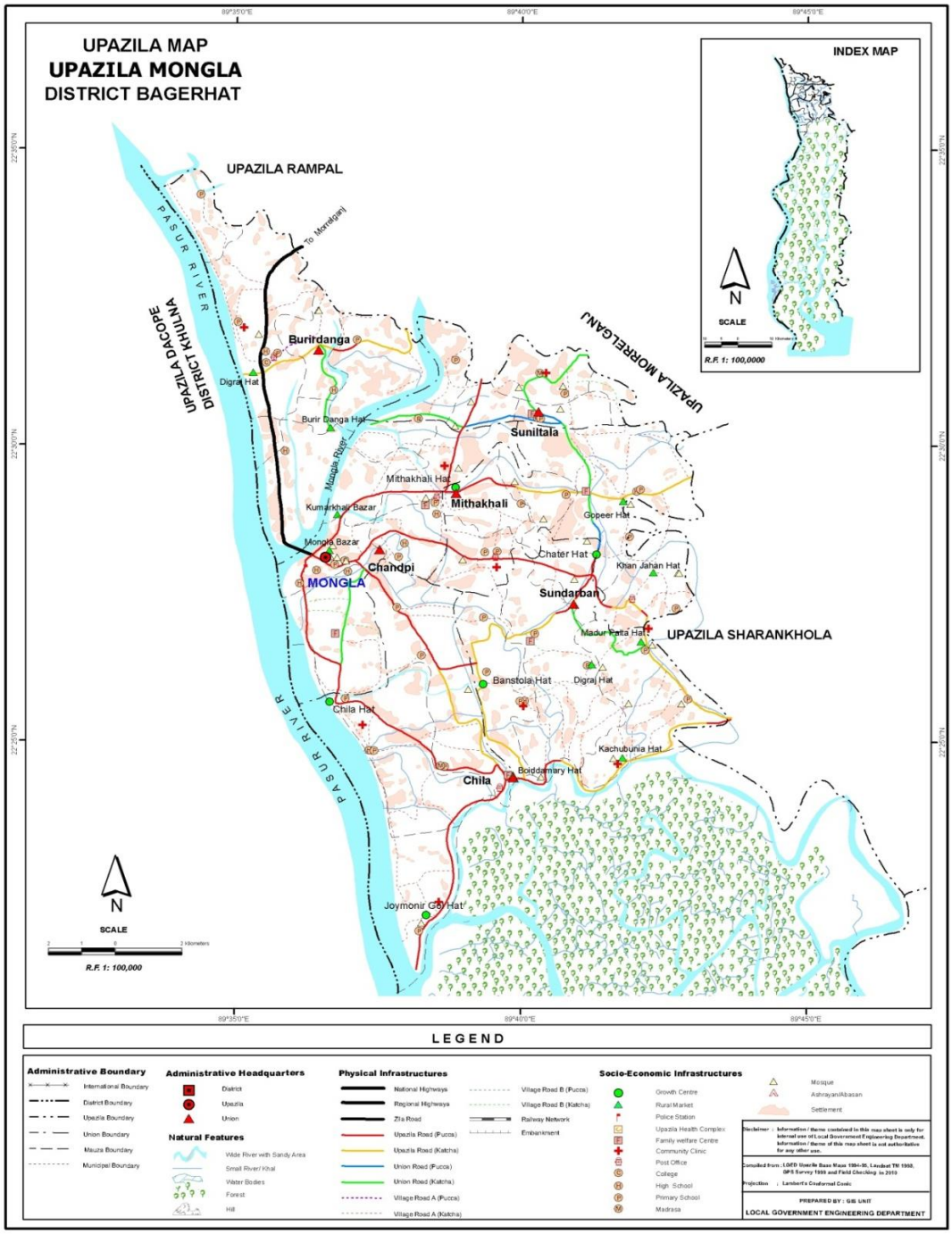



Figure 5.1: Location of Project Site in Mongla Upazila of Bagerhat District

## 5.3 Sources of Data Collection

In this SIA study data were collected from different sources. However, all of these sources can be broadly classified into two categories: primary sources and secondary sources.

### 5.3.1 Primary Sources

Primary data were collected directly through field visits, discussion with port officials and other officials in the port area, questionnaire survey, public consultation with common people, and focus group discussion with the stakeholders living around the zone and port workers to know how the project may affect the community.

### 5.3.2 Secondary Sources

To prepare the baseline situation of the study area, information about some socio-economic parameters were collected from the census and survey reports of Bangladesh Bureau of Statistics (BBS), Mongla port authority (MPA), Survey process and impact analysis was adapted from the report "Feasibility Study for the Construction of an Overflow Container Yard at Dock Workers Colony of Chittagong Port Authority" by Bureau of Research Testing & Consultancy (BRTC), BUET and "Environmental Impact Assessment for dredging in Passur River from Mongla Port to Rampal" by IWM, 2015.

## 5.4 Historical Context

### 5.4.1 Mongla-Passur River Bay

Mongla-Passur river bay area, having imminence of the reserve forest 'Sundarban', has played an important role in the human settlement history of both Khulna and Bagerhat district during the Khalifabad Pargana founded by Khan Jahan Ali, the ruler of Pargana from 1429-1459. Later on British, Portuguese, Dutch, Chinese and Arakanese came to South Asia for business purposes through the river routes of Mongla and the Sundarban at the time of Emperor Akbar during late fifteen centuries after establishing Nawara, an imperial naval department. History suggested strong pirates' activity and oppression on the earlier settler nearby the Mongla-Possur river bay. The Arakanese (Maghs) Pirates, the Ferringhees (Portuguese), Dutch and English renegades started regular piracy and robbery in the Sundarban area (MPA, 2015). They entered into the Sunderbans through the rivers like

Marjjal (now known as Zulfiquar channel), Malancha, Jamuna, Arapangsia and into the channels and arms of these rivers and between all these isles of the lower Bengal and often penetrating even beyond the Sundarbans up into the countryside towns, assemblies, and markets. They used to torch people and make women slaves with cruelty and burning the households. This area was known as Magher Mulluk (the territory of Maghs) for ages due to terror activities by the Maghs and the Portuguese fleet. Many fine isles became deserted and no inhabitants were found except wild beasts, which were formerly populated by them. Bengali rulers even built Forts in the confluence of Sibsa/Marjjal, Araibaki (Known as Ferringhee Fort) and Malancha and Jamuna. There are still channels in the Sundarban, which is known as Ferringhee Fari/Khal, Ferringheer Doaniakhal as these used to be places for heavy encounter with the Maghs, Arakenese pirates beside the confluence of Marjjal, Malancha and Possur and Arapangsia. After set up Mongla sub-division in 1842 Bankim Chandara established the law and order in the river routes/canals to avoid conquest in this area. The Government of British India also established a port at Morelganj in 1869, which was to expedite the movement of merchandise via Mongla.

### 5.4.2 Mongla Port

The name Mongla originated from Mongla River presently known as Mongla Nulla, the confluence of Possur and Mongla Nulla River. According to the Mongla Pourashava (2014) it is mentioned that a Greek ship was anchored in 1950 near the present place of Mongla Port by mistake. The captain of ship came out with his speedboat and tried to find out the right direction along the Possur River and after a short while met one hindu priest named Mongal Rhishi at the present location of the Mongla port. He declared this location as the Mongla port. The original inhabitants in the Mongla, Bagerhat and Khulna area might be a mixture of the non-Aryan the Dravidian and the Mongolian races.

The demand of export and import goods between East and West Pakistan was increased significantly after the partition of the Indian sub-continent in 1947. Sudden increasing pressures of export and import commodities on Chittagong port with limited and inadequate facilities caused severe congestion and provide option of emerging the second seaport for smooth handling of all commodities including jute and jute products. Admiral Jefford from Pakistan Navy approached to the newly surveyed channel to Chalna anchorage.

Subsequently, the light vessel "Sindhi" approached to the Passur river and arrived Chalna from Karachi Port.

The legal framework of Chalna Port existed effecting from December 01, 1950 under the Ministry of Communication. A British merchant ship "City of Lyons" first entered in the port and anchored at Joymonirgol on 11 Dec. 1950, thus making the auspicious beginning of cargo handling operation at the anchorage. On March 17, 1951, the anchorage was shifted near Chalna Bazar, 22 km upstream. In 1954, Sir Claude English surveyed the Possur- Sibsa river basin for suitable anchorage site and recommended for Mongla, about 16 km downstream from Chalna Bazar. Then the Directorate of Chalna Anchorage was shifted to Mongla between Mongla Nulla and Possur River in June 20, 1954. Five jetties were constructed at Mongla port with necessary facilities including handling of containers in 1978. Mongla become a police station on September 19, 1976 and was upgraded to an Upazila on September 14, 1983. The port directorate declared as an autonomous body named, Chalna Port Authority under the Ministry of Shipping from 1978 and finally renamed as Mongla Port Authority since March 08, 1987 (MPA, 2015).

## 5.5 Socio-Economic Status

The general purposes of social impact assessment (SIA) is to define the present socio- economic conditions of the people of the project and surrounded areas which will provide sound reference and assessment for probable socio-economic impact of the proposed interventions. This will enable us to compare the changes and impacts of the project interventions in future.

### 5.5.1 Population and Households

Population distribution by gender and household, by age group and community, by ethnic groups, and by religion is shown in Table 5.1 to Table 5.4, respectively.

Mongla Upazila has a total population of 1,36,588 including male (71,492) and female (65,096) having 32383 Households (Muslim 102298, Hindu 29426, Christian 4837, Buddhist 21 and others 6) with population density of 1018 per sqkm (BBS, 2011). The Male population was found more in all studied communities except Araji Makordone (96%) and Purba Selabunia (94%). The total child population (shown in Table 2) in the upazila is 50468 (0-19 yrs), which is 36.95% of total population. This category of population is divided

according to age as 10241 nos. (0-4 yrs), 13209 nos. (5-9 yrs), 15860 nos. (10-14 yrs) and 11128 nos. (15-19 yrs). Community data provides more age specific information for child population. The data found can be listed as 31,257 nos. (0-18 yrs), 1955 nos. (0-1 yrs), 2068 nos. (1-2 yrs), 3465 nos. (5-6 yrs) and 9199 nos. (6-10 yrs). The average size of household in the studied areas of the proposed project was found approximately from 4.0 to 4.4, which is similar to the average household size (4.1) of Bagerhat District.

Table 5.1: Distribution of Population by Gender, Community, and Household (BBS, 2016)

| Community | Total population | Male population | Female population | Gender ratio | Households | Avg. size of Household |
|---|---|---|---|---|---|---|
| Bagerhat District (Total) | 1476090 | 740138 | 735952 | 101 | 350537 | 4.1 |
| Mongla Upazila (Total) | 136588 | 71492 | 65096 | 110 | 31912 | 4.0 |
| Mongla Pourashava | 39837 | 21607 | 18230 | 119 | 8615 | 4.2 |
| Araji Makordone | 4832 | 2371 | 2461 | 96 | 1083 | 4.4 |
| Bazar Area Mahalla | 1841 | 973 | 868 | 112 | 407 | 4.2 |
| Labour Colony | 2750 | 1588 | 1162 | 137 | 536 | 4.4 |
| Purba Selabunia | 7032 | 3416 | 3616 | 94 | 1722 | 4.0 |
| Madhya Selabunia | 3634 | 1837 | 1797 | 102 | 880 | 4.1 |
| Burirdanga Union (Total) | 15311 | 7810 | 7501 | 104 | 3789 | 4.0 |
| Digraj | 5557 | 2882 | 2675 | 108 | 1356 | 3.9 |
| Uttar Burirdanga | 1971 | 1001 | 970 | 103 | 490 | 4.0 |

Table 5.2: Distribution of Population by Age Group and Community (BBS, 2016)

| Community | Total population | Percentage of population in the age group | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-4 | 5-9 | 10-14 | 15-19 | 20-24 | 25-29 | 30-49 | 50-59 | 60-64 | 65+ |
| Bagerhat district (Total) | 1476090 | 9.0 | 11.5 | 11.8 | 8.1 | 8.0 | 8.6 | 26.2 | 7.3 | 3.3 | 6.3 |
| Mongla Upazila (Total) | 136588 | 7.6 | 9.7 | 11.6 | 8.1 | 8.3 | 9.6 | 29.2 | 7.3 | 3.1 | 5.6 |
| Mongla Pourashava | 39837 | 7.2 | 9.2 | 12.3 | 9.7 | 8.7 | 9.8 | 29.4 | 6.7 | 2.6 | 4.3 |
| ArajiMakordone | 4832 | 8.1 | 9.9 | 13.6 | 10.5 | 7.7 | 7.3 | 27.0 | 6.6 | 3.1 | 6.2 |
| Bazar Area Mahalla | 1841 | 8.3 | 9.9 | 12.9 | 9.7 | 8.1 | 9.2 | 29.2 | 5.4 | 3.1 | 4.2 |
| Labour Colony | 2750 | 6.6 | 8.7 | 12.9 | 10.0 | 7.8 | 9.4 | 32.2 | 5.6 | 2.5 | 4.2 |
| PurbaSelabunia | 7032 | 7.4 | 9.2 | 13.2 | 10.2 | 7.8 | 9.6 | 28.4 | 6.9 | 2.7 | 4.6 |
| Madhya Selabunia | 3634 | 7.5 | 10.2 | 12.7 | 10.2 | 9.1 | 9.1 | 26.7 | 6.9 | 3.0 | 4.5 |
| Burirdanga Union (Total) | 15311 | 7.2 | 9.0 | 9.7 | 7.6 | 9.4 | 10.0 | 30.1 | 7.2 | 3.0 | 6.9 |
| Digraj | 5557 | 8.9 | 10.3 | 9.7 | 7.8 | 10.8 | 12.4 | 28.6 | 5.2 | 1.8 | 4.3 |
| Uttar Burirdanga | 1971 | 6.6 | 9.0 | 8.9 | 7.0 | 8.3 | 8.5 | 32.2 | 9.4 | 2.4 | 7.6 |

Table 5.3: Distribution of Population and household by Ethnic groups (BBS, 2016)

| Community | Ethnic | | Ethnic Main groups | | | |
|---|---|---|---|---|---|---|
| | Household | Total population | Barmon | Khiyang | Chakma | Others |
| Bagerhat District (Total) | 703 | 3327 | 657 | 24 | 10 | 2636 |
| Mongla Upazila (Total) | 5 | 5 | 0 | 0 | 3 | 2 |
| Mongla Pourashava | 5 | 5 | 0 | 0 | 3 | 2 |
| Bazar Area Mahalla | 0 | 0 | 0 | 0 | 0 | 0 |
| Labour Colony | 0 | 0 | 0 | 0 | 0 | 0 |
| PurbaSelabunia | 0 | 0 | 0 | 0 | 0 | 0 |
| Madhya Selabunia | 0 | 0 | 0 | 0 | 0 | 0 |
| Burirdanga Union (Total) | 0 | 0 | 0 | 0 | 0 | 0 |
| Digraj | 0 | 0 | 0 | 0 | 0 | 0 |
| Uttar Burirdanga | 0 | 0 | 0 | 0 | 0 | 0 |
| GolachipaDigraj and Kamardanga | 5 | 5 | 0 | 0 | 3 | 2 |

Table 5.4: Distribution of Population by Religion (BBS, 2016)

| Community | Total population | Muslim | Hindu | Christian | Buddhist | Others |
|---|---|---|---|---|---|---|
| Bagerhat District (Total) | 1476090 | 1198593 | 270874 | 6115 | 43 | 465 |
| Mongla Upazila (Total) | 136588 | 102298 | 29426 | 4837 | 21 | 6 |
| Mongla Pourashava | 39837 | 35285 | 2802 | 1734 | 16 | 0 |
| ArajiMakordone | 4832 | 4263 | 561 | 8 | 0 | 0 |
| Bazar Area Mahalla | 1841 | 1777 | 54 | 10 | 0 | 0 |
| Labour Colony | 2750 | 2730 | 18 | 2 | 0 | 0 |
| Purba Selabunia | 7032 | 5320 | 1068 | 644 | 0 | 0 |
| Madhya Selabunia | 3634 | 3276 | 90 | 265 | 3 | 0 |
| Burirdanga Union (Total) | 15311 | 6649 | 8467 | 194 | 1 | 0 |
| Digraj | 5557 | 3695 | 1820 | 41 | 1 | 0 |
| Uttar Burirdanga | 1971 | 511 | 1460 | 0 | 0 | 0 |

### 5.5.2 Education

Mongla Upazila has a total of 2483 pre-school aged children of which 1741 children are enrolled in pre-primary class run by government and non-government schools according the survey conducted by the DPE (2014). Tables given above show the distribution of population (age 6-19 years) by school non-attendee and literacy, respectively. A substantial number of children missed pre-primary education because of limited early learning centres, long distance and poor communication system. At primary level there are 9222 children of 6-10 years old and out of them 9207 are enrolled in the primary schools run by Government and NGOs (MP, 2014). Many children are also attending Madrassa (Arabic based) education both at primary and secondary level. At secondary level, 13046 children were enrolled in different schools (MP, 2014). Population distribution by school non-attendee and by literacy is shown in Table 5.5 and Table 5.6, respectively.

Table 5.5: Distribution of Population (age 6-19 years) by School Non-attendee (BBS, 2016)

| Community | Age group 6-10 years | | Age group 11-14 years | | Age group 15-19 years | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Bagerhat District (Total) | 17449 | 15246 | 12771 | 7078 | 30425 | 31678 |
| Mongla Upazila (Total) | 1335 | 1175 | 1301 | 638 | 3007 | 2963 |
| Mongla Pourashava | 300 | 307 | 306 | 173 | 998 | 860 |
| ArajiMakordone | 51 | 40 | 44 | 12 | 107 | 110 |
| Bazar Area Mahalla | 28 | 30 | 23 | 12 | 60 | 63 |
| Labour Colony | 22 | 14 | 45 | 15 | 104 | 80 |
| PurbaSelabunia | 27 | 33 | 30 | 30 | 107 | 161 |
| Madhya Selabunia | 20 | 25 | 14 | 8 | 61 | 81 |
| Burirdanga Union (Total) | 250 | 246 | 113 | 108 | 77 | 59 |
| Digraj | 48 | 52 | 34 | 25 | 103 | 148 |
| Uttar Burirdanga | 8 | 5 | 4 | 5 | 26 | 31 |

The secondary school going children are 17772 or more and the school enrolment is only 12826 which means that a large number of children (4946) are not enrolled or do not attend in or dropped out from secondary education (BBS, 2011). The school non-attendee numbers (age 6-19 years) is a major concern especially for the age group 6-10 years. More than 500 non-attendee children (6-10 years) were located surrounding the project areas. Initiatives are required for resolve all relevant issues related to the deprivation from school education. Mongla Upazila has Government primary schools (68 nos.), community school (1 no.), NGO schools (40 nos.) for pre-primary and primary education comprising Head Teachers of 68 nos. and Assistant Teacher of 220 nos. (MP, 2014). There are some villages in the upazila without primary school. However, there are some schools in those villages run by NGOs to cover only PPE of one class within 1-5. The Mongla Upazila has 29 nos. secondary schools, 13 nos. secondary level madrasa, and 4 nos. collages for higher education. The standard teacher and student ratio for pre-primary and primary class is 1:30 and 1:45, respectively. However, average class size in some cases was found as 1:40 for pre-primary

class (MP, 2014). Few schools are overcrowded and more than 50 children are enrolled in each class hampering the standard learning process.

