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Environmental Impact Assessment Report

Mirershorai Economic Zone

Submitted to
Bangladesh Economic Zones Authority
August 2015

Bangladesh Economic Zones Authority (BEZA)

pwc

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Abbreviation & Glossary

Abbreviation	
%	Percentage
°C	Degree Celsius
µg/m3	microgram per cubic meter
AEZ	Agro Economic Zone
amsl	Above Mean Sea Level
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BEPZA	Bangladesh Economic Processing Zone Authority
BEZA	Bangladesh Economic Zone Authority
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
BRRI	Bangladesh Rice Research Institute
BSRM	Bangladesh Stell re-Rolling Mills
BTCL	Bangladesh Telecom Company Limited
BUA	Built-up Area
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
$CaCO_3$	Calcium Carbonate
CCC	Criterion Continuous Concentration
CDSP	Char Development and Settlement Project
CETP	Common Effluent Treatment Plant
cm	Centimetre
CMC	Criterion Maximum Concentration
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CoI	Corridor of Impact
CPP	Captive Power Plant
Cr	Chromium
CRPA	Climate Resilience Participation Afforestation
CSTP	Common Sewage Treatment Plant
Cum	Cubic meter
DG	Diesel Generator
DMB	Disaster Management Bureau
DO	Dissolve Oxygen
DoE, B	Department of Environment, Bangladesh
DPHE	Department of Public Health and Engineering
DTA	Domestic Tariff Area
E	East
EC	Electrical Conductivity
ECA	Environment Conservation Act
ECC	Environment Clearance Certificate
ECR	Environment Conservation Rules
EIA	Environment Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EPZ	Economic Processing Zone
ETP	Effluent Treatment Plant
EZ	Economic Zone
FAR	Floor Area Ratio
FCD	Flod Control & Drainage
FDI	Foreign Direct Investment
FGDs	Focus Group Discussions

FMD	Foot & Mouth Disease
Ft.	Feet
g	Gram
GDP	Gross Domestic Product
GIS	Geo-Informatics System
gm/cc	gram per cubic centimetre
GoB	Government of Bangladesh
GSB	Geological Survey of Bangladesh
GSHAP	Global Seismic Hazard Assessment Program
Ha	Hectares
HDPE	High-Density Polyethylene
HHs	Households
HT	High Tension
HYV	High Yielding Variety
ICT	Inland Container Terminal
IEE	Initial Environment Examination
IFC	International Finance Corporation
JICA	Japan International Cooperation Agency
Kg	Kilogram
Kg/day	Kilogram Per Day
KLD	Kilo litres Per Day
Km	Kilometre
km	Kilometre
Km/h	Kilometre per Hour
KV	Kilo Volts
LCV	Low Carriage Vehicles
L_{eq}	Equivalent Noise Level
LPCD	Litre per Capita per Day
LPG	Liquefied Petroleum Gas
LT	Low Tension
LU	Land Use
M	Meter
m/s	meter / second
m/yr	meter / year
MAV	Multi-Axle Vehicles
max.	Maximum
mg/kg	microgram per kilogram
mg/l	microgram per litre
Mile/h	Mile per Hour
min.	Minimum
MLD	Million Litres Per Day
mm	Millimetre
Mm/day	Millimetre per Day
Mm/hr	Millimetre per hour
MT	Million Tonnes
MVA	Mega Volt Ampere
MVA	Mega Volts Ampere
MW	Mega Watt
N	North
NaCl	Sodium Chloride
NE	North East
NGL	Normal Ground Level
NNE	North-North-East
NOC	No Objection Certificate
NO_x	Oxides of Nitrogen
NW	North West
O.P.	Operational Policy

PCC	Pretoria Portland Cement
PCMs	Public Consultation Meetings
PCU	Passenger Car Unit
PDMs	Public Disclosure Meetings
PF	Protected Forest
PGA	Peak Ground Acceleration
PM_{10}	Particulate Matter less than 10 micron size
$PM_{2.5}$	Particulate matter less than 2.5 micron size
PMC	Project Management Consultant
PPE	Personal protective Equipment
PPP	Public Private Partnership
PPR	Peste des petits ruminants (disease in ruminants)
PRA	Participatory Rural Appraisal
PSDSP	Private Sector Development Support Project
PUC	Pollution Under Control Certificate
R & R	Rules and Regulations
RAP	Resettlement Action Plan
REB	Rural Electricity Board
RF	Reserve Forest
ROW	Right of Way
RRA	Rapid Rural Appraisal
RWH	Rain Water Harvesting
S	South
SE	Socio Economic
SE	South East
SIA	Social Impact Assessment
SMF	Social Management Framework
SO_2	Sulphur Dioxide
SPT	Standard Penetration Test
Sq Ft	Square Feet
sq.km	Square kilometre
sq.m.	Square Meter
STP	Sewage Treatment Plant
SW	South West
TCS	Typical Cross Section
ToR	Terms of Reference
TPP	Thermal Power Plant
TSS	Total Suspended Solids
UK-DFID	Department for International Development, United Kingdom
UNDP	United Nations Development Programme
US$	United States Dollars
VOCs	Volatile Organic Compounds
W	West
WARPO	Water Resources Planning organization
WP	Water Pollution
XEN	Executive Engineer
YPSA	Young Power in Social Action
NGO	Non Government Organization
µmhos / cm	micromhos per centimetre