Table 5.6: Distribution of Population by Literacy (BBS, 2016)

| Community | Total population | Total Literacy (%) | Male Literacy (%) | Female Literacy (%) |
|---|---|---|---|---|
| Bagerhat District (Total) | 1476090 | 59.0 | 60.0 | 58.0 |
| Mongla Upazila (Total) | 136588 | 57.2 | 58.9 | 55.3 |
| Mongla Pourashava | 39837 | 64.1 | 65.5 | 62.3 |
| ArajiMakordone | 4832 | 51.6 | 52.6 | 50.7 |
| Bazar Area Mahalla | 1841 | 43.9 | 47.6 | 39.6 |
| Labour Colony | 2750 | 48.7 | 47.4 | 50.5 |
| Purba Selabunia | 7032 | 73.9 | 76.5 | 71.5 |
| Madhya Selabunia | 3634 | 75.6 | 78.8 | 72.5 |
| Burirdanga Union (Total) | 15311 | 65.8 | 72.8 | 58.7 |
| Digraj | 5557 | 67.1 | 74.2 | 59.4 |
| Uttar Burirdanga | 1971 | 73.3 | 83.2 | 63.2 |

### 5.5.3 Disability and Child Labor

Table 5.7 shows the population with different types of disability. 1.6% of total population in Mongla was found with disability including speech, vision, hearing, physical, mental related problems. Among them very few children are attending school as there is no adequate infrastructure and disability-friendly environment in the school. Table 5.8 shows the school non-attendee employed population by their employment sector. About 3406 nos (age 7+ non-school attendee) were engaged in informal labour force. These children are mainly engaged in agricultural works, fishing and non-formal sector like in the tea stall and small hotels and restaurants and these children are out of schools (MP, 2014). The government supported by UNICEF provides conditional cash for some of these children, however, this is very insufficient.

Table 5.7: Distribution of Population by type of disability (BBS, 2016)

| Community | Total population | Type of Disability, % | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | All | Speech | Vision | Hearing | Physical | Mental | Autism |
| Bagerhat District (Total) | 1476090 | 1.7 | 0.2 | 0.3 | 0.2 | 0.7 | 0.2 | 0.1 |
| Mongla Upazila (Total) | 136588 | 1.6 | 0.2 | 0.3 | 0.1 | 0.7 | 0.2 | 0.1 |
| Mongla Pourashava | 39837 | 1.6 | 0.2 | 0.5 | 0.2 | 0.5 | 0.2 | 0.1 |
| Bazar Area Mahalla | 1841 | 1.2 | 0.1 | 0.2 | 0.1 | 0.6 | 0.1 | 0.1 |
| Labour Colony | 2750 | 0.7 | 0.0 | 0.1 | 0.0 | 0.4 | 0.1 | 0.0 |
| PurbaSelabunia | 7032 | 1.1 | 0.2 | 0.1 | 0.1 | 0.3 | 0.2 | 0.2 |
| Madhya Selabunia | 3634 | 1.2 | 0.2 | 0.3 | 0.1 | 0.2 | 0.2 | 0.1 |
| Burirdanga Union (Total) | 15311 | 1.0 | 0.1 | 0.1 | 0.1 | 0.5 | 0.2 | 0.1 |

Table 5.8: Distribution of School Non-Attendee (age 7+) by Employment sector (BBS,2016)

| Community | Total | Employment sector | | | | | |
|---|---|---|---|---|---|---|---|
| | | Agriculture | | Industry | | Service | |
| | | Male | Female | Male | Female | Male | Female |
| Bagerhat District (Total) | 102723 | 65585 | 2329 | 3420 | 567 | 26835 | 3987 |
| Mongla Upazila (Total) | 12041 | 4024 | 234 | 161 | 17 | 6521 | 1084 |
| Mongla Pourashava | 3406 | 218 | 12 | 53 | 4 | 2708 | 411 |
| Araji Makordone | 399 | 160 | 9 | 11 | 2 | 184 | 33 |
| Bazar Area Mahalla | 281 | 1 | 0 | 11 | 0 | 213 | 56 |
| Labour Colony | 543 | 0 | 0 | 0 | 0 | 494 | 49 |
| Purba Selabunia | 266 | 13 | 1 | 9 | 0 | 202 | 41 |
| Madhya Selabunia | 191 | 2 | 0 | 2 | 0 | 148 | 39 |
| Burirdanga Union (Total) | 998 | 329 | 14 | 2 | 0 | 493 | 160 |
| Digraj | 398 | 122 | 5 | 0 | 0 | 198 | 73 |
| Uttar Burirdanga | 58 | 34 | 2 | 0 | 0 | 14 | 8 |

### 5.5.4 Health Services

The upazila has one health complex, 6 Family Welfare Center (FWC), 11 functional Community Clinics (CC) and 48 Satellite Clinics. There are health services in the upazila provided by NGOs which are mainly community awareness. According to the health section 1216, children have fully vaccinated out of 1,589 of 1 year age and 407 children dropped from full vaccination coverage. Community thought that every child is vaccinated however there might be a few left out children from fully vaccinated package.

### 5.5.5 Drinking Water and Sanitation Facilities

Table 5.9 shows the distribution of households by drinking water source and sanitation facilities. DPHE, Mongla does not have the record provided by NGO or personally installed tube wells, Rain water harvesting, PSF and pipe line supply water points in the Upazilla. About 4.4% of households (1404) have tube wells water source facilities, 6.6% (2106) HH used tap water (running water) and 88.9% HH used others source (BBS, 2011). However, community data shows that only six unions of the upazila has 181 nos. of Tap, PSF, and tube wells, 7617 nos. of rain water harvesting system (RWHS) in HH and community level and about 63% Households are getting safe water round the year (MP, 2014). During rainy season and about 8 months of the year all Households have access to safe drinking water.

Sanitation coverage in the Mongla Upazila is fairly good compared with others. The upazila (only six unions) has 23446 households, out of which 10084 households (43%) have hygienic latrines, 12173 (91.92%) households have unhygienic latrines and 1196 households do not have any latrines (BBS, 2011; MP, 2014). However, community data indicates that 18449 nos. of households (73.94%) have hygiene latrines, 5255 nos. of households use unhygienic latrines and 268 nos. of households do not have any latrines out of 24952 households (BBS, 2011). About 21 NGOs have been working in the upazila on health, education, child protection, agriculture, disaster preparedness, community awareness, local government strengthening, water and sanitation etc.

Table 5.9: Distribution of households by Drinking water source and sanitation (BBS, 2016)

| Community | No of Households | Source of Drinking Water, % | | | Sanitation Facility, % | | | |
|---|---|---|---|---|---|---|---|---|
| | | Tap | Tube-well | Others | Sanitary (Watersealed) | Sanitary (Non-watersealed) | Non-sanitary | None |
| Bagerhat District (Total) | 350537 | 6.4 | 59.9 | 33.7 | 3.5.4 | 43.3 | 19.5 | 1.8 |
| Mongla Upazila (Total) | 31912 | 6.6 | 4.4 | 88.9 | 44.2 | 37.1 | 14.7 | 4.1 |
| Mongla Pourashava | 8615 | 23.1 | 0.4 | 76.5 | 47.4 | 36.5 | 14.7 | 1.3 |
| AraJiMakordone | 1083 | 3.0 | 0.0 | 97.0 | 42.4 | 54.6 | 2.5 | 0.6 |
| Bazar Area Mahalla | 407 | 37.8 | 2.2 | 60.0 | 13.8 | 53.1 | 13.2 | 2.0 |
| Labour Colony | 536 | 49.8 | 0.0 | 50.2 | 27.6 | 27.1 | 39.6 | 5.8 |
| Purba Selabunia | 1722 | 30.3 | 0.5 | 69.2 | 49.7 | 35.2 | 15.0 | 0.1 |
| Madhya Selabunia | 880 | 1.1 | 0.0 | 98.9 | 68.5 | 21.5 | 9.5 | 0.5 |
| Burirdanga Union (Total) | 3789 | 0.2 | 24.4 | 75.4 | 63.7 | 30.6 | 3.8 | 1.9 |
| Digraj | 1356 | 0.4 | 5.2 | 94.5 | 46.4 | 47.2 | 6.0 | 0.4 |
| Uttar Burirdanga | 490 | 0.0 | 25.9 | 74.1 | 66.5 | 29.8 | 1.0 | 2.7 |

### 5.5.6 House Infrastructure and Electricity Connection

Table 5.10 shows the distribution of households based on the type of structure and electricity connection. According to BBS (2011), Pucka (3.8%), semi-pucka (19%), Kutcha (74%), and Jupri (3.2%) types of houses were identified in Digraj area located in the proximity of MP. It is well understood that the prosperity of a nation immensely depends on the adequacy of education status, industry and extensive agriculture practices which greatly depends on electricity. All villages are under electric connection having low electricity coverage as expected (MP, 2014). Madhya Selabunia community reached the highest percentage (89.7%) of electricity coverage whereas average Bagerhat district covers only 40.8%.

Table 5.10: Distribution of households by type of structure and electricity connection (BBS, 2016)

| Community | Total Households | Type of structure, % | | | | Electricity connection, % |
|---|---|---|---|---|---|---|
| | | Pucka | Semi-pucka | Kutcha | Jhupri | |
| Bagerhat District (Total) | 350537 | 5.1 | 11.8 | 78.3 | 4.8 | 40.8 |
| Mongla Upazila (Total) | 31912 | 6.1 | 7.1 | 80.5 | 6.3 | 44.9 |
| Mongla Pourashava | 8615 | 18.6 | 15.8 | 56.9 | 8.7 | 80.2 |
| Araji Makordone | 1083 | 5.0 | 5.7 | 81.7 | 7.6 | 75.6 |
| Bazar Area Mahalla | 407 | 13.0 | 15.0 | 59.7 | 12.3 | 70.3 |
| Labour Colony | 536 | 23.5 | 4.3 | 38.8 | 33.4 | 74.4 |
| Purba Selabunia | 1722 | 14.6 | 22.1 | 58.2 | 5.1 | 85.9 |
| Madhya Selabunia | 880 | 12.2 | 30.1 | 56.9 | 0.8 | 89.7 |
| Burirdanga Union (Total) | 3789 | 3.2 | 9.3 | 85.7 | 1.7 | 62.6 |
| Digraj | 1356 | 3.8 | 19.0 | 74.0 | 3.2 | 77.1 |
| Uttar Burirdanga | 490 | 4.1 | 8.8 | 86.7 | 0.4 | 74.5 |

### 5.5.7 Economic Activities and Occupation

According to BBS (2011) about 60-70% people are living below the poverty line similar to other rural areas of Bangladesh having the average literacy rate is 57.2 % with small variation in literacy rate for male (58.9%) and female (55.3%). Livelihood groups and their corresponding activities of the study area are very much diversified. The major livelihood activities include farming, fish culture, agri-labour, fishing, service, business, van/rickshaw/ nocimon (mechanized van) pulling, cart pulling, gachhi (date/palm climber), carpenter (wood), masonry, pottery, boat plying, blacksmith, barber, handicraft, imam, etc. Mongla Sea port and Chandpai forests range significantly contribute to the economy of Mongla. Several industries and factories such as EPZ (1no), Cement factory (4 nos), Gas factory (3 nos), Auto rice mill (8 nos), Husking rice mill (6 nos) and Flower mill (2 nos) are also contributing to the economic wheel of Mongla (MP, 2014). A large number of people at Mongla involve in agriculture, fishing, day labor, Port labor, shrimp farming and honey

collection from Sundarban. The main crops are paddy and vegetable, while the main export items are paddy, fish (shrimp) and honey. Agriculture and fishing are considered as major livelihood sectors. Children can be found engaged in fishing boats resulting deprivation of education and other basic rights.

### 5.5.8 Other Features

#### 5.5.8.1 Forests

Forests can act as a buffer and prevents thread joining areas from severe hazards like Tornado, Tsunami, drought, etc. The vegetation of the forest is very much significant to the ecological balance. There is mainly Sundori, Gaoa, Kaora, Goalpata, Mehgoni, Sirish, Babla, Chambul, Nim and trees that are fruit bearing of the wood trees, mahogany, epil-epil, and shisoo trees are mains. In the past, there were a lot of varieties of medicinal plants, for instances neem, tamarind, thankuni, amgrass, pepoljangi, gandhovadalia, kalodhutra, pathorchuna, arjunin the study area. Now-a-days these plants are mostly extinct (CRA, 2009). The natural forests are very few but the public and private afforestation is increasing over the years.

#### 5.5.8.2 Livestocks

Livestock is a significant asset of each household. This sector acts as a supplementary income and also provides animal protein to the family members. Most of the households possess a number of livestocks and poultry species. The Upazilla has the animals like cows, goats, buffalos, ducks .hens, pigeon, sheep etc. The cow lives on straws, oil cakes, water, brans, grass etc. The goats live on grass and green leaves of grass; and the poultry live on broken rice, brans, rice, water, insects, etc.

#### 5.5.8.3 Landscape Features and Use

According to CRA (2009), the landscape feature of the Mongla Upazilla is very simple. The demarcation of the land elevation is not so prominent though the cropping pattern changes according to land elevation. The settlements are also scattered and mostly along the roads. Most of the houses are built with tin, timber and bamboo. Slightly elevated lands are mainly used for vegetable cultivation. Medium elevated and low lands are used for different crops.

Very low lands are meant for cultivation of Aaman and Rabi rice crops. Now less elevated land is used as a gher for Shirmp cultivation.

#### 5.5.8.4 Infrastructure and Utilities (Road, bridge, culvert)

According to CRA (2009) terrestrial road is the only medium of transportation and communication. These roads are categorized into three major types, for instances paved, semi-paved and mud roads. These roads are also very important during the natural hazards to rescue the people and their precious assets from the total loss. Most of the bridges and culverts are not suitable for use and are dilapidated. Many important places are devoid of bridges and culverts and as a result people face problems in carrying goods and for daily communication. Due to lack of these bridges and culverts water logging is a common phenomenon in these areas.

#### 5.5.8.5 Social Institutions, Hat-bazars and Playgrounds

The presence of the numbers of social institutions determines the cultural and socio-economical level of an area. The social assets include educational and religious institutes, prayer places, post office, banks, cultural centers, growth centers, common places, playgrounds, etc.

#### 5.5.8.6 Disaster Related Activities and Management Strategies by Local Community

**Shelter center**

According to CRA (2009), people during devastating floods and storm surge people take shelter in educational or religious institutions or on high places. However during storms of moderate intensity, they take shelter in the strong houses of the neighbors.

**Traditional preparedness of disaster risk and management**

According to CRA (2009), the preparedness and management based customs and practicesof the areas are accomplished by the followings:

- Grow crops by irrigation with the help of shallow machines without waiting for rains;
- Sow seeds in the seed beds without depending on the nature;
- Plough the lands with ploughs and cows;

- Remove water standing due to excessive rainfall by hand irrigation at their own initiatives;

**During disasters**

- Remove water standing due to excessive rainfall by hand irrigation at their own initiatives;
- Take shelter in the designated shelter center or on a high place;
- Transport livestock and properties to a safer place by making raft with banana plants and covering the surface with planks;
- Boats are used for communication;
- Make arrangement for portable stove for cooking.

**Pre-disaster preparedness**

People do not have any such preparedness for managing disaster.

## 5.6 Social Impact Assessment Methodology

The SIA carried out in the areas of Mongla port and surroundings are based on the following methodology, impact assessment criteria and approach.

The SIA study comprises the preparation of data collection instrument such as questionnaire survey, discussions and consultations with the potentially affected persons and concerned stakeholders; initial site reconnaissance, desk study and literature review; field visits for consultations, discussions with local officials and observations; data analysis and reporting.

Detailed SIA was pursued on the areas of the port and surroundings that would be impacted by the proposed project. For this reason, a standard questionnaire was prepared for conducting the socio-economic survey of the potentially affected persons where the issues like affect to land, structure, income, occupation, gender issues, indigenous or ethnic minority issues, etc. were reviewed. In order to pursue the social impact assessments of the project survey, focus group discussion (FGD) and public consultation (PC) methods were used. Before setting the survey framework the consultant at the outset fixed the impact assessment criteria taking into account the possible impacts that the proposed project may involve. Therefore, reconnaissance visits were conducted to the port and surrounding areas in order to identify the nature and types of impact that likely to have due to implementation

of the project. The survey covered the areas of impact and the areas that likely to be utilized directly and indirectly by the project.

Eleven criteria were used for the SIA. These are:

**i) Physical condition of the port** (facilities for new construction, security, etc.)

**ii) Land area for the Project** (Land availability, acquisition etc)

**iii) Property loss** (partial or total, even partial loss may render land/structure unviable for economic or residential activity, if any), loss may be temporary or permanent, etc. loss of property (houses, other structures – type of structures)

**iv) Income loss** (partial or total, temporary or permanent, etc.)

**v) Dislocation** (temporary or permanent, shifting, etc), requisition of land during construction, affect to public property, removal of structures, loss of trees, disruptions in traffic and travel routes, etc.

**vi) Disturbances** (temporary or permanent),

**vii) Cultural properties** (removal or affect to schools, colleges, hospitals, mosques, temples, graveyards, war cemetery, historical places or monuments, etc.

**viii) Indigenous people** (Adibashi, ethnic minority, etc)

**ix) Marginal people (**sweeper, Dom, Transgender, Bihari, Rishi, etc.)

**x) Employment generation**

**xi) Economic development**

For in depth understanding of the possible impacts arising from the project, public opinion was gathered through **FGDs** and **PCs**.

**Survey:** For conducting survey, PCs were carried out in the form of questionnaire survey. The questionnaire is framed to capture all the possible aspects of the affect that may take. FGDs and PCs were carried out for documenting the opinions and concerns of the people regarding the proposed project, and also for assessment of social impacts of project activities

during construction and operation phase of this project. The conducted surveys cover different stakeholders like local Government representatives, officials of MPA, custom house office staffs, EPZ officials, clearing and forwarding agent, Mongla port workers, the people living and operating within the port and surrounding areas, etc.

### 5.6.1 Questionnaire survey

A series of questionnaire surveys have been carried out for documenting the respondents' existing socio economic conditions as well as their views, opinions and concerns regarding the proposed Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project. The questionnaire surveys were carried out in an area covering about 5 km radius from the center point of the proposed project sites. The questionnaire was designed with an aim to recognize the socio-economic characteristics that may be impacted due to the proposed project activities.

#### 5.6.1.1 Socio-economic background of the respondents

In order to categorize the background of the respondents, data on several factors pertaining to their socio-economic status were collected through questionaire survey on local people in the study area. In questionaire survey maximum participants (99% ) were male as shown in Figure 5.2. This is due to their availability and willingness. All thethe respondents were Bengali, no tribal respondent was found in the project study site. 40% of the respondents' age was between 25 to 34 years and 29% of the respondents' age was between 35 to 44 years (Figure 5.3), which indicates that young people were more willing to participate in the questionaire survey.

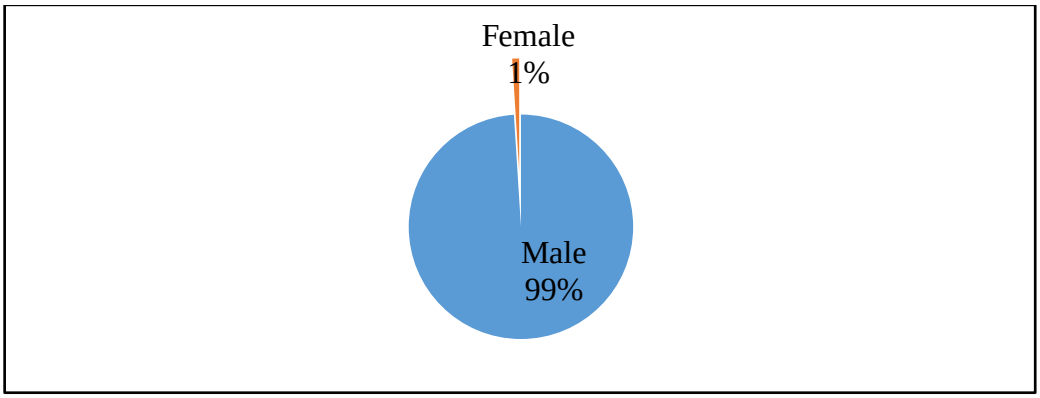



Figure 5.2: Gender of the Respondents who Participated in the Questionnaire Survey

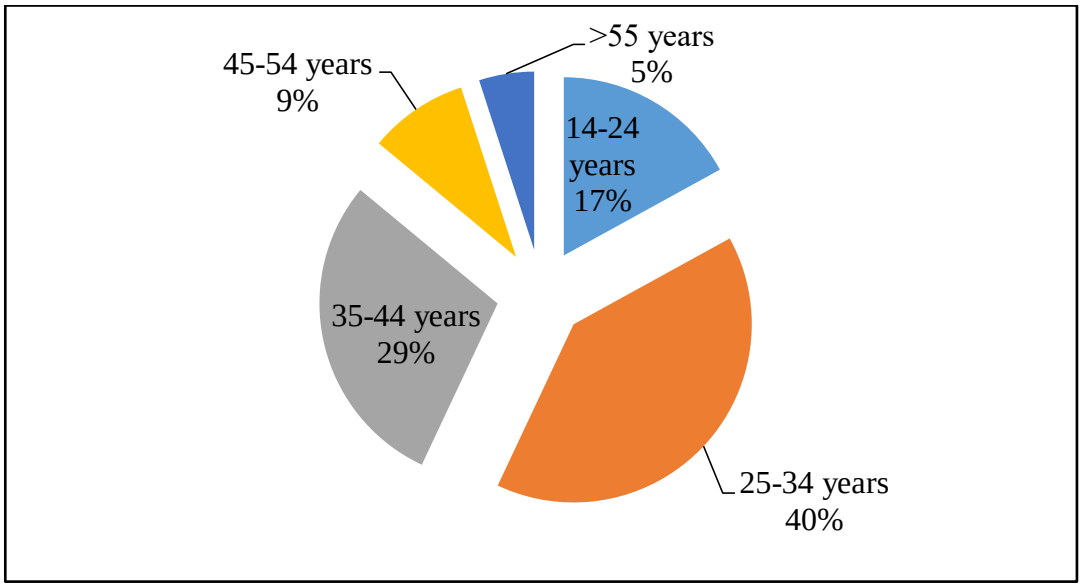



Figure 5.3: Age of the Respondents who Participated in the Questionnaire Survey

### 5.6.1.2 General consent of the respondents about the project

Information was collected regarding the awareness of the respondents regarding the general aspects of the project and its future benefits and impact of the project on the social environment of the area. The information collected has been summarized below which provides a brief understanding of respondents' views and concerns about the proposed Dredging at the Inner Bar of Mongla Port Channel project.

It was observed that most of the (94%) respondents were aware of this project (Figure 5.4a). Moreover, Most of them (99%) support the the proposed "Dredging at the Inner Bar of Mongla Port Channel" project (Figure 5.4 b).

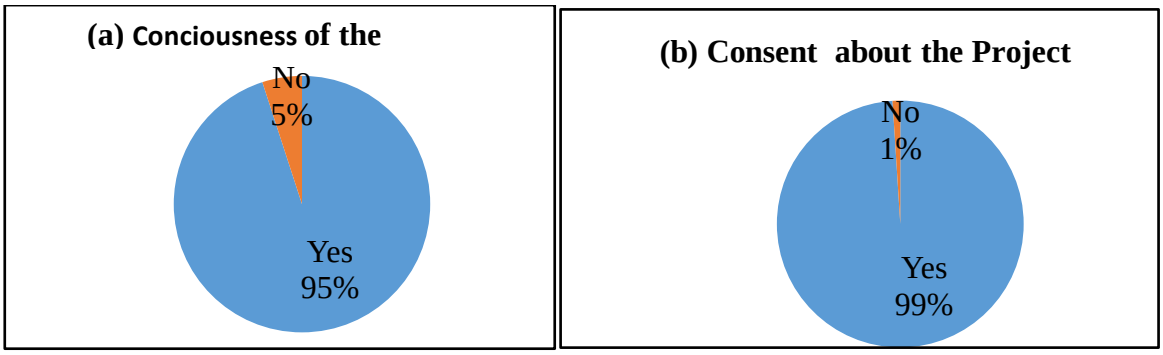



Figure 5.4: Consciousness and Support of the Respondents about the Project

Information was collected about the major reasons of respondents' support on this project. It was found that about 35% of the respondents desire this project because it will create new accommodation facilities. About 45% of the respondents desire this project for overall progress in the area, 75% of them think that it will result in advancement of business, 70% of them think it will be helpful for port facilities and 25 % of them desire that it will create new employment (Figure 5.5).

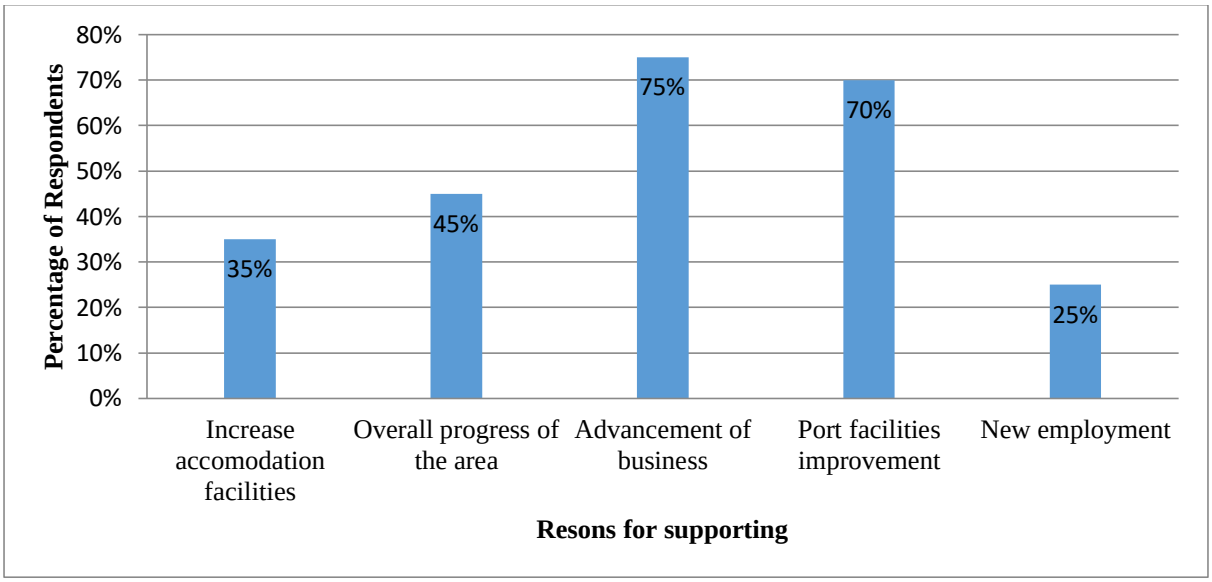



Figure 5.5: Reasons Described by the Respondents for Supporting the Project (Note: multiple answers are provided by the respondents)

### 5.6.1.3 Respondents' Perception about the Effects on Physical Environment

Respondents' perception about the effects on physical environment includes the effect on air, soil, usable water and noise level. These are illustrated in Fig. 10.6 to 10.10. About 85% respondents think that the project will not have any effect on air. About 10% of the respondents think that it will result in increased amount of dust during construction. About 5% of the respondents feel that it will cause air pollution.

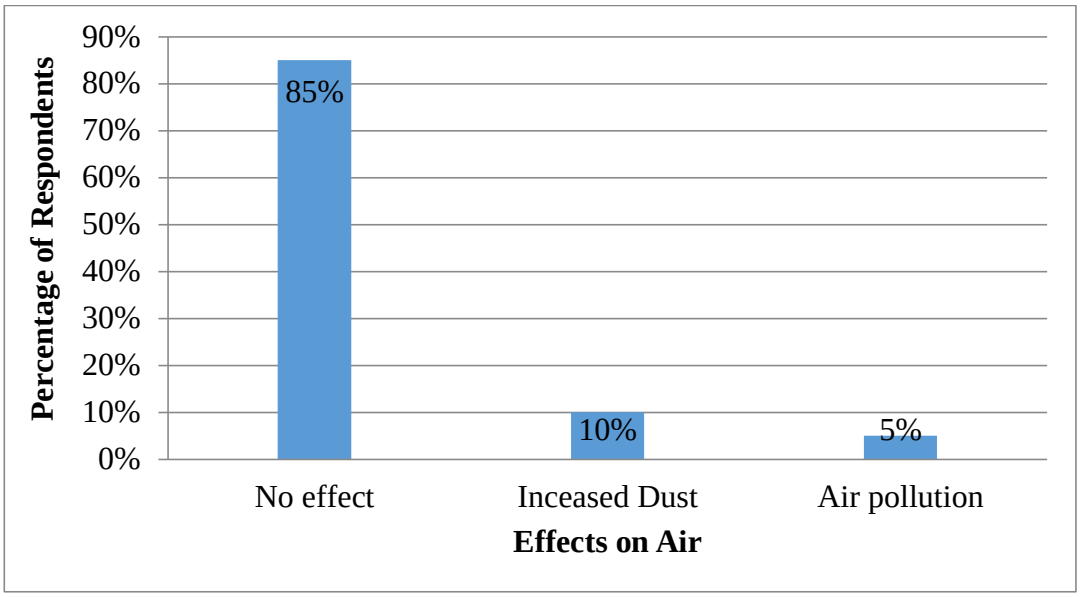



Figure 5.6: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on air (Note: multiple answers are provided by the respondents)

About 72% respondents think that the project will have no effect on soil and 28% think that the project will raise land value (Fig. 10.7). On the other hand, 50% respondents think it will increase water demand, 35% think it will cause water pollution, 10% respondents consider that the project will have no effect on usable water and 5% believe it will cause wastage of water and (Fig. 10.8).

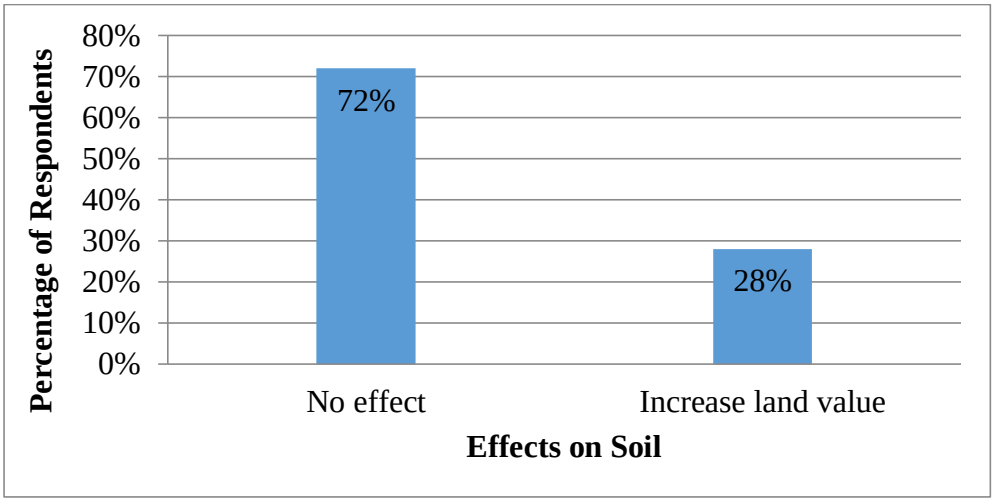



Figure 5.7: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on soil

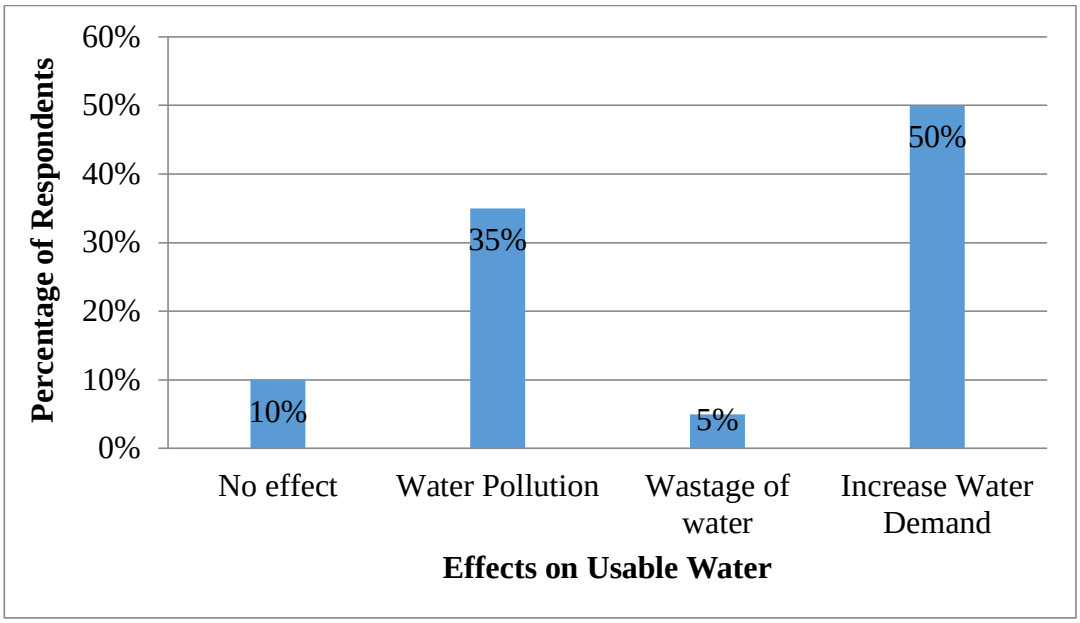



Figure 5.8: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on usable water

About 65% respondents feel that the project will not have any effect on sound and 35% think that sound pollution may occur (Fig. 5.9). On the other hand, 56% respondents consider that the project will have no effect on river water, 36% believe it will cause pollution by dredged material and 8% think that it will cause pollution by solid waste (Fig. 5.10).

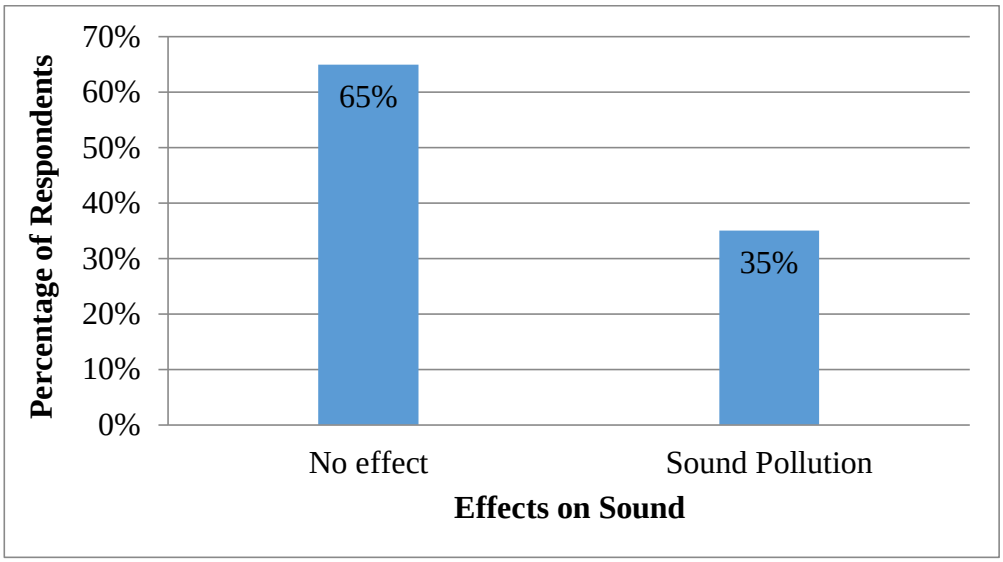



Figure 5.9: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on Sound

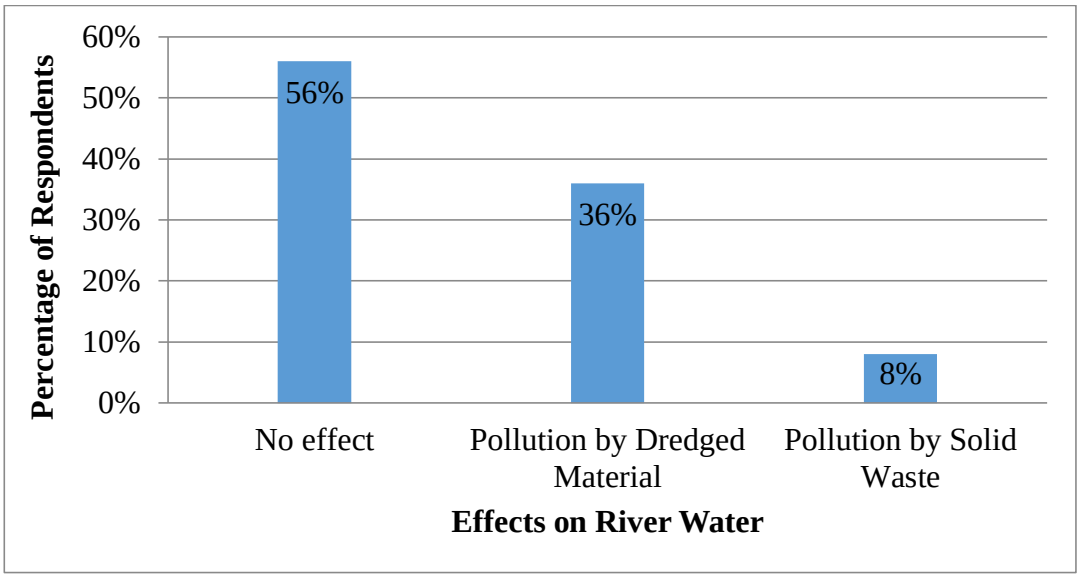



Figure 5.10: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on River Water

#### 5.6.1.4 Respondents' Perception about the Effects on Biological Environment

Respondents' perception about the effect of the proposed project on various features of biological environment was gathered. The features include the effects on trees, inland and aquatic animals. 71% of the respondents' think that the project will have no effect on trees. However, 25% of the respondents' think that trees may die due to disposal of dredged material (Fig5.11). 75% of the respondents' think that the project will have no effect on aquatic animals. On the other hand, 25% think that it may cause change of habitats of aquatic animals (Fig5.12). About 96% of the respondents' think that the project will have no effect on inland animal as shown in Fig 5.13.