TOR COMPLIANCE

S. No.	ToR Point	Compliance
I	The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said project in accordance with this ToR and following additional suggestions	EIA study has been carried out in line with the ToR Approved by DoE, WB guidelines & EMF of PSDSP
II	The EIA Report should be prepared in accordance with following indicative outlines:	Agreed
1	Executive Summary	Refer Chapter 1
2	Introduction: (background, brief description, rationale of the project, scope of study, methodology, limitation, EIA team, references)	Refer Chapter 2
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III	Without obtaining approval of EIA report by the Department of Environment, the Project authority shall not be allowed to conduct earth filling or any kind of physical intervention in the proposed project site and also not be able to start the physical activity of the project.	Agreed
IV	This approval of the Terms of Reference (ToR) would not mean any acceptance or site clearance of the Project.	Agreed
V	The proposed EIA study would not establish any claim, right in favour of the proponent for getting site clearance or environmental clearance.	Agreed
VI.	Without obtaining Environmental Clearance, the project authority shall not be able to start the operation of the project.	Agreed
VII.	The project authority shall submit the EIA along with the No Objection Certificate (NOC) from the local authority, NOC from Forest Department (if it is required in case of cutting any forested plant, private	Agreed

S. No.	ToR Point	Compliance
	or public) and NOC from other relevant agencies for operational activity etc. to the Chittagong District Office of DOE with a copy to the Head Office of DOE in Dhaka.	

1. Executive Summary

1.1. Introduction

The Bangladesh Economic Zone Act, 2010, was passed by Government of Bangladesh to make provisions for the establishment of Economic Zones (EZs) in all the potential areas with an ambit to encourage rapid economic development and to instil confidence in investors and signal the Government's commitment to a stable EZ policy regime.

With an ambit of enhancement of economic development in the country, Government of Bangladesh with support from World Bank and the Department for International Development, United Kingdom (UK-DFID) has proposed to develop EZs at various potential locations in Bangladesh as Private Sector Development Support Project (PSDSP).

Bangladesh Economic Zone Authority (BEZA) is the overall agency responsible for establishments of EZs in all the potential areas including the backward and undeveloped regions. BEZA has been formed under the Bangladesh Economic Zone Act, 2010 on 9th November, 2010. BEZA has identified various locations for development of EZs. One of the potential sites is located at Mirershorai Upzila and has an approximate area of 610 acres (246.86 ha)

1.2. Project Background

BEZA has planned to develop EZ to be located at Mirershorai Upzila, Chittagong District. Economic zone will be developed under PPP mode. BEZA will develop the land and will also cover the off-site infrastructure at the proposed project site. Other services and infrastructure of EZ will be developed by the private developer at a later stage. BEZA is carrying out EIA study for the proposed EZ Zone. Developer will carry out separate EIA study for developing the EZ and separate approval will be obtained from DoE, Bangladesh, for developing the EZ, if any major modification in master planning will be carried out by developer. The off-site development will broadly include the following:

- Construction of Administration building
- Access road of 6 km length and 5 m width
- Site Preparation which includes
    - Boundary wall
    - Landfilling and construction of bund for 610 acres
    - Retaining wall around Isakhali channel
    - Sluice Gate for managing flow of Isakhali Channel (Entry point of canal at site)

Taking into consideration the site location, available infrastructure, existing industries, investors interest and infrastructure & logistic requirement of the proposed industries, Mirershorai Economic Zone will be most suitable for food processing, textile and light engineering industries. Options for other industries can also be explored by the developer at the time of development of EZ depending on the investor's interest and availability of resources. At present, off-site infrastructure will be developed by BEZA for the proposed site identified for Mirershorai EZ. BEZA is carrying out EIA study for the proposed EZ Zone. Developer will carry out separate EIA study for developing the EZ and separate approval will be obtained from DoE, Bangladesh, for developing the EZ, if any major modification in master planning will be carried out by developer.