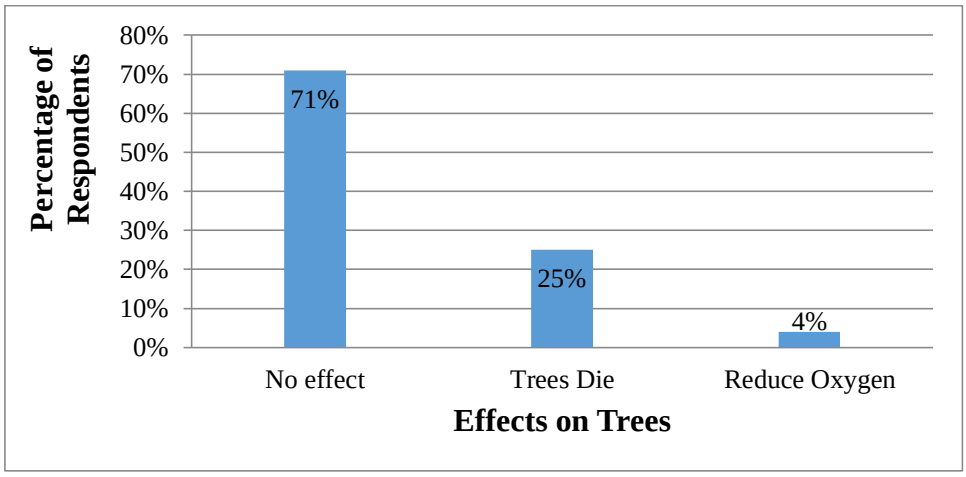



Figure 5.11: Dredging at the Inner Bar of Mongla Port Channel Project

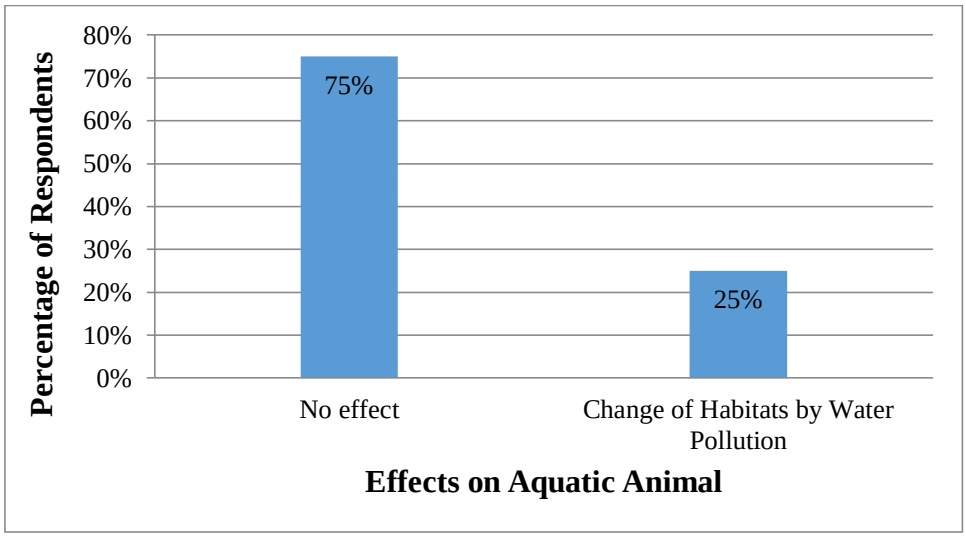



Figure 5.12: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on Aquatic Animal

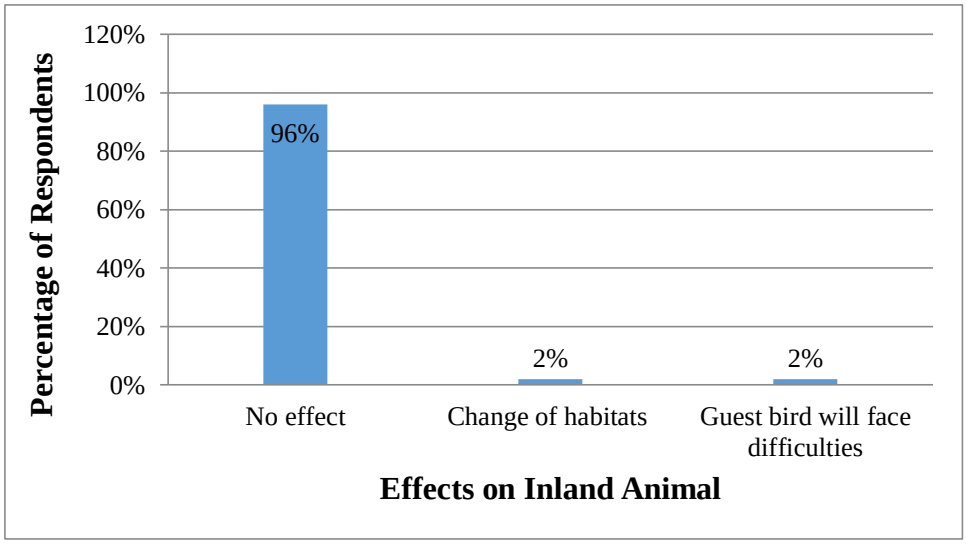



Figure 5.13: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on Inland Animal

### 5.6.1.5 Respondents' Perception about the Effects on Social Environment

About 85% of the respondents believed that the proposed project will have no effect on road, 9% think that it may increase traffic congestion, 4% think that it may cause road damage and 2% think that it may cause traffic accidents as shown in Figure 5.14.

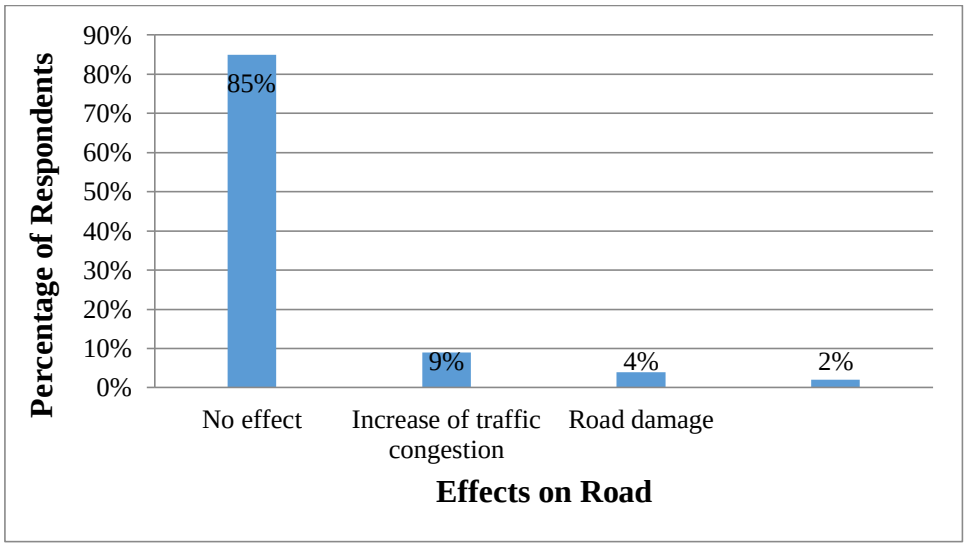



Figure 5.14: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on Road

56% of the respondents think that the project will increase tourism, 29% think that it will increase social activity and 15% believe that it will increase accommodation as shown in Fig. 5.15.

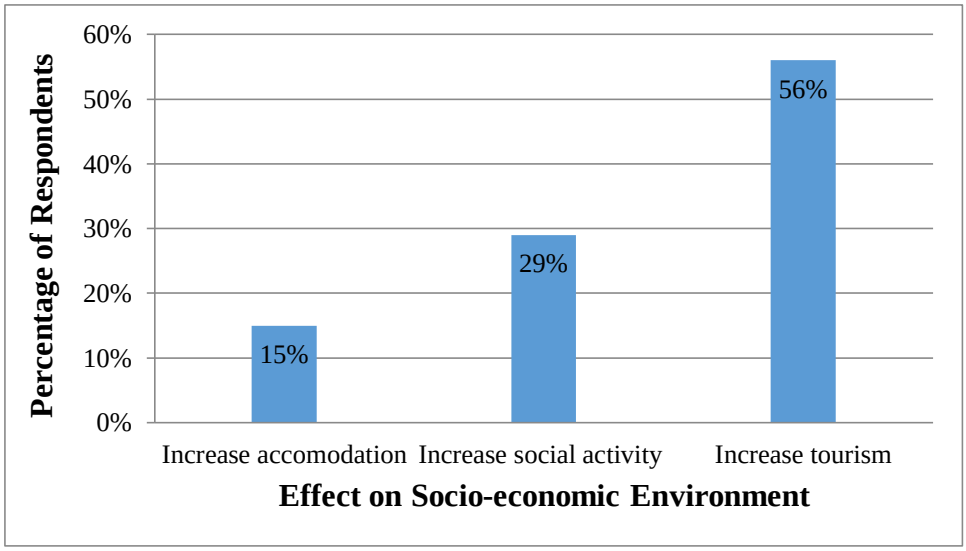



Figure 5.15: People's perception regarding the effect of proposed "Dredging at the Inner Bar of Mongla Port Channel Project" on Socio-economic Environment

### 5.6.2 Focus Group Discussions (FGDs)

In order to carry out SIA, stakeholder consultation was conducted to assess the opinions of local people who will be affected directly due to project intervention. Consultations were

conducted arranging several sessions of Focus Group Discussions (FGDs) with local people for assessing their opinion and to share their experiences. Consultants organized FGDs with the stakeholders living in Mongla port and surrounding areas with the assistance of the port officials. FGD participants were mainly better informed people, educated and aware of different development activities taking place in the locality like Mayor of Khulna City Corporation (KCC), Upazilla Nirbbahi Officer (UNO) of Mongla Upazila, Agriculture Officer, AC (Land), Businessman (Fish farming/Gher), port users, custom house officers and staffs, port engineers, nearby industry officials, Mongla Export Processing Zone (EPZ) officers, clearing and forwarding agent, transport workers, port workers, teachers of school and college and people living within the project study area, etc as shown in Figure 5.16 and Figure 5.17. Possible development plans were communicated to those present in the consultation meeting.


Figure 5.16: Meeting with KCC Mayor on November 6, 2019 at Khulna regarding the proposed "Dredging at the Inner Bar of Mongla Port Channel Project"


Figure 5.17: Meeting with UNO of Mongla Upazila on October 29, 2019 at Mongla regarding the proposed "Dredging at the Inner Bar of Mongla Port Channel Project"

### 5.6.3 Public Consultations (PCs)

The purpose of public consultation meetings is to invite comments and necessary suggestions on any social issues considered relevant by the people living in the project and surrounding areas. PCs were carried out with common people living around the possible zone of influence and the area of impact. Following a guideline, they were asked to give their opinions. The attendees were from different occupational and income groups. The gathering of the attendees was mostly spontaneous. PCs were attended by 3-5 persons depending upon the place and time. In the public consultations, attempts were made to disseminate information, discussion about possible impacts, and mitigation measures.

## 5.7 SIA Study Outcomes

The outcomes of the SIA study of the project are stated briefly in the following sections.

### 5.7.1 Physical Condition

The port has sufficient area for the proposed dredging project. Site visits were made to the project area and port surroundings to assess potential social and resettlement issues. During the visit, discussions were held with port officials on the land acquisition, challenges and

issues facing the port. During the field visits, most infrastructures were observed to be in good condition. The port is well secured. Security personnel are well alert and have high level control on the vehicle and persons of moving in/out of the port gate. Armed security personnel are also stationed and keep on patrol within the port boundary.

### 5.7.2 Area for the Project

The port has sufficient land area provided for the development of additional capacity. The port has a land area of 2322 acres, more of which is still to be developed as per the approved Master Plan. The Master Plan is comprehensive and has all the necessary elements for a full-fledged operational port, including residential sites, training facilities, commercial buildings, waste disposal facility, green spots, schools, medical facilities, religious building and recreational areas. The study area of the project (during field experiment and water and soil sample collection) is shown in Figure 5.18.

Figure 5.18: Photographs of the Passur Channel during field experiment and sample collection of the "Dredging at the Inner Bar of Mongla Port Channel Project"

### 5.7.3 Property Loss

The consultant, after conducting site visit, found that there is no private residential or make shift structures which are likely to be affected due to the activities of the project. Therefore, there is no possibility of property loss. However, required area for the proposed disposal sites of the dredge material along the river side is 1694 acre (from Chilla bazar to Joymonir gol), which are now used as fish farming (gher). The land owners/people

involved with this fish farming will be compensated by MPA @ Tk 20000/Acre/yr (which is allocated in the project cost) for 10 years. After that the land will be used for potential agriculture by the land owner.

### 5.7.4 Income Loss

There is no likelihood of loss of income arising from the implementation of the proposed project. Rather, additional facilities provided at the port will increase employment opportunities and perhaps higher income with higher productivity through the use of technology. However, the proposed disposal sites of the dredge material along the river side (from Chilla bazar to Joymonir gol) are now used as fish farming (gher). The land owners/people involved with this fish farming will be compensated by MPA @ Tk 20000/Acre/yr (which is included in the project cost) for 10 years. After that the land will be used for potential agriculture by the land owner.

### 5.7.5 Dislocation

Since there is no private residence or make shift structures in the port area, no dislocation of people is required. However, the proposed disposal sites of the dredge material along the river side (from Chilla bazar to Joymonir gol) are now used as fish farming (gher), which need to be dislocated. There is no likelihood of disturbance to existing groups with the increase in facilities and services provided by the project. However, during dredging process some additional traffic will be generated for bringing in equipment. This increased traffic flow may cause disturbance (noise, dust etc.) to the people working in the office areas located close to the project site.

### 5.7.6 Impact on Cultural Properties

The MP area was also a historical area during the war of independence of Bangladesh in 1971. There is no other cultural property within the port area which is likely to be affected by the proposed project. The historical battle places are outside the port land area.

### 5.7.7 Indigenous or Marginal people

Indigenous people were not found in and around the port area and during the site visits, none in this category was noted to be working as a labor in the port. Likewise, there are no marginal people living in the port area.

### 5.7.8 Public health and Safety

The activities of the proposed project are likely to have some impact on human due to increased noise pollution and vibration, local air pollution within and around the project site. Dredging activities may generate dust that are likely to be exposed to increases dust pollution. Accident during dredging activities may be an issue. Proper measures including regular maintenance of equipment and use of protective gears are needed to reduce the risk of such accidents during the construction phase.

### 5.7.9 Generation of Employment

The significant potential positive impact on employment generation is highly expected for the activities of proposed project. During dredging period, the employment will be generated both for skilled and unskilled professionals at different levels directly. It will also generate indirect employment for the peoples in the project area and outside the project area those related to project operation. However, there will be overall positive impacts in the employment and livelihood.

### 5.7.10 Economic Development

The proposed project will provide a vital work to progress the overall business framework in southern part of Bangladesh. This project indirectly will support development in an area that has been poorly utilized before.

## 5.8 Evaluation of Socio-Economic Impacts

For evaluation of socio-economic impacts associated with the dredging phase, post-dredging period and river training phase of the proposed project, a semi-quantitative descriptive checklist method has been used (adapted from BRTC, 2015 and IWM, 2015). Firstly, the activities during dredging period, post-dredging period and river training were identified and

listed in the impact table. Then the corresponding impacts on socio-economic factors were evaluated depending on their typical interaction with project activities. Assessment were made so as to whether the impacts were positive (beneficial) or negative (harmful), short time (short recovery time) or long term (long recovery time) and of high or low/moderate intensity. The results of the assessment are summarized in Table 5.11 and Table 5.12, which show that most of the adverse impacts are of low or moderate intensity and are short–term in nature. On the other hand, most of the beneficial impacts are of moderate to high intensity and long –term in nature.

Table 5.11: Physico- Chemical Impacts from Activities Associated with the the Proposed Dredging at the Inner Bar of Mongla Port Channel of Mongla Port

| Phase | Project Activities | Pollution due to waste water | Air pollution | Noise pollution | Drainage congestion | Pollution due to solid waste/dredge material |
|---|---|---|---|---|---|---|
| Dredging Phase | Labor camp setting | -1S | 0 | 0 | 0 | -2S |
| | Dredging/excavation | 0 | 0 | -2S | -1S | -1S |
| | Sediment dispersal | 0 | 0 | 0 | -1S | -2S |
| | Geo-morphology and bathymetry | 0 | 0 | 0 | -1S | -1S |
| | River traffic clearing | -1S | -1S | -1S | 0 | -1S |
| | Dredge spillage and leakage | -2S | 0 | 0 | 0 | 0 |
| Post Dredging Phase | Solid waste/ hazardous waste and waste water generation | 0 | 0 | 0 | -1S | -1S |
| | Additional river traffic generation | 0 | 0 | -1L | 0 | 0 |
| | Facilitated port activities with sufficient navigability in the project area | 0 | 0 | 0 | 0 | +3L |
| | Deposition of dredge material | 0 | 0 | 0 | -1S | -2S |

[+3= High Positive Impact, +2= Moderate Positive Impact +1= Low Positive Impact 0= No Impact, -3= High Negative Impact, -2= Moderate Negative Impact, -1= Low Negative Impact, S= Short Term Impact, L= Long term Impact]

Table 5.12: Social Impact from Activities Associated with the the Proposed Dredging at the Inner Bar of Mongla Port Channel

| Phase | Project Activities | Impact on historical sites | Loss of Income | River Traffic Congestion | Worker health and safety | Employment and commercial activities |
|---|---|---|---|---|---|---|
| Dredging | Dredging/excavation | 0 | 0 | -1S | -1S | +2S |

| | | | | | | |
|---|---|---|---|---|---|---|
| Phase | Sediment dispersal | 0 | 0 | -1S | -2S | +1S |
| | Geo-morphology and bathymetry | 0 | 0 | 0 | -1S | +1S |
| | River traffic clearing | 0 | 0 | 0 | -1S | +1S |
| | Dredge spillage and leakage | 0 | 0 | 0 | -1S | +2S |
| | Dredging/excavation | 0 | 0 | 0 | -1S | +2S |
| | Demand for safe water and sanitation facilities | 0 | 0 | 0 | -2L | 0 |
| | Accidents | 0 | 0 | -1S | -1S | 0 |
| Post Dredging Phase | Solid waste/ hazardous waste and waste water generation | 0 | 0 | 0 | -2S | 0 |
| | Additional river traffic generation | 0 | 0 | -1L | 0 | +2L |
| | Facilitated port activities with service facility in the project area | 0 | 0 | -1S | -1S | 0 |
| | Deposition of dredge material | 0 | 0 | 0 | 0 | + 3L |

[+3= High Positive Impact, +2= Moderate Positive Impact +1= Low Positive Impact 0= No Impact, -3= High Negative Impact, -2= Moderate Negative Impact, -1= Low Negative Impact, S= Short Term Impact, L= Long term Impact]

## 5.9 Social Management Plan-Mitigation Measures

The social management plan describes mitigation and performance improvement measures and actions that address to identify the social risks and impacts of the project on partners, staff and project affected community. The Contractor and the Mongla Port Authority (MPA) will be responsible for development of the Social Management Plan.

The objective of the management plan is:

- To ensure the health safety and security of the community is not affected by project at construction or operations phases;
- To generate safety awareness in local communities to ensure that they are pro-active in managing their own safety with regard to the project.
- To minimize the adverse impacts of the project and maximize the benefit sharing opportunities for the local communities affected by the project at construction and operations activities continue.
- To manage any grievances arising from the project activities during the construction and operations.

The Social Management Plan (SMP) (adapted from BRTC, 2015) presented in Table 5.13 and Table 5.14 are aimed at minimizing the possible adverse impacts and enhancing the positive impacts.

Table 5.13: Social Management Plan During Dredging Phase

| **Activity/ Issues** | **Potentially Significant Impact** | **Potential Mitigation and Enhancement Measures** | **Responsible Parties** |
|---|---|---|---|
| Arrival of workers | • Generation of sewage and solid waste | • Construction of sanitary latrines and septic tank system (one latrine for 20 persons)<br>• Waste minimization, recycling and reuse<br>• Proper disposal of solid waste | Contractor (monitoring by MPA) |
| | • Possible spread of diseases from workers | • Regular medical monitoring of workers<br>• Raising awareness about hygiene practices among workers | |
| Transportation of materials, equipment | • Increased traffic<br>• Generation of noise | • Scheduling of deliveries after regular office or school working hours<br>• Installation of proper traffic sign and warnings for pedestrians<br>• Arranging signal light | Contractor (monitoring by MPA) |
| | • Deterioration of air quality from increased vehicle | • Ensuring all project vehicles are in good operating condition. | |
| Dredging activities, including excavation, sediment dispersion, operation of equipment etc. | • Generation of noise from dredging activities | • Avoiding, as much as possible, equipment producing excessive noise<br>• Regulate use of horns and avoid use of hydraulic horns in project vehicles | Contractor (monitoring by MPA) |
| | • Accidents due to dredging activity | • Regular inspection and maintenance of equipment.<br>• Provide the workers with personal protective equipment.<br>• Providing health and safety training | |
| | • Sediment dispersal | • Apply good control of ladder swing speed and cutter head rotation speed to minimize sediment dispersion | |
| | • Demand for water and medical facilities | • Need to develop a long term development plan for the areas to enhance the quality and quantity of basic services such as water supply and medical facilities. | |

Table 5.14: Social Management Plan during Post Dredging Phase

| **Activity/ Issues** | **Potentially Significant Impact** | **Potential Mitigation and Enhancement Measures** | **Responsible Parties** |
|---|---|---|---|
| River traffic clearing | • Obstruction to river traffic. | • Satisfactory precautionary measures, prior announcement and proper workmanship | MPA with local traffic police |
| | • Hindrance of other ship | • Organize location of dredging activity with vessel operators and MPA | |
| Water consumption | • Increase water demand | • Proper water supply system with respect to consumers demand should be ensured.<br>• Regular monitoring of water supply and demand.<br>• Rainwater harvesting system can also be an alternative option. | MPA |
| Waste generation | • Disposal of sewage<br>• Blockage of drain<br>• Possible water pollution | • Ensuring proper storage, treatment and disposal of solid waste<br>• Forbid direct connection of sanitation system with water source.<br>• Regular cleaning and maintenance of drain | MPA |
| Post dredging activities | • Additional traffic generation | • Employ traffic control measures | MPA |
| | • Spill of fuel or lubricants | • Employees must be trained and proper maintenance of equipment and vehicles | |
| | • Disposal of dredged material on low land (fish gher/farm) near river | • The people involved with this fish farming need to be compensated. | |

In line with these objectives, specific targets will be set and negotiated with the contractor. For example, a target is likely to be set around ensuring no major health or safety incidents affecting community members.

The Contractor will be accountable for providing assurance during the dredging phase and post dredging phase that the above objectives and agreed targets are met. The MPA will have responsibility for monitoring activities during both dredging and post dredging. Major health and safety incidents such as fatalities or serious accidents will be reported by community liaison immediately.

## 5.10 Final Remarks on SIA

MPA has sufficient space or supporting infrastructure to construct the Feasibility Study for Dredging and River Training in Passur Channel of Mongla Port project. The port land area remains under the strong control of the authority and therefore no vendor, hawker or shopkeeper can operate within the port premises. There is no private residential or make shift commercial structures within. However, the proposed disposal sites of the dredged material along the river side (from Chilla bazar to Joymonir gol) are now used as fish farming (gher). The people involved with this fish farming will be compensated by the MPA @ Tk 20000/Acre/yr (which is included in the project cost) for 10 years. After that the land will be used for potential agriculture by the land owner. Therefore, implementation of the proposed project would have no direct adverse impact. On the other hand, there are significant positive impacts due to development of the port facilities as well as increase of employment opportunities in various tiers in port activities. Therefore, it can be concluded that the proposed project is socially feasible.

# Chapter 6
# ENVIRONMENTAL IMPACTS EVALUATION

## 6.1 Environmental Impact Evaluation Methodology

The identified environmental impacts have been evaluated based on their types, extend, spatial and temporal dimensions, likelihoods, reversibility, and scale of magnitudes as depicted in Table 6.1. In this study, "Delphi Approach" has been followed for the evaluation of environmental impacts using expert judgment. To finalize the evaluation, several round table discussion meeting were made with the team members. In this evaluation, a matrix method has been adopted to indicate the magnitude of each impact based on a word scale defined by word scenario instead of numeric scale. The word scales for various scenarios are outlined as below:

| **Scale** | | **Word Scenario or Description** |
|---|---|---|
| **Code** | **Meaning** | |
| **Impact** | | |
| D | Direct Impact | Directly related with project activities |
| Id | Indirect Impact | Resultant of any other impacts |
| S | Short Term | Impact occurs only for a particular time |
| L | Long term | No particular time, it may extends project life time |
| Lo | Localized | Impact is limited within the study area |
| W | Widespread | Impact spreads outside the study area also |
| R | Reversible | If the loss can be recoverable through implementing EMP or by naturally |
| Ir | Irreversible | If the loss cannot be recoverable |
| **Likelihood** | | |
| Fr | Frequent | Consequence occurs before, during and after the project implementation |
| Lk | Likely | Conditions may allow the consequence to occur during the project lifetime |
| O | Occasional | Exceptional consequences to occur within the project lifetime |
| Sl | Seldom | Conditions do not seem to occur any consequence except some extreme cases |
| Rr | Rare | Reasonable to expect that the consequence will not occur though it has rare possibility to occur |
| **Consequence** | | **Defined based on combination of the nature mentioned above** |
| In | Insignificant | No significant negative impact |
| Mr | Minor | Localized short term degradation of Environmental quality |
| M | Moderate | Localized long term/ short term, widespread and reversible loss of environmental quality |
| Sg | Significant | Widespread, long term and reversible loss of environmental quality or Local Long term, irreversible loss of environment |
| Ct | Catastrophic | Widespread, long term and irreversible loss of environmental quality |

Table 6.1: Environmental Impact Matrix

| Potential Impacts | Nature | Temporal | Spatial | Reversibility | Likelihood | Consequence |
|---|---|---|---|---|---|---|
| | D/Id | S/L | Lo/W | R/Ir | Fr/Lk/O/Sl/Rr | In/Mr/M/Sg/Ct |
| **Pre-Dredging Phase (Equipment Movement)** | | | | | | |
| **Air and water quality** | | | | | | |
| Deterioration of air and water quality due to movement of equipment, wash out of sediments and wastewater from the Dredging Vessel | D | S | Lo | R | O | Mr |
| **During Dredging Phase** | | | | | | |
| **Dredging Operation** | | | | | | |
| **Surface Water Quality** | | | | | | |
| Generation of dredged material deteriorate surface water quality due to increasing the turbidity from dredging work | D | S | Lo | R | Lk | M |
| **Air pollution** | | | | | | |
| Air pollution due to exhaust emissions of $SO_2$, $NO_x$, CO, $CO_2$ from dredging operation | D | S | W | R | Lk | Mr |
| **Noise generation** | | | | | | |
| Noise above water: disturbance to the terrestrial animals and birds.<br>Noise under water: disruption to fish migration and | D | S | Lo | R | Fr | M |

| Potential Impacts | Nature | Temporal | Spatial | Reversibility | Likelihood | Consequence |
|---|---|---|---|---|---|---|
| | D/Id | S/L | Lo/W | R/Ir | Fr/Lk/O/Sl/Rr | In/Mr/M/Sg/Ct |
| disturbance to dolphins | | | | | | |
| **Navigation Traffic** | | | | | | |
| The presence of dredged materials disposal pipes, barges and associated dredging equipment will pose obstruction to the navigating boats/vessels | D | S | Lo | R | Lk | Mr |
| **Oil spillage** | | | | | | |
| Oil spillage may occur accidentally from dredging equipment during operation due to leakage in oil tanks/equipment. | D | S | W | R | Rr | Mr |
| **Fisheries** | | | | | | |
| Impact on fish habitats and diversity due to dredging in the Passur channel resulting change in fish habitats, spawning, etc. | Id | S | Lo | R | Lk | M |
| **Ecosystem** | | | | | | |
| • Impact on benthic habitat due to sediment extraction from the river bed of the dredging area<br>• Disturbance to Dolphin colony in Passur River<br>• Disturbance to nocturnal animal due to lighting in dredging vessel | D | S | Lo | R | Lk | M |
| **Wastewater generation** | | | | | | |

| Potential Impacts | Nature | Temporal | Spatial | Reversibility | Likelihood | Consequence |
|---|---|---|---|---|---|---|
| | D/Id | S/L | Lo/W | R/Ir | Fr/Lk/O/Sl/Rr | In/Mr/M/Sg/Ct |
| Wastewater generation from the barges and associated vessels | D | S | Lo | R | Lk | Mr |
| **Socioeconomic condition** | | | | | | |
| Possibility of employment opportunities | D | S | W | R | Lk | M (positive) |
| Impact on communication: the communication may be developed as the increased navigable depth | Id | S | Lo | R | Lk | +Sg (positive) |
| **Dredged Materials** | | | | | | |
| **Transportation of dredged materials** | | | | | | |
| Accidental leakages and spillage during dredged materials transport | D | S | Lo | R | Lk | Mr |
| **Placement of dredged materials** | | | | | | |
| Dispersion of sediments and release of high sediment laden runoff from the disposal sites | D | S | Lo | R | Lk | Mr |
| **Ecosystem** | | | | | | |
| Impact on habitat quality and ecosystem due to deposition of dredged materials from dredging activities. | D | S | Lo | R | Lk | Mr |

| Potential Impacts | Nature | Temporal | Spatial | Reversibility | Likelihood | Consequence |
|---|---|---|---|---|---|---|
| | D/Id | S/L | Lo/W | R/Ir | Fr/Lk/O/Sl/Rr | In/Mr/M/Sg/Ct |
| **Post- Dredging Phase** | | | | | | |
| **Dredged Materials** | | | | | | |
| **Land and agriculture** | | | | | | |
| Impact on soil fertility due to disposal of dredged materials in the disposal sites | Id | L | Lo | R | Lk | M |
| **Drainage Congestion** | | | | | | |
| • Where applicable, the canal "khal" outlets near disposal locations; which might be blocked by the disposal of dredged materials resulting poor drainage at the affected location.<br>• Drainage congestion may occur if the dredged materials block drainage of the reclaimed area at disposal locations;<br>• If the drainage is hampered water logging in the catchments will affect ecology of the area. | Id | L | Lo | R | Lk | M |
| **Other Impacts from Project Development due to Increasing Water Traffic** | | | | | | |
| **Air pollution** | | | | | | |
| Emission of $SO_2$, $NO_x$, CO, $CO_2$ from increased water traffic movement. | Id | L | W | R | Lk | Mr |
| **Noise** | | | | | | |

| Potential Impacts | Nature | Temporal | Spatial | Reversibility | Likelihood | Consequence |
|---|---|---|---|---|---|---|
| | D/Id | S/L | Lo/W | R/Ir | Fr/Lk/O/Sl/Rr | In/Mr/M/Sg/Ct |
| Noise generation from increased water traffic movement. | Id | L | Lo | R | Lk | Mr |
| **Waste generation** | | | | | | |
| Waste generation from extra vessels and discharge to natural environment | Id | L | Lo | R | Lk | Mr |
| **Surface Water Quality** | | | | | | |
| • Surface water contaminated by vessel effluents<br>• Oil spillage from vessels<br>• River bank erosion may increase due to wave action for frequent movement of water traffic | Id | L | Lo | R | Lk | Mr |
| **Land and agriculture** | | | | | | |
| Crop damage due to dry and wet deposition of SOx and NOx from increased ship movement. | Id | L | W | R | Sl | Mr |
| **Fisheries** | | | | | | |
| Disturbance on Fish migration due to marine transportation and other water way traffic movement | Id | L | W | R | Lk | Mr |
| **Ecosystem** | | | | | | |
| Impact on ecosystem habitat quality and ecosystem health due to Greenhouse gas emission and Air Pollution from increased ship movement | Id | L | W | R | Lk | Mr |

| Potential Impacts | Nature | Temporal | Spatial | Reversibility | Likelihood | Consequence |
|---|---|---|---|---|---|---|
| | D/Id | S/L | Lo/W | R/Ir | Fr/Lk/O/Sl/Rr | In/Mr/M/Sg/Ct |
| Impact on Mangrove habitat of the Sundarbans due to seldom ballast water dumping and oil spillage from vessels | Id | S | Lo | R | Sl | Mr |
| Disturbance to wildlife due to noise generation from water vessels during transportation and increased river traffic across the Sundarbans | Id | L | Lo | R | Lk | Mr |
| Disturbance to migratory birds due to marine transportation | Id | L | Lo | R | Lk | Mr |
| Disturbance to Dolphin colony in the Sundarbans and Passur river | Id | L | Lo | R | Lk | Mr |
| Disturbance to nocturnal animal in the Sundarbans due to lighting of water vessel | Id | L | Lo | R | Lk | Mr |
| **Socioeconomic condition** | | | | | | |
| Improved waterway traffic. | Id | L | W | R | Lk | M (positive) |
| Biodiversity | Id | L | Lo | R | Sl | Mr |
| Employment opportunities | Id | L | W | R | Lk | M (positive) |
| Socio-economic development | Id | L | W | R | Lk | M (positive) |
| Attraction of tourists | Id | L | W | R | Lk | M (positive) |

## Pre-Dredging Phase (Equipment Movement)

Air and water quality

There would be a direct, short-term, localized, reversible, occasional and minor impact on air and water quality due to the movement of equipment during pre-dredging phase. The impact will mainly occur because of deterioration of water quality due to wash out of sediments and wastewater from the dredging vessel.

## During Dredging Phase

### Dredging Operation

Surface Water Quality

There would be a potential direct, short-term, localized, reversible, likely and moderate impact on surface water quality due to the generation of the dredged materials (i.e. increasing the turbidity of river water) from dredging operation.

Air pollution

There would be a direct, short-term, widespread, reversible, likely and minor impact on air pollution due to exhaust emissions of $SO_2$, $NO_x$, CO, $CO_2$ from dredging operation.

Noise generation

There would be a direct, short-term, localized, reversible, frequent and moderate impact due to the noise generation from dredging operation (Noise above water: disturbance to the terrestrial animals and birds, and Noise under water: disruption to fish migration and disturbance to dolphins).

Navigation Traffic

There would be a direct, short-term, localized, reversible, likely and minor impact on navigation traffic due to the presence of dredged materials disposal pipes, barges and associated dredging equipment will pose obstruction to the navigating boats/vessels.

Oil spillage

There would be a potential direct, short-term, widespread, reversible, rarely and minor impact due to accidentally occurred oil spillage from dredging equipment during operation due to leakage in oil tanks/equipment.

Fisheries

There would be a potential indirect, short-term, localized, reversible, likely and moderate impact on fish habitats and diversity due to dredging in the Passur channel resulting change in fish habitats, spawning, etc.

Ecosystem

There would be a potential direct, short-term, localized, reversible, likely and moderate impact on ecosystem of benthic habitat due to sediment extraction from the river bed of the dredging area, disturbance to Dolphin colony in Passur River, and disturbance to nocturnal animal due to lighting in dredging vessel.

Wastewater generation

There would be a potential direct, short-term, localized, reversible, likely and minor impact due to wastewater generation from the barges and associated vessels.

Socioeconomic condition

There would be a potential direct, short-term, widespread, reversible, likely and moderate positive impact due to possibility of employment opportunities.

There would be a potential indirect, short-term, localized, reversible, likely and significant positive impact on communication due to development of the increased navigable depth.

**Dredged Materials**

Transportation of dredged materials

There would be a potential direct, short-term, localized, reversible, likely and minor impact due to accidental leakages and spillage during dredged materials transport.

Placement of dredged materials

There would be a potential direct, short-term, localized, reversible, likely and minor impact due to dispersion of sediments and release of high sediment laden runoff from the disposal sites.

Ecosystem

There would be a potential direct, short-term, localized, reversible, likely and minor impact on habitat quality and ecosystem health due to deposition of dredged materials from dredging activities.

## Post- Dredging Phase

### Dredged Materials

Land and agriculture

There would be a potential indirect, long-term, localized, reversible, likely and moderate impact on soil fertility due to disposal of dredged materials in the disposal sites.

Drainage Congestion

There would be a potential indirect, long-term, localized, reversible, likely and moderate impact on drainage congestion due to the followings:

- Where applicable, the canal "khal" outlets near disposal locations; which might be blocked by the disposal of dredged materials resulting poor drainage at the affected location.
- Drainage congestion may occur if the dredged materials block drainage of the reclaimed area at disposal locations;
- If the drainage is hampered water logging in the catchments will affect ecology of the area.

**Other Impacts from Project Development for Increasing Water Traffic**

Air pollution

There would be a potential indirect, long-term, widespread, reversible, likely and minor impact on air pollution due to the emission of $SO_2$, $NO_x$, CO, $CO_2$ from increased water traffic movement.

Noise

There would be a potential indirect, long-term, localized, reversible, likely and minor impact due to Noise generation from increased water traffic movement.

Waste generation

There would be a potential indirect, long-term, localized, reversible, likely and minor impact due to waste generation from extra vessels and discharge to natural environment.

Surface Water Quality

There would be a potential indirect, long-term, localized, reversible, likely and minor impact on surface water quality due to the following reasons:

- Surface water contaminated by vessel effluents
- Oil spillage from vessels
- River bank erosion may increase due to wave action for frequent movement of water traffic

Land and agriculture

There would be a potential indirect, long-term, widespread, reversible, seldom and minor impact due to the damage on crop for dry and wet deposition of $SO_x$ and $NO_x$ from increased ship movement.

Fisheries

There would be a potential indirect, long-term, widespread, reversible, likely and minor impact due to disturbance on fish migration for marine transportation and other water way traffic movement.

Ecosystem

There would be a potential indirect, long-term, widespread, reversible, likely and minor impact on ecosystem habitat quality and ecosystem health due to greenhouse gas emission and air pollution from increased ship movement.

There would be a potential indirect, short-term, localized, reversible, seldom and minor impact on mangrove habitat of the Sundarbans due to seldom ballast water dumping and oil spillage from vessels.

There would be a potential indirect, long-term, localized, reversible, likely and moderate impact due to disturbance to wildlife for noise generation from water vessel during transportation and increased river traffic across the Sundarbans.

There would be a potential indirect, long-term, localized, reversible, likely and minor impact on migratory birds due to disturbance for marine transportation.

There would be a potential indirect, long-term, localized, reversible, likely and minor impact due to disturbance to Dolphin colony in the Sundarbans and Passur river by increased ship movement.

There would be a potential indirect, long-term, localized, reversible, likely and minor impact due to disturbance to nocturnal animal in the Sundarbans for lighting of water vessel.

Socioeconomic condition

There would be a potential indirect, long-term, widespread, reversible, likely and minor positive impact due to improved waterway traffic.

There would be a potential indirect, long-term, localized, reversible, seldom and minor impact on available biodiversity for nutritional requirement due to increased waterway traffic causing disturbance to fish population and other biota.