BEZA has appointed M/s Price Water Coopers Pvt. Ltd. to provide transaction advisory services for development of EZs in Bangladesh which also includes Environment Impact Assessment (EIA) study of the upcoming projects. The project attracts the applicability of Environment Conservation Act, 1995 & Environmental Conservation Rules, 1997. The proposed project is classified under red category as per Environmental Conservation Rules, 1997. Thus it is required to carry out EIA study for the

proposed project as per Environmental Conservation Rules, 1997 and obtain approval of DoEB before taking up any construction activity for the project. Project is being implemented with the financial support of World Bank. As per the World Bank Policy O.P.4.01 and the Environment Management Framework of PSDS project, development of the economic zone is classified as Category A project which requires a detailed environment assessment study prior development of zone to identify the potential threats of project to environment and to frame mitigation and environment management plan to reduce the negative impact of the project.

As per the procedure, an Initial Environment Examination (IEE) Report for development of EZ along with proposed Terms of Reference (ToR) was submitted to DOE on 04.05.2015. Approved ToR was granted by DoE vide Memo No. DoE/Clearance/5341/2014/201 dated 14th May, 2015. Copy of ToR letter is attached as Annexure I. The EIA study for the development of proposed Mirershorai EZ has been carried out as per the ToR issued by DoEB and World Bank's requirements and EMF of PSDS project.

1.3. Project Description

Mirershorai EZ is proposed to be located in Mirershorai Upzila of Chittagong district, Bangladesh near Abu Torab Village. As of now, there is no infrastructure development including power, drainage, electrical, water, sewage and telecom line and buildings at the proposed project site. The proposed project site is flat low land area classified as Char land/wet land as per land revenue records. The land belonged to Government and has now been transferred to BEZA and land documents are attached as Annexure II. Upcoming EZ covers area of 610 acres (246.85 ha). Site is trisected by Isakhali canal. Out of 610 developments will be carried out within 550 acres only and remaining 60 acres is covered by Isakhali canal.

The location map of the proposed Project site is presented in following Figure. The proposed project site is bounded by Mangrove plantation in NW & SE direction, CDSP bund in East direction and Wetland & Feni River in South direction. Geographical coordinates of the corners and centre of the project site is given in tables 1 & 2 below.

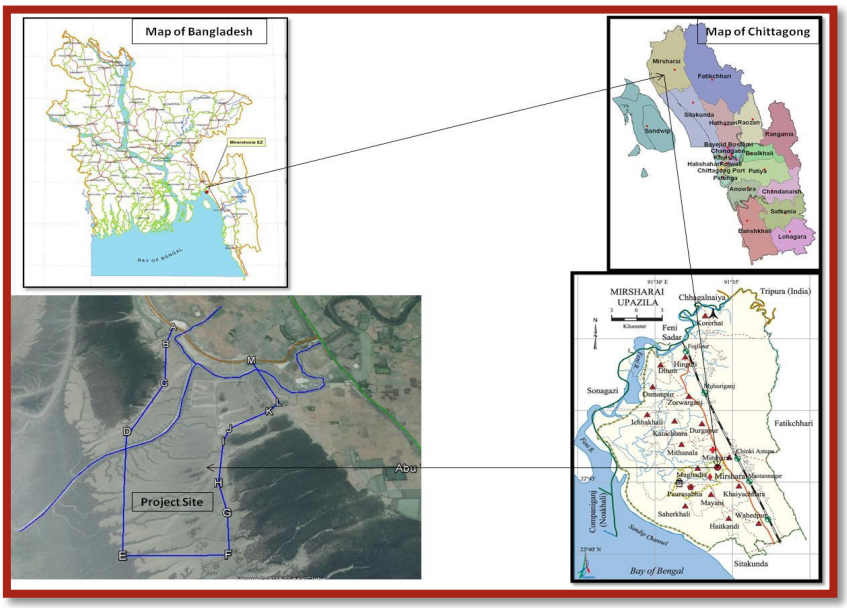


Figure 1: Location Map

Table 1: Coordinates of the proposed project site

Points	Latitude	Longitude
A	22°45'58.93"N	91°27'43.15"E
B	22°45'50.14"N	91°27'41.21"E
C	22°45'31.34"N	91°27'42.80"E
D	22°45'7.78"N	91°27'31.08"E
E	22°44'26.12"N	91°27'37.43"E
F	22°44'26.34"N	91°28'9.91"E
G	22°44'40.11"N	91°28'8.81"E
H	22°44'50.59"N	91°28'5.29"E
I	22°45'6.41"N	91°28'6.07"E
J	22°45'11.49"N	91°28'8.00"E
K	22°45'18.85"N	91°28'21.90"E
L	22°45'22.73"N	91°28'25.37"E
M	22°45'42.01"N	91°28'14.77"E