There would be a potential indirect, long-term, widespread, reversible, likely and moderate positive impact due to employment opportunities in the project area.

There would be a potential indirect, long-term, widespread, reversible, likely and moderate positive impact due to socio-economic development in the project area.

There would be a potential indirect, long-term, widespread, reversible, likely and moderate positive impact due to attraction of tourists in the project area.

# Chapter 7
# ENVIRONMENTAL IMPACTS MITIGATION AND MANAGEMENT PLAN

## 7.1 Mitigation of Impacts and Management Plan

The environmental impacts identified in this study were later evaluated considering their types, spatial dimensions and temporal extents, reversibility, frequency of occurrences, and scale of magnitudes. Then, mitigation measures have been suggested with the objective of preventing environmental pollution in compliance with ECA 1995. All of the identified impacts were further evaluated in letter scale of magnitude with and without the mitigation measures adopted. Table 7.1 represents the mitigation measure required for controlling the negative impacts from project activities and contingency measures required for reducing risk of accidental hazards and enhancement measures for positive impacts with regards to sustainable implementation as well as operation of the project ensuring environmental and community safety. The consequence analysis with and without consideration of the mitigation measures adopted would give an impression of effectiveness of the measures. The details of the mitigation measures for various anticipated environmental impacts are outlined in the table below.

| **Legend (Word Scale)** | | |
|---|---|---|
| **Consequence** | | **Defined based on combination of the nature mentioned above** |
| In | Insignificant | No significant negative impact |
| Mr | Minor | Localized short term degradation of Environmental quality |
| M | Moderate | Localized long term/ short term, widespread and reversible loss of environmental quality |
| Sg | Significant | Widespread, long term and reversible loss of environmental quality or Local Long term, irreversible loss of environment |
| Ct | Catastrophic | Widespread, long term and irreversible loss of environmental quality |

Table 7.1: Mitigation/ Enhancement/ Compensation/ Contingency measure to control environmental impacts from project activities

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| **Pre-Dredging Phase (Equipment Movement)** | | | | | |
| **Air and water quality:** Deterioration of air and water quality during equipment movement and placement | Mr | • The dredging equipment should be carry and place with due care to avoid the deterioration of air and water quality along the channel. | MPA / Contractor | In | - |
| **During Dredging Phase** | | | | | |
| **Dredging Operation** | | | | | |
| **Surface Water Quality:** Generation of dredged material deteriorate surface water quality due to increasing turbidity of river water for re-suspension of sediment during dredging operation resulting loss of transparency which would have impacts on marine and benthic habitats. | M | • Selection of efficient dredging equipment with low risk of sediment dispersal. The dredging work should be carried out to minimize suspension of sediments, minimize destruction of benthic habitat, and increase the accuracy of the operation. Suspended sediment concentrations due to dredging activities should not exceed 4,000 mg/L near the dredger;<br>• Monitor the dredging equipment for efficient operation;<br>• Pause the dredging works during new moon and full moon for one cycle to reduce the extent of dispersion of sediment plume;<br>• Inspection and monitoring of dredging activities should be done for any further re-adjustment where necessary;<br>• In order to evaluate the impacts of the dredging and develop additional mitigation measures, an ongoing ecological monitoring would be | MPA / Contractor | In | 500 |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| | | required;<br>• During dredging operation, suitable measure should be taken to protect channel bed and banks;<br>• In order to control sediment dispersion within the dredging area, an environmental friendly **silt curtain or other site specific measures** should be taken to prevent dispersion of sediment along the channel | | | |
| **Air pollution:**<br>Air pollution due to exhaust emissions of $SO_2$, $NO_x$, CO, $CO_2$ from dredging operation | Mr | • Routine inspection and maintenance for dredging equipment to ensure good working condition. Proper maintenance of engines for ensuring complete fuel combustion with low soot emissions;<br>• Use fuels with low-sulphur to reduce noxious emissions;<br>• Provide **exhaust filtering**, where applicable;<br>• Gaseous emissions to be monitored carefully and emissions should be within limits as prescribed in the DoE air quality standards | MPA / Contractor | In | 30 |
| **Noise generation**<br>Noise above water: disturbance to the terrestrial animals and birds.<br>Noise under water: disruption to fish migration and disturbance to dolphins | M | • Selection of efficient dredging equipment to reduce the noise both above and under water during dredging operation (e.g. isolation of exhaust systems, by keeping close the door of the engine room)<br>• The dredging work should be carried out during daytime, where possible, rather than at sunrise or sunset (e.g. significant disturbance to wildlife) or during night time. Otherwise, the dredger should be ramp up slowly at the starting time to the levels of engines so that minimum disturbance will have to the marine and terrestrial fauna for them to move away from the dredging area for significant noise emissions. | MPA / Contractor | In | - |
| **Navigation Traffic**<br>The presence of dredged | Mr | • Provide proper navigational **sign and lighting** for the barges and associated vessels so that they do not obstruct the navigation channel; | MPA / | In | 20 |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| materials disposal pipes, barges and associated dredging equipment will pose obstruction to the navigating boats/vessels; | | • Routine monitoring of all navigational lights should be conducted to ensure that they are working properly;<br>• Limit the motor boat speed (between 7 knots to 8 knots) in accordance with the best international practices and to avoid any collision with dolphins; | Contractor | | |
| **Oil spillage**<br>Oil spillage may occur accidentally from dredging equipment during operation due to leakage in oil tanks/equipment. | Mr | • The recent advanced dredging equipment should be adopted for this proposed dredging work, which has less possibility of oil spillage issues;<br>• The dredging barges and boats should be refueling with proper care to avoid any oil spillage;<br>• **Spill kits** should be available at accessible location, and **oil absorbent materials** at refueling points on the barges;<br>• Routine monitoring for oil leakage in oil tanks/equipment during dredging operation. | MPA / Contractor | In | 20 |
| **Fisheries**<br>Impact on fish habitats and diversity due to dredging in the Passur channel resulting change in fish habitats, spawning, etc. | M | • Selection of highly efficient advanced dredging equipment which will produce less turbulence for sediment resuspension, less air pollution and noise in both above and under water during dredging operation.<br>• The fish in the Passur channel has already adopted with dredging operation around the project area since the beginning of Mongla Port operation which has long history of dredging activities in the Passur channel for keep its serviceability/accessibility for water traffic to the Port Jetty area. | MPA / Contractor | In | - |
| **Ecosystem**<br>• Impact on benthic habitat due to sediment extraction from the river | M | • Selection of highly efficient advanced dredging equipment which will product less disturbance on the river bed for sediment extraction, less air and noise pollution with minimum lighting effects ultimately reduce environmental impact on benthic habitat, Dolphin colony, and nocturnal | MPA / Contractor | In | - |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| bed of the dredging area<br>• Disturbance to Dolphin colony in Passur River<br>• Disturbance to nocturnal animal due to lighting in dredging vessel | | animal ecosystem. | | | |
| **Wastewater generation**<br>Wastewater disposal from the barges and associated Vessels | Mr | • The wastewater generated from the barges and associated vessels should be properly collected, **treated** and discharge to the environment. | MPA / Contractor | In | 20 |
| **Dredged Materials** | | | | | |
| **Transportation of dredged materials**<br>• Accidental leakages and spillage during dredged materials transport | Mr | • Routing monitoring for any leakage or damage on the pipe network for transporting dredging materials to disposal site;<br>• Develop emergency response plan for any spillage/leakage of dredged material from the piping network;<br>• Provide appropriate signage on/around the piping network for water traffic to avoid any accidental damage on the system during operation;<br>• Provide notification about the dredging activities to the navigating boats/vessels to minimize risks of collision;<br>• Provide adequate **training to staff** at dredging site to operate heavy equipment. | MPA / Contractor | In | 10 |
| **Placement of dredged materials** | Mr | • Before commencing the filling process at the disposal site where the water depth is less, and there should be a delta building process with | MPA / Contractor | In | 400 |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| • Dispersion of sediments and release of high sediment laden runoff from the disposal sites | | **geo-tubes** filled by sand and subdivided into compartments;<br>• Use of environmental friendly silt curtain or other site specific measures to prevent dispersion of sediment plume.<br>• The dredged materials should be placed in the disposal sites in such a way so that to keep a low laying areas (e.g. acts as a pond) with specified distance, which will serve as a pool of freshwater reservoirs (e.g. recharged from the monsoon rain). This feature will create a freshwater ponding system (like a grid pattern if possible) to cultivate freshwater fish in these area:<br>• These ponds will serve as a source for freshwater for the nearby resident around these areas; and<br>• The bank of these ponding system will potentially use for growing vegetables. | | | |
| **Ecosystem**<br>Impact on habitat quality and ecosystem due to deposition of dredged materials from dredging activities. | Mr | • The dredged materials should be placed in the disposal sites in such a way so that to keep a low laying areas (e.g. acts as a pond) with specified distance, which will serve as a pool of freshwater reservoirs (e.g. recharged from the monsoon rain). This feature will create a freshwater ponding system which will finally balance the ecosystem in this area.<br>• Rehabilitation of benthic habitats by conserving and extending the existing nursing ground and mangrove forest area | MPA / Contractor | In | - |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| **Post- Dredging phase** | | | | | |
| **Dredged Materials** | | | | | |
| **Land and agriculture**<br>Impact on soil fertility due to disposal of dredged materials in the disposal sites. | M | It is recommended to grow/cultivate mangrove and/or suitable crops which are tolerant to this silty dredged material (such as crops tolerant to salinity, conductivity, etc.). | MPA / Contractor | In | - |
| **Drainage Congestion**<br>• Where applicable, the canal "khal" outlets near disposal locations; which might be blocked by dredging dredged materials resulting poor drainage at the affected location.<br>• Drainage congestion may occur if the dredged materials block drainage of the reclaimed area at disposal locations;<br>• If the drainage is hampered water logging in the catchments will affect ecology of the area. | M | • Remove sediment accumulation at the outfalls of the natural khals;<br>• Before commencing the filling process a delta building process using **geo-tubes** filled with dredged materials to be placed to prevent any blockage of drainage canals near these disposal sites;<br>• Use of environmental friendly silt curtains or other site specific measures will prevent sediment dispersion and khal blockage. | MPA / Contractor | In | As above |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| **Other Impacts from Project Development for Increasing Water Traffic** | | | | | |
| **Air pollution**<br>**Noise**<br>**Waste generation**<br>**Surface Water Quality**<br>**Land and agriculture**<br>**Fisheries**<br>**Ecosystem** | Mr | • All vessel should be provided with GPS, radar and other electronic navigation systems to prevent grounding or collisions, such as depth sounder, radar and radio equipment for communication.<br>• All vessel should comply with rules and regulation of IMO, Port authority, BIWTA and national laws of safety, and environmental conservations<br>• Spot check of shipping and barging activities by MPA and concerned authority.<br>• Enforce the relevant law of restricting Ballast water Dumping and controlling the oil spillage in the Sundarbans territory<br>• Restrict blowing of whistle within Sundarbans Territory<br>• Introduce speed limitation (between 7 knots to 8 knots) for vessel in Sundarbans Territory.<br>• Anchorage should be allowed at particular location within the Sundarbans area<br>• Restrict outside lighting of the water vessel during navigation across the Sundarbans<br>• Restrict the beaming of searchlight on Forest area<br>• Use low beam of searchlight during navigation across the Sundarbans | MPA | In | 500 |

| Impact | Consequence without EMP | Mitigation/ Enhancement/ Compensation/ Contingency measure | Responsible Institution (s) | Consequence with EMP adopted | Cost (BDT in Lac) |
|---|---|---|---|---|---|
| | | • Proper training for vessel crews, traffic inspectors, in charges, and other concerned professionals | | | |
| **Socioeconomic condition** | M (Positive) | • Proper **training and motivational program** should be undertaken to enhance the business/job opportunities in this area under this project.<br>• Currently, the proposed disposal site along the river is used as fish farming (gher). It needs to be ensured that the land owner will be compensated properly by the MPA as discussed in Chapter 5 (Social Impact Assessment). | MPA | Sg (Positive) | 10 |
| | | | | **TOTAL EMP COST (BDT in Lac)** | **1510** |

## Pre-Dredging Phase (Equipment Movement)

Air and water quality

There would be a minor impact on air and water quality due to the movement of equipment during pre-dredging phase. The impact will mainly occur because of deterioration of water quality due to wash out of sediments and wastewater from the dredging vessel. The dredging equipment should be carry and place with due care to avoid the deterioration of water quality along the channel. With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

## During Dredging Phase

### Dredging Operation

Surface Water Quality

There would be a moderate impact on surface water quality due to generation of dredged material resulting increasing turbidity of river water for re-suspension of sediment during dredging operation, which will ultimately result loss of transparency and impacts on marine and benthic habitats. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Selection of efficient dredging equipment with low risk of sediment dispersal. The dredging work should be carried out to minimize suspension of sediments, minimize destruction of benthic habitat, and increase the accuracy of the operation. Suspended sediment concentrations due to dredging activities should not exceed 4,000 mg/L near the dredger;
- Monitor the dredging operation for efficient operation;
- Pause the dredging works during new moon and full moon for one cycle to reduce the extent of dispersion of sediment plume;
- Inspection and monitoring of dredging activities should be done for any further re-adjustment where necessary;

- In order to evaluate the impacts of the dredging and develop additional mitigation measures, an ongoing ecological monitoring would be required;
- During dredging operation, suitable measure should be taken to protect channel bed and banks through proper design and construction of river training works;
- In order to control sediment dispersion within the dredging area, an environmental friendly silt curtain or other site specific measures should be taken to prevent dispersion of sediment along the channel

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Air pollution

There would be a minor impact on air pollution due to exhaust emissions of SO2, NOx, CO, CO2 from dredging operation. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Routine inspection and maintenance for dredging equipment to ensure good working condition. Proper maintenance of engines for ensuring complete fuel combustion with low soot emissions;
- Use fuels with low-sulphur to reduce noxious emissions;
- Provide exhaust filtering, where applicable;
- Gaseous emissions to be monitored daily and emissions should be within limits as prescribed in the DoE air quality standards.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Noise generation

There would be a moderate impact due to noise above water for disturbance to the terrestrial animals and birds and noise under water for disruption to fish migration and disturbance to dolphins. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Selection of efficient dredging equipment to reduce the noise both above and under water during dredging operation (e.g. isolation of exhaust systems, by keeping close the door of the engine room)
- The dredging work should be carried out during daytime, where possible, rather than at sunrise or sunset (e.g. significant disturbance to wildlife) or during night time. Otherwise, the dredger should be ramp up slowly at the starting time to the levels of engines so that minimum disturbance will have to the marine and terrestrial fauna for them to move away from the dredging area for significant noise emissions.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Navigation Traffic

There would be a minor impact due to the presence of dredged materials disposal pipes, barges and associated dredging equipment posing obstruction to the navigating boats/vessels. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Provide proper navigational lighting and navigation aids for the barges and associated vessels so that they do not obstruct the navigation channel;
- Routine monitoring of all navigational lights should be conducted to ensure that they are working properly;

- Limit the motor boat speed (between 7 knots to 8 knots) in accordance with the best international practices and to avoid any collision with dolphins.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Oil spillage

There would be a minor impact due to accidentally occurred oil spillage from dredging equipment during operation for leakage in oil tanks/equipment. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- The recent advanced dredging equipment should be adopted for this proposed dredging work, which has less possibility of oil spillage issues;
- The dredging barges and boats should be refueling with a proper care to avoid any oil spillage;
- Spill kits should available at accessible location, and oil absorbent material at refueling points on the barges;
- Routine monitoring for oil leakage in oil tanks/equipment during dredging operation.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Fisheries

There would be a moderate impact on fish habitats and diversity due to dredging in the Passur channel resulting change in fish habitats, spawning, etc. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Selection of highly efficient advanced dredging equipment which will product less turbulence for sediment resuspension, less air pollution and noise in both above and under water during dredging operation.
- The fish in the Passur channel has already adopted with dredging operation around the project area since the begging of Mongla Port operation which has long history of dredging activities in the Passur channel for keep its serviceability/accessibility for water traffic to the Port Jetty area.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Ecosystem

There would be a moderate impact on ecosystem of benthic habitat due to sediment extraction from the river bed of the dredging area, disturbance to Dolphin colony in Passur River, and disturbance to nocturnal animal due to lighting in dredging vessel. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Selection of highly efficient advanced dredging equipment which will product less disturbance on the river bed for sediment extraction, less air and noise pollution with minimum lighting effects ultimately reduce environmental impact on benthic habitat, Dolphin colony, and nocturnal animal ecosystem.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Wastewater generation

There would be a minor impact due to wastewater disposal from the barges and associated vessels. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- The wastewater generated from the barges and associated vessels should be properly collected, treated and discharge to the environment.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

**Dredged Materials**

Transportation of dredged materials

There would be a minor impact due to accidental leakages and spillage during dredged materials transport. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Routing monitoring for any leakage or damage on the pipe network for transporting dredging materials to disposal site;
- Develop emergency response plan for any spillage/leakage of dredged material from the piping network;
- Provide appropriate signage on/around the piping network for water traffic to avoid any accidental damage on the system during operation;
- Provide notification about the dredging activities to the navigating boats/vessels to minimize risks of collision;
- Provide adequate training to staff at dredging site to operate heavy equipment.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Placement of dredged materials

There would be a minor impact due to dispersion of sediments and release of high sediment laden runoff from the disposal sites. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Before commencing the filling process at the disposal where the water depth is less, and there should be a delta building process with geo-tubes filled by sand and subdivided into compartments;
- Use of environmental friendly silt curtain or other site specific measures to prevent dispersion of sediment plume.
- The dredged materials should be placed in the disposal sites in such a way so that to keep a low laying areas (e.g. acts as a pond) with specified distance, which will serve as a pool of freshwater reservoirs (e.g. recharged from the monsoon rain). This feature will create a freshwater ponding system (like a grid pattern if possible) to cultivate freshwater fish in these areas:
- These ponds will serve as a source for freshwater for the nearby resident around these areas; and
- The bank of these ponding system will potentially use for growing vegetables.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Ecosystem

There would be a minor impact on habitat quality and ecosystem due to deposition of dredged materials from dredging activities. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- The dredged materials should be placed in the disposal sites in such a way so that to keep a low laying areas (e.g. acts as a pond) with specified distance, which will serve as a pool of freshwater reservoirs (e.g. recharged from the monsoon rain). This feature will create a freshwater ponding system which will finally balance the ecosystem in this area.
- Rehabilitation of benthic habitats by conserving and extending the existing nursing ground and mangrove forest area

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

## Post- Dredging Phase

### Dredged Materials

Land and agriculture

There would be a moderate impact on soil fertility due to disposal of dredged materials in the disposal sites. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- It is recommended to grow/cultivate mangrove and/or suitable crops which are tolerant to this silty dredged material (such as crops tolerant to salinity, conductivity, etc.).

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Drainage Congestion

There would be a moderate impact on the drainage congestion in the disposal sites due to the following reasons:

• Where applicable, the canal "khal" outlets near disposal locations; which might be blocked by dredging dredged materials resulting poor drainage at the affected location.

• Drainage congestion may occur if the dredged materials block drainage of the reclaimed area at disposal locations;

• If the drainage is hampered water logging in the catchments will affect ecology of the area.

In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

- Remove sediment accumulation at the outfalls of the natural khals;
- Before commencing the filling process, a delta building process using geo-tubes filled with dredged materials to be placed to prevent any blockage of drainage canals near these disposal sites;
- Use of environmental friendly silt curtains or other site specific measures will prevent sediment dispersion and khal blockage.

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

**Other Impacts from Project Development for Increasing Water Traffic**

Increased water traffic would cause minor negative impacts due to air pollution, noise generation, wastewater, surface water contamination, land and agricultural impairment, loss of fisheries, and ecosystem. In order to overcome these impacts, the followings mitigation/ enhancement/ compensation/ contingency measures should be taken:

• All vessel should be provided with GPS, radar and other electronic navigation systems to prevent grounding or collisions, such as depth sounder, radar and radio equipment for communication.
• All vessel should comply with rules and regulation of IMO, Port authority, BIWTA and national laws of safety, and environmental conservations
• Spot check of shipping and barging activities by MPA and concerned authority.
• Enforce the relevant law of restricting Ballast water Dumping and controlling the oil spillage in the Sundarbans territory
• Restrict blowing of whistle within Sundarbans Territory
• Introduce speed limitation (between 7 knots to 8 knots) for vessel in Sundarbans Territory.
• Anchorage should be allowed at particular location within the Sundarbans area
• Restrict outside lighting of the water vessel during navigation across the Sundarbans
• Restrict the beaming of searchlight on Forest area

• Use low beam of searchlight during navigation across the Sundarbans

• Proper training for vessel crews, traffic inspectors, in charges, and other concerned professionals

With these Environmental Impact Mitigation measures the impacts will be considered as insignificant.

Socioeconomic condition

There would be moderate positive impacts on socioeconomic condition around the project area for this development project. In order to enhance this positive impact, the followings enhancement/ compensation measures should be taken:

- Proper training and motivational program should be undertaken to enhance the business/job opportunities in this area under this project.
- Currently, the proposed disposal site along the river is used as fish farming (gher). It needs to be ensured that the land owner will be compensated properly by the MPA as discussed in Chapter 5 (Social Impact Assessment).

With these Environmental Impact Mitigation/Enhancement measures the impacts will be considered as significant (positive).

## 7.2 Environmental Monitoring

Environmental Monitoring outlines the way as how to implement the mitigation measures identified and discussed in the previous section. The main objective is to guide the implementing agency- Mongla Port Authority (MPA) to achieve sustainability of the project ensuring environmental conservation as per national and international standard. Each component of the Environmental Monitoring describes frequency, implementation procedure, task to be completed, and responsible institutes. External measures include air quality monitoring stations, water quality monitoring stations, acoustic monitoring and regular training and monitoring to the respective management plan.

The implementation and monitoring of EMP shall have to be ensured. Therefore, a team of Environmental Specialist and Environmental Auditor has to be engaged with

responsibility of strong monitoring during implementation of EMP and their environmental and social consequences. The team should be a combination of multidisciplinary professionals. The team composition could be as:

- Environmental and Safety Manager (Team Leader)
    - Dredging Operation Supervisor
    - Air/Noise/Water Quality Professional
        - Field Inspector/ Sample Collector
        - Ecology Inspector
    - Dredged Material/Disposal Site Inspector
        - Field Inspector/ Sample Collector
    - Marine Traffic Inspector
    - Social Management Instructor/ Trainer

Table 7.2: Environmental Monitoring: Frequency, Monitoring parameters and Monitoring Methods

| Activity/Parameter | Frequency | Guidelines/ Standards | Monitoring parameters | Monitoring Method | Responsible Institution (s) | Cost (BDT in Lac) |
|---|---|---|---|---|---|---|
| **Pre-Dredging Phase** | | | | | | |
| **Air, Water & River Bed Sediment Quality** | Monthly | Air and water quality standard of Bangladesh | Air Parameters:<br>CO, $CO_2$, NOx, $SO_X$, $PM_{2.5}$, $PM_{10}$, Wind Speed, Wind Direction, Humidity, Temp<br>Water Parameters:<br>pH, Temp, Electrical Conductivity (EC), Dissolved Oxygen (DO), Turbidity, Cl- concentration, Total Solid (TS), Total Suspended Solids (TSS), $BOD_5$, COD, Oil and Grease, Total Coliform (TC), Nitrate-N ($NO_3$--N), Phosphate ($PO_4^{3-}$), Iron (Fe), Manganese (Mn).<br>River Bed Sediment:<br>Pb, Cu, Fe, Mn, Zn, Ni, Cd | Inspection and field survey, on-site monitoring (air), sampling and laboratory analysis (water and sediment), report review | MPA / Contractor | 50 |

| Activity/Parameter | Frequency | Guidelines/ Standards | Monitoring parameters | Monitoring Method | Responsible Institution (s) | Cost (BDT in Lac) |
|---|---|---|---|---|---|---|
| **During Dredging Phase** | | | | | | |
| **Dredging Operation** | | | | | | |
| **Surface water quality** | Daily (During active dredging) | Surface water quality standard of Bangladesh | Water Parameters:<br>pH, Temp, EC, DO, Turbidity, TDS | Inspection and on-site monitoring, report review | MPA / Contractor | 10 |
| | Bi-weekly | | Water Parameters:<br>pH, Temp, Electrical Conductivity (EC), Dissolved Oxygen (DO), Turbidity, Cl- concentration, Total Solid (TS), Total Suspended Solids (TSS), Nitrate-N ($NO_3$--N), Phosphate ($PO_4^{3-}$), Iron (Fe), Arsenic (As), Manganese (Mn), $BOD_5$, COD, Oil and Grease, Total Coliform (TC) | Inspection and field survey, sampling and laboratory analysis, report review | MPA / Contractor | 40 |
| **Air quality** | Weekly | Air quality standard of Bangladesh | Air Parameters:<br>CO, $CO_2$, NOx, $SO_X$, $PM_{2.5}$, $PM_{10}$, Wind Speed, Wind Direction, Humidity, Temp | Inspection and on-site monitoring, report review | MPA / Contractor | 20 |
| **Noise generation** | Daily (During active dredging) | Noise Pollution Control Rules (2006) of Bangladesh | Measurement of Noise Level in dBL | Inspection, and on-site monitoring | MPA / Contractor | 10 |

| Activity/Parameter | Frequency | Guidelines/ Standards | Monitoring parameters | Monitoring Method | Responsible Institution (s) | Cost (BDT in Lac) |
|---|---|---|---|---|---|---|
| **Navigation Traffic** | Daily (During active dredging) | Bangladesh Environment Conservation Act (ECA) & Environment Conservation Rules (ECR) | On-site monitoring and inspection for proper traffic sign, light, and motor boats speed in place. | Inspection and field survey, report review | MPA / Contractor | |
| **Oil spillage** | | | On-site monitoring and inspection for oil spillage on both upstream and downstream (at lead 5 km) during active dredging operation. | | Contractor, MPA, Bangladesh Coast Guard | 10 |
| **Fisheries** | | | On-site monitoring and inspection for any dead fish colony floating on both upstream and downstream (at lead 5 km) during active dredging operation. | | MPA / Contractor | 5 |
| **Ecosystem** | | | On-site monitoring and inspection for any damage to benthic habitats and/or Dolphin colony on both upstream and downstream (at lead 5 km) during active dredging operation. | | MPA / Contractor | 20 |
| **Wastewater generation** | Weekly | Wastewater discharge standard for Inland water body (ECR, Bangladesh) | Wastewater Parameters: pH, Temp, Electrical Conductivity (EC), Dissolved Oxygen (DO), Turbidity, Cl- concentration, Total Solid (TS), Total Suspended Solids (TSS), Nitrate-N ($NO_3$--N), Phosphate ($PO_4^{3-}$), Iron (Fe), Arsenic (As), Manganese (Mn), $BOD_5$, COD, Oil and Grease, Total Coliform (TC) | Sampling and laboratory analysis, report review | MPA / Contractor | 10 |
| **Dredged Materials** | | | | | | |

| Activity/Parameter | Frequency | Guidelines/ Standards | Monitoring parameters | Monitoring Method | Responsible Institution (s) | Cost (BDT in Lac) |
|---|---|---|---|---|---|---|
| **Transportation of dredged materials** | Daily | Bangladesh (ECA & ECR) | On-site monitoring and inspection for any leakage/damage on the pipe network during active dredging work. | On-site monitoring, report review | MPA / Contractor | 10 |
| **Placement of dredged materials** | Weekly | | Dredged materials analytical parameters: pH, Cl-, moisture content, Total organic, Nitrate-N ($NO_3^-$-N), Phosphate ($PO_4^{3-}$), Arsenic (As), Chromium (Cr), Oil & Grease | Sampling and laboratory analysis, report review | MPA / Contractor | 50 |
| **Ecosystem** | Monthly | | Monitoring of the disposal site for any damage to benthic habitats or imbalance of natural ecosystem. | On-site monitoring, report review | MPA / Contractor | 10 |
| **Post-Dredging Phase** | | | | | | |
| **Dredged Materials** | | | | | | |
| **Land and agriculture** | Quarterly | Bangladesh (ECA & ECR) | Monitoring of the disposal site for any significant changes or imbalance of natural ecosystem | Inspection and field survey, report review | MPA / Contractor | 10 |
| **Drainage Congestion** | Quarterly | | On-site monitoring of turbidity parameter for the surface seepage water passed through the geo-tube used at the disposal sites. | Inspection and field survey, report review | MPA / Contractor | 10 |
| **Inspection of Water Traffic** | | | | | | |
| **Air & Noise pollution, Waste generation** | Daily | | • Check post for monitoring Foreign & Local Ships.<br>• Vessels should comply with rules and | Inspection and report review | MPA | 100 |

| Activity/Parameter | Frequency | Guidelines/ Standards | Monitoring parameters | Monitoring Method | Responsible Institution (s) | Cost (BDT in Lac) |
|---|---|---|---|---|---|---|
| | | | regulation of IMO and MPA.<br>• Restrict blowing of whistle, speed limit (between 7 knots to 8 knots), anchorage at particular location, beaming of searchlight on Forest area, Ballast water Dumping etc. within Sundarbans Territory. | | | |
| **Total Monitoring Cost (BDT in Lac):** | | | | | | **325** |

# Chapter 8
# OUTSTANDING UNIVERSAL VALUE (OUV) OF THE SUNDARBANS

## 8.1 Outstanding Universal Value (OUV) of the Sundarbans

Outstanding Universal Value is one of the central ideas underpinning the World Heritage Convention (Department of the Environment and Energy, 2019). Broadly, its meaning follows the common sense interpretation of each word:

- Outstanding: For properties to be of Outstanding Universal Value they should be exceptional, or superlative - they should be the most remarkable places on earth.
- Universal: Properties need to be outstanding from a global perspective. World Heritage does not aim to recognize properties that are remarkable only from a national or regional perspective. Countries are encouraged to develop other approaches to recognize these places. Australia does this through its National Heritage List.
- Value: What makes a property outstanding and universal is its "value", or the natural and/or cultural worth of a property. This value is determined based on standards and processes set out in the World Heritage Operational Guidelines.

This value is determined based on standards and processes in the Operational Guidelines for the Implementation of the World Heritage Convention (the Operational Guidelines, Intergovernmental Committee for the Protection of the World Cultural and Natural Heritage, 2013). The Committee considers a property as having Outstanding Universal Value if the property meets one or more of the ten criteria set by the World Heritage Center (WHC). To be considered of Outstanding Universal Value, a property needs to:

- ✓ meet one or more of ten criteria
- ✓ meet the conditions of integrity

- ✓ if a cultural property, meet the conditions of authenticity, and
- ✓ have an adequate system of protection and management to safeguard its future.

**The Sundarbans:**

The Sundarbans region inhabits the Sundarbans Natural World Heritage Site. It is lying within the Bangladesh coastal region of the Ganges-Brahmaputra Rivers Delta, which is gifted with vast natural resources, a delta, tidal flat, mangrove forests, marches, lagoons, bars, spilt, estuaries and coastal ecological environment. It is the largest floodplain wetland region worldwide and is located in the South Asian Region (Makowski, 2018). The Sundarbans Reserve Forest (SRF), which is located in the south-west coastal region of Bangladesh between the river Baleswar in the East and the Harinbanga in the West, adjoining to the Bay of Bengal, is the largest contiguous mangrove forest in the world. Lying between latitude 21° 27′ 30″ and 22° 30′ 00″ North and longitude 89° 02′ 00″ and 90° 00′ 00″ East and with a total area of 10,000 km2, 60% of the property lies in Bangladesh and the rest in India. The land area, including exposed sandbars, occupies 414,259 ha (70%) with water bodies covering 187,413 ha (30%) (Figure 8.1).

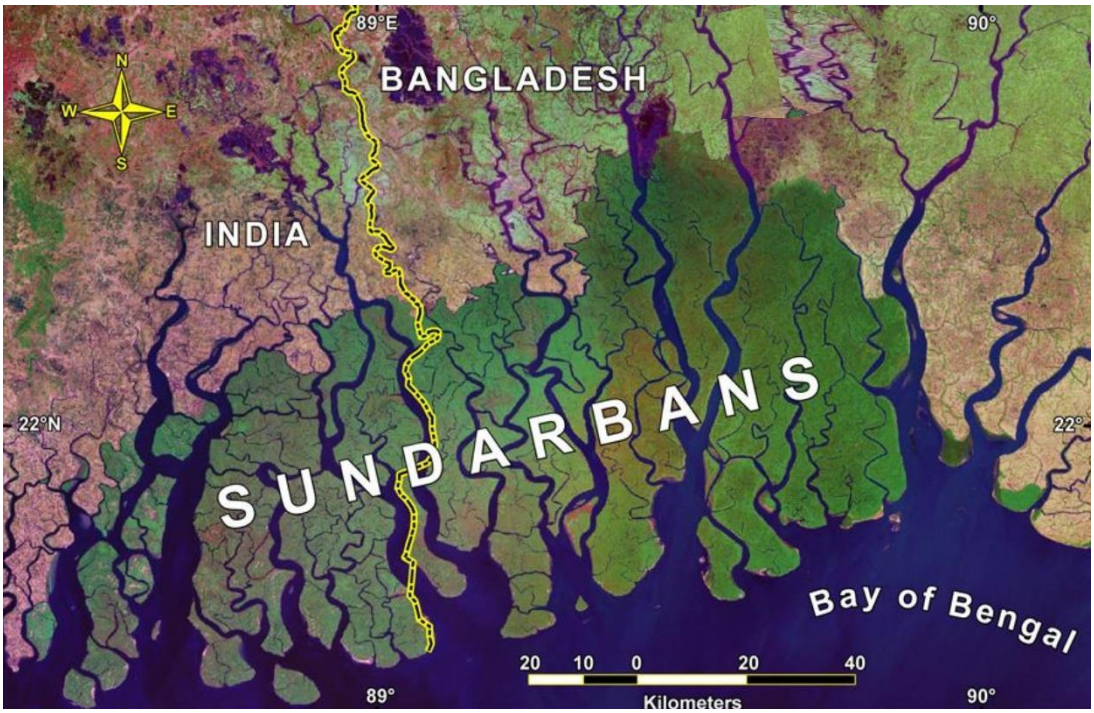



Figure 8.1: Location and Extend of the Sundarbans Reserve Forest (SRF

The Sundarbans mangrove forests, wetlands and their native as well as invasive plant species are lying within the Bangladesh coastal region, which is gifted with vast natural resources, a delta, tidal flat, mangrove forests, marches, lagoons, bars, spilt, estuaries and coastal ecological environment. These habitats, biotopes and ecosystems also serve as habitat for especially four dominant tree species of the Sundarbans, the Sundri (Heritiera fomes), Gewa (Excoecaria agallocha), (Ceriops decandra) and (Sonneratia apetala) (Makowski, 2018). The three wildlife sanctuaries in the south cover an area of 139,700 ha and are considered core breeding areas for a number of endangered species. Mangroves are the unique ecosystem that provides a wide range of ecosystem services. The world's largest single tract mangrove forest located in Bangladesh – the Sundarbans provides a wide range of ecosystem services and contributes to socio-economic development of the neighboring communities and the country. Situated in a unique bioclimatic zone within a typical geographical situation in the coastal region of the Bay of Bengal, it is a landmark of ancient heritage of mythological and historical events. Bestowed with magnificent scenic beauty and natural resources, it is internationally recognized for its high biodiversity of mangrove flora and fauna both on land and water. Timber, fisheries and other non-timber forest products (NTFP) are the main products of the forest. Also, the Sundarbans serves as coastal defense and reduces winds and storm surges, coastal flooding and coastal erosion. Over 3.5 millions of people living around the Sundarbans are directly or indirectly dependent on ecosystem services. In addition, the forest has regional and global importance for its ecological resources. UNESCO has declared the Sundarbans as "The World Heritage Site" in 1997 (Uddin et al., 2013).

The immense tidal mangrove forests of Bangladeshs' the Sundarbans Forest Reserve, is in reality a mosaic of islands of different shapes and sizes, perennially washed by brackish water shrilling in and around the endless and mind-boggling labyrinths of water channels. The site supports exceptional biodiversity in its terrestrial, aquatic and marine habitats; ranging from micro to macro flora and fauna. This mangrove is of universal importance for globally endangered species including the Royal Bengal Tiger, Ganges and Irawadi dolphins, estuarine crocodiles and the critically endangered endemic river

terrapin (Batagur baska). It is the only mangrove habitat in the world for Panthera tigris species.

In 1997, the Sundarbans was recognized as UNESCO World Heritage Site considering two (two) i.e. criterion (ix) and criterion (x). Criterion (ix) and criterion (x) are illustrated below;

(ix) be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

(x) contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.

According to guidelines, to be deemed of Outstanding Universal Value, a property must also meet the conditions of integrity and/or authenticity and must have an adequate protection and management system to ensure its safeguarding.

Nine (9) Characterization of the Sundarbans was made by the Committee in the perspective of criteria (ix) and (x), which is described in the following section.

Criterion (ix): The Sundarbans provides a significant example of on-going ecological processes as it represents the process of delta formation and the subsequent colonization of the newly formed deltaic islands and associated mangrove communities. These processes include monsoon rains, flooding, delta formation, tidal influence and plant colonization. As part of the world's largest delta, formed from sediments deposited by three great rivers; the Ganges, Brahmaputra and Meghna, and covering the Bengal Basin, the land has been moulded by tidal action, resulting in a distinctive physiology.

Criterion (x): One of the largest remaining areas of mangroves in the world, the Sundarbans supports an exceptional level of biodiversity in both the terrestrial and marine environments, including significant populations of globally endangered cat species, such as the Royal Bengal Tiger. Population censuses of

Royal Bengal Tigers estimate a population of 440 individuals, a higher density than any other population of tigers in the world (GRTP 2012). However, the tiger population is found much less, about 106 individuals, in 2015 Tiger Census (Bangladesh Forest Department, 2015).

The property is the only remaining habitat in the lower Bengal Basin for a wide variety of faunal species. Its exceptional biodiversity is expressed in a wide range of flora; 334 plant species belonging to 245 genera and 75 families, 165 algae and 13 orchid species. It is also rich in fauna with 693 species of wildlife which includes; 49 mammals, 59 reptiles, 8 amphibians, 210 white fishes, 24 shrimps, 14 crabs and 43 mollusks species. The varied and colorful bird-life found along the waterways of the property is one of its greatest attractions, including 315 species of waterfowl, raptors and forest birds including nine species of kingfisher and the magnificent white-bellied sea eagle.

## 8.2 Environmental Impact on the OUV of the Sundarbans

The potential environmental impact of dredging operation is localized at the designated dredging and disposal locations as discussed in the previous sections. **The dredging activities (e.g., pre, during, and post dredging phases) will have insignificant impact on on-going ecological and biological processes of the Sundarbans (criterion ix) since sediment plume is not dispersed into the Sundarbans and does not increase the turbidity.** The present dredging of the Passur Channel is proposed at the river stretch, which has been experiencing river bed scouring and formation of bars over the years. The dredging operation is suggested to deepen the river for improvement of navigability for safe ship movement. The proposed dredging operation won't affect the Sundarbans' exceptional level of biodiversity in both the terrestrial and marine environments, including significant populations of globally endangered cat species, such as the Royal Bengal Tiger since impact is localized as dredging and disposal processes are building with nature. The proposed dredging project at this location is building with nature since river deepening is occurring naturally. In order to reduce the sediment dispersion extent and turbidity level of river water, environmental friendly silt curtain and/or other site specific measures should be taken as proposed in EMP for

mitigation measure. A third party monitoring shall be carried out to control the dredging to limit the increased level and extent of turbidity along the channel during dredging operation. The dredging will be done along the river flow and turbidity of water is very likely to increase along the river not transversely, which implies no impact on the Sundarbans area. **However, during spring tides (i.e. in full moon and new moon) dredging will remain paused since high current due to higher tidal range is likely to disperse sediment plume to the Sundarbans.** The dredged material disposal plan includes disposing of dredged materials on naturally accreting zone, eroding bank to reduce erosion of mangroves.

The proposed dredging work won't remove or have any effects on habitats required to maintain the diversity of fauna and flora in the Sundarbans WHS (Criterion x) since chance of change of physical environment is very insignificant such as change of turbidity and other water quality parameter. The proposed dredging activities won't cause loss to any whole OUV element (Wholeness Criterion) regarding retaining the Integrity of the World Heritage Site (WHS) of the Sundarbans, there will be no reduction in the size of the WHS property. The dredging activities will be carried out following the natural thalweg and flow of the channel to increase navigability at the shallower stretch. Simulations of the hydrodynamic conditions reveals that dredging in the river does not increase current speed in the river and there is no change in current speed along the riverbanks due to dredging. However, current speed is slightly decreased along the dredged channel and the adjacent area. No significant change of current speed is evident near the banks of Passur river due to dredging operation along the proposed location. This implies that the dredging in the proposed locations will not cause erosion of the banks. The minor decrease in mean current speed is very likely to cause resiltation on the riverbed at the dredging locations. Resiltation of dredged materials along the riverbeds will decrease suspended sediment concentration of river water. The change of depth of channel will occur at the specific locations but at neither upstream or downstream nor left or right bank of the river.

Immediate consequence of dredging is the destruction of benthos and the obliteration of spawning and nursery grounds for fish. Due to locally increased turbidity, light penetration are reduced, interfering with the photosynthetic process. However, since the type of sediment remains the same, a rapid re-colonization by the same type of benthos will take place. Mobile biota, such as fish, are the least affected, as they are capable of avoiding a disturbed area. Dredging operations will affect relatively small areas. Moreover, the dredging alignment was selected along the deeper part of the river, where the velocity is high. Generally larger fishes/biota live there. Small, young and weak biota lives in low velocity region. Therefore, the effect of dredging on aquatic environment is not significant.

Figure 8.2 shows the WHS of the Sundarbans and the surrounding areas. In addition, the three different (e.g., east, west and south) wildlife sanctuaries are illustrated in Table 8.1. About 32,400 hectares of the Sundarbans have been declared as three wildlife sanctuaries, and came under the UNESCO World Heritage Site in 1997. These wildlife sanctuaries were established in 1977 under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. These are Sundarbans West (9,069 ha), Sundarbans South (17,878 ha), and Sundarbans East (5,439 ha).

Table 8.1: Three Wildlife Sanctuaries of the Sundarbans According to UNESCO WHS in 1997

| ID | Name & Location | State Party | Property |
|---|---|---|---|
| **798-001** | Sundarbans West Wildlife Sanctuary | Bangladesh | 71,500 ha |
| **798-002** | Sundarbans South Sanctuary | Bangladesh | 37,000 ha |
| **798-003** | Sundarbans East Sanctuary | Bangladesh | 31,000 ha |

**It is evident from the map that none of the disposal locations is within the WHS of the Sundarbans and there is no scope of loss of the mangrove forest due to dredging operation and/or by dredged materials disposal at designated locations.** Rather, there is a huge potential of growth of mangroves on the land reclaimed by the disposal of the dredged materials. It is also likely to increase the area of the Sundarbans and enhance the natural environment. Moreover, it will protect the Sundarbans land against erosion, cyclonic wind

and cyclone induced storm surge since the reclaimed land will act as a barrier to the main land of the Sundarbans.

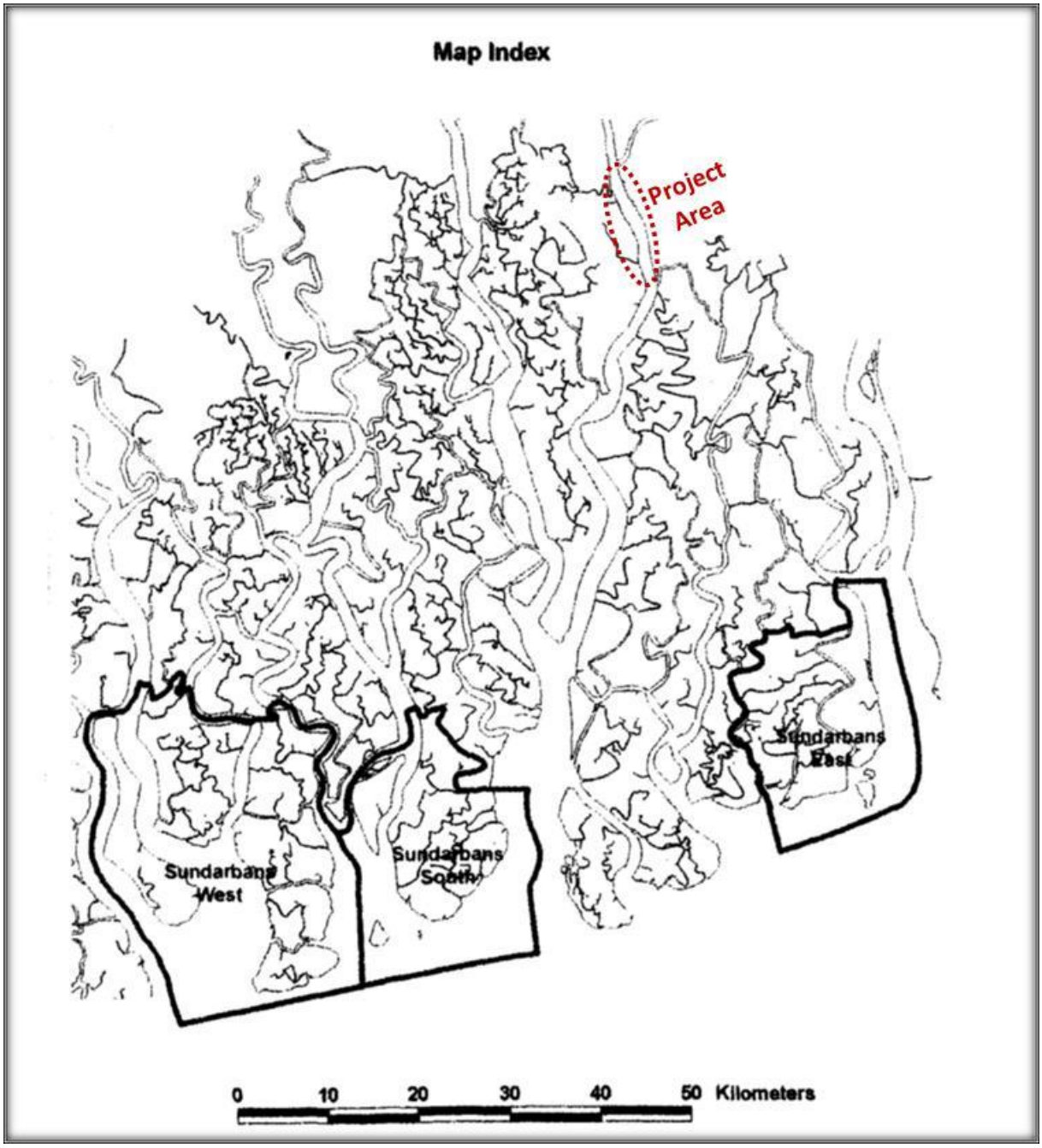



Figure 8.2: The World Heritage Site (WHS) of the Sundarbans Area (Source: https://whc.unesco.org/en/list/798/multiple=1&unique_number=943)

The environmental impacts of the dredging operations on the Sundarbans are summarized below:

- There will be no significant negative impact on the erosion of the rivers banks;
- Proposed dredging locations along the channel will have temporary loss of benthic environment though area of the dredging areas is very small compared to the Passur Estuary;
- The dredging activities will very likely to increase sediment concentration in water and subsequently affect the breeding of fish and other aquatic species. To mitigate this effect dredging will be suspended during new moon and full moon in order to control sediment dispersal rate;
- The proposed disposal locations (Chapter 3) are far away from the WHS of the Sundarbans and mostly fish farming "Gher" owned by the local people;
- There are high potentials for erosion control and land reclamation if the dredged dredged materials are disposed at these proposed locations;
- Mangroves are very likely to grow on the reclaimed land and contribute in enhancement of the coastal ecology as it is recommended to keep low laying area at disposal location with specified distance, which will have served as pool of freshwater reservoirs (e.g. recharged from the monsoon rain).

# Chapter 9
# CONCLUSIONS AND RECOMMENDATIONS

## 9.1 Conclusions

Following conclusions are being made after the comprehensive study with detail investigation. Mongla Port Authority (MPA) of Bangladesh has taken a plan for the dredging and river training in Passur channel to meet up the increasing demand of container as well as bulk cargo navigation for imports/exports activities. With the purpose of obtaining Environmental Clearance Certificate from Department of Environment under Environment Conservation Act, 1995 and through the procedure defined in Environment Conservation Rules, 1997, MPA entrusted Khulna University of Engineering & Technology (KUET), Bangladesh for the responsibility of Environmental Impact Assessment. The study has been carried out following the Environmental Impact Assessment Guideline of DoE that includes multidisciplinary tools and techniques of Physical, Water resources, Forest, Land and soil, Fisheries, Ecology and Socio-economic surveys and investigation.

In order to fulfill the objectives, existing environmental and socio-economic conditions detail assessment was made to prepare the environmental and socioeconomic baseline condition of the proposed project site. Flat topography with some low lying areas, tidal flushing, exposure to cyclone and storm surge, port area activities, the Sundarbans mangrove forest, and migratory routes of Dolphin are the noteworthy aspect of existing environmental condition around the study site.

Attempts were made to assess all the predicted environmental and social impacts with evaluating the nature, temporal and spatial extent, reversibility and likelihood of the predicted impacts. Finally, the predicted impacts were summarized in a qualitative scale of consequence. The assessment includes impacts of dredging activities along with dredged materials disposal on physical setting, impacts on air quality, impacts on water resources, impacts on land and

forest resources, impacts on fisheries, impacts on ecosystem resources, and impacts on socio-economic environment.

The potential impact of dredging is localized at the dredging and disposal locations. The project activities will have insignificant impact on on-going ecological and biological processes of the Sundarbans (Criterion ix, UNESCO World Heritage Site) since sediment plume won't have dispersed into the Sundarbans and won't increase the turbidity. In addition, the proposed dredging does not affect the Sundarbans' exceptional level of biodiversity in both the terrestrial and marine environments, including significant populations of globally endangered cat species, such as the Royal Bengal Tiger since the environmental impact of the proposed project work is localized at dredging and disposal areas. The reasons of negligible impact on the Sundarban's Outstanding Universal Value (OUV) as per UNESCO World Heritage Site (WHS) are explained as below:

The proposed dredging of the Passur Channel is located at the river stretch, which has been experiencing river bed scouring and formation of bars naturally over the years. Moreover, environmental friendly silt curtain and/or other site specific measures will be adopted to reduce the sediment dispersion extent and turbidity level along the channel during the dredging operation. The dredging will be done along the river flow, and turbidity of water is very likely to increase along the river not transversely, which implies a very limited impact on the Sundarban area. In addition, during full moon and new moon time, dredging work will remain suspended since high current due to higher tidal range is likely to disperse sediment plume to the Sundarbans. The dredged materials disposal plan includes disposing of dredged material on naturally accreting zone, eroding bank to reduce erosion of mangroves. Mangroves are very likely to grow on the reclaimed land and contribute in enhancement of the coastal ecology as it is recommended to keep low laying areas at disposal locations with specified distance, which will have served as pool of freshwater reservoirs (e.g. recharged from the monsoon rain) as discussed in the EMP section of this EIA report. Placement of dredged material causes the dispersion of sediments and release of high sediment laden runoff from the disposal sites. Thus, the

filling process should be commenced from low water depth at the selected locations and there should be a delta building process with geo-tubes filled by sand. Environment friendly silt curtain and/or other site specific measures would be used to prevent dispersion of sediment plume.

The proposed dredging stretches will experience temporary loss of benthic environment though area of the dredging stretches is very small compared to the Passur Estuary and outer bar areas. The dredging activity would have limited effects on habitats required to maintain the diversity of flora and fauna in the Sundarbans WHS (Criterion x) since chance of change of physical environment is very insignificant such as change of turbidity and other water quality parameters. In relation to retaining the integrity of the WHS (the Sundarbans), the proposed dredging Project does not cause loss to any whole OUV element (Wholeness Criterion), and there will be no reduction in the size of the WHS property.

The dredging will be carried out following the natural thalweg and flow of the river only to increase navigability at the shallower stretch. Simulations of the hydrodynamic conditions reveal that dredging in the river does not increase current speed in the river and there is no change in current speed along the riverbanks due to dredging. However, current speed is slightly decreased along the dredged channel and the adjacent area. No significant change of current speed is evident near the banks of Passur river due to dredging operation along the proposed locations. This implies that the dredging in the proposed locations will not cause any significant erosion of the banks. The minor decrease in mean current speed is very likely to cause re-siltation on the riverbed at the dredging locations. Re-siltation of dredged materials along the riverbeds will decrease suspended sediment concentration of river water. The change of depth of channel will occur at the specific locations but at neither upstream or downstream nor left or right bank of the river. None of the disposal locations is within the WHS of the Sundarbans and there is no scope of loss of the mangrove forest due to dredging and dredged materials disposal locations. Rather, there is a huge potential of growth of mangroves on the land reclaimed by the disposal of the dredged materials as it is recommended to keep low

laying area at disposal location with specified distance, which will have served as pool of freshwater reservoirs (e.g. recharged from the monsoon rain) as discussed above.

Noise during dredging operation would cause disturbance to the neighboring terrestrial animals and birds and disruption to migration of fish and dolphins. In this context, efficient dredging equipment should be selected to reduce the noise both above and under water during dredging operation (e.g. isolation of exhaust systems, by keeping close the door of the engine room). The dredging work should be carried out during daytime, where possible, rather than at sunrise or sunset (e.g. significant disturbance to wildlife) or during night time. Otherwise, the dredger should be ramp up slowly at the starting time to the levels of engines so that minimum disturbance would happen to the marine and terrestrial fauna for them to move away from the dredging area for significant noise emissions.

The potential benefits of the project will compensate the negative impact if the prescribed Environmental Management Plan (EMP) were implemented. The proposed project will create enormous potentiality of economic and social development of the region. The negative impact of the project on Physical, Water resources, Forest, Land and soil, Fisheries, Ecology and Socio-economic environment was found minor and can be mitigated/compensated by adoption of different environmental and pollution abatement measures. Therefore, it can be concluded that the proposed project is socially viable and environmentally feasible.

## 9.2 Recommendations

Finally, the following recommendations are made on the basis of EIA study that should be considered for achieving the goal of minimum environmental impact and optimum benefits:

- Findings and suggestion of EIA study in project planning, design and operation should be considered and implemented with intensive monitoring;
- All activities (pre-dredging, dredging and post-dredging phases) should be implemented according to EMP;
- Environmental Management Plan and Safety Management Plan should be implemented at every suggested stage of the project;
- Establishment of institutional arrangement with proper logistic and training for Environment, Health and Safety in Project Management unit during pre, post, and dredging operation of the project;
- The surrounding and inter tidal area of the project should be brought under mangrove plantation and/or afforestation;
- Special care should be taken for Dolphin community protection as per EMP;
- Relevant national laws and IMO conventions signed by the GOB should be enforced properly by the relevant authorities (MPA, DG Shipping, BIWTA, etc);
- Environmental Management Plan has been formulated considering anticipated impacts. However, further updating of impact management procedure must be made with respect to spatial and temporal environmental impacts based on regular monitoring during the dredging and post-dredging periods of the project.

# Appendix A

Government of the People's Republic of Bangladesh
**Department of Environment**
www.doe.gov.bd
Head Office, E-16 Agargaon
Dhaka-1207

Memo No: 22.02.0000.018.72.063.19 · 276 Date: 08/02/2019

Subject: Approval of Terms of Reference for EIA of the Dredging and River Training in Pussur **Channel of Mongla Port, Mongla Port Authority, Mongla, Bagerhat.**

Ref: Your Application dated 21/01/2019.

With reference to your letter dated 21/01/2019 for the subject mentioned above, the Department of Environment hereby gives Approval of Terms of Reference for EIA of the Dredging and River Training in Pussur Channel of Mongla Port, Mongla Port Authority, Mongla, Bagerhat subject to fulfilling the following terms and conditions.

I. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE) and additional suggestions provided herein.
II. The EIA report should be prepared in accordance with following indicative outlines:

1. Executive summary
2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references)
3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)

4a. Project activities:
- A list of the main project activities to be undertaken during site clearing, construction as well as operation
- Project Plan, Design, Standard, Specification, Quantification, etc.

4b. Project schedule: The phase and timing for development of the Project

4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.

4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.

5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
   - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
   - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
   - Environment Quality : Air, Water, Soil and Sediment Quality
   - Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions

6. Socio-economic environment should include, inter alia, following:
   - Population: Demographic profile and ethnic composition
   - Settlement and housing
   - Traffic and transport
   - Public utilities: water supply, sanitation and solid waste
   - Economy and employment: employment structure and cultural issues in employment
   - Fisheries: fishing activities, fishing communities, commercial important species, fishing resources, commercial factors.

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7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
   In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man maid or natural, wildlife, socio-economic aspect shall be incorporated in detail.
8. Management Plan/Procedures:
   For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
   An outline of the Environmental Management Plan shall be developed for the project.
   In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project) Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
10. Emergency Response Plan & disaster Impact Assessment
11. Conclusion 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 the filled-in application for Environmental Clearance in prescribed form, the feasibility study report, the applicable Environmental Clearance fee in a treasury chalan, the applicable VAT on clearance fee in a separate treasury chalan, the No Objection Certificate (NOC) from local authority, NOC 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 Bagerhat District Office of DoE in Bagerhat with a copy to the Head office of DoE in Dhaka.

08.07.2019

**(Syed Nazmul Ahsan)**
Director (Environmental Clearance)
Phone # 02-8181673

**Chief Engineer**
Mongla Port Authority
Mongla, Bagerhat.

**Copy Forwarded to :**

1) PS to the Secretary, Ministry of Environment, Forest and Climate Change, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Khulna Divisional Office, Khulna.
3) Deputy Director, Department of Environment, Bagerhat District Office, Bagerhat.
4) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.