Table 2: Existing Features surrounding the project site

Direction	Features
North	Bamon Sundar Forest, agriculture and aqua culture land
East	Agriculture and aqua culture land
SE	Bamon Sundar Forest
South	Wetland
West	Wetland

The proposed project site is generally flat, low lying and poorly drained. The proposed site will be required to be filled and levelled. Elevation of site varies from 5-7 m. The elevation within the 10 km radius area varies from 0 m to 11 m.

1.4. Connectivity of the Project Site

Site is at 10 Km west of the national Highway (Dhaka-Chittagong Highway) with Chittagong City 60 Km south of this location. Bartakia Railway station and Mirershorai Railway station is at distance of 9.5 & 10.0 km respectively in East direction to the site. The Shah Amanat International Airport at Chittagong is located south of the site at a distance of 79 Km, and, the seaport is 67 Km south of the site. Azampur Bazar, the nearest market, is only 2 Km north from the site.

Site is accessible through two roads/bunds constructed by CDSP & BWDB to protect inland area from flooding. These two bunds are connected to two roads namely; project road in North of direction and Abu Torab Beri Bandh Road in South direction of project site. These two roads further connect the Dhaka Chittagong highway. Access road of 5 m width and 6 km length will be constructed on the existing bund from Abu Torab Junction to project site to make site easily accessible. Proximity of the site to Chittagong Dhaka Highway, Sea & Chittagong Port makes the proposed project site an ideal location for the development of EZ.

Table 3: Connectivity & Surroundings of Proposed Project Site

Connectivity	Name	Distance	Direction
Nearest Road/Highway	CDSP Bund BWDB bund Abu Torab Road Dhaka Chittagong Highway	Abuts site 800 m 3.7 kms 10 kms	East East SE East
Nearest Railway Station	Bartakia Railway Station Mirershorai Railway Station	9.5 km 10 km	East
Nearest Airport	Shah Amanat International Airport	79 km	South
Available inland water transport	Feny River Isakhali Canal Bamon Sundar Canal	900 m Within EZ site 2 kms	West Within EZ site SE
Nearest Village/Residential Area	Nayapara Village Charsharadh Village	4 km 3 km	SW SW
Nearest Port	Chittagong Port	67 km	South

Source: Based on analysis of area maps, satellite imageries and topo-sheets

There are no ecological sensitive locations such as National Park, Sanctuary, Elephant/Tiger Reserve, Migratory routes and wetlands within the 10 km radius of the study area. Mangroves plantation carried out by forest department along the coast line labuts the EZ site. River Feni is app 900 m distance from EZ site. Isakhali canal traverse throughout the length of the site and divides it into three parts. Bamon Sundar canal also flows close to the site.

1.5. Project Activities and Area Statement

Total area of the proposed EZ is approximately 610 acres (246.85 ha). At present only off-site developments will be carried out by BEZA. Proposed project involves development of off-site facilities for EZ. Details are provided below:

Boundary Wall: A compound wall all along the EZ boundary to a height of 2.1 m above NGL is proposed to be constructed and provided with 0.9 m height barbed wire fencing on top. The total length of the compound wall is estimated to be 6500 m. Area covered by boundary wall will be 650 sq. m.

Access Road: Access road of 6 km length and 5 m width will be constructed from Abu Torab junction to the project site. Access road will be constructed over the existing CDSP bund. CDSP bund at some portion is kaccha land and in some portion covered with brick bed. Same bund will be strengthened and black top will be laid over it.

Administrative Building: Administration building will be constructed within EZ site. Building will have ground coverage of 3600 sq. m and built up area of 1680 sq. m. It will consist of 3 floors (G+2).

Land Filling & Construction of Bund: Site is flat land with various drainage channels in it. Site will be leveled and filled to height of 0.75 m. Sand of 16,69,316 cum will be required for filling the land. Sand for filling will be sourced from deep sea. A bund will be constructed in West direction to protect the site from the water ingress from Sea during high tide and monsoon. A A bund will be constructed all along the EZ boundary except in North direction to protect the site from the water ingress from Sea during high tide and monsoon. North direction is already protected by existing CDSP bund. Height of the proposed bund will be +8m amsl. Total length of the bund will be 6.5 kms. Sand

requirement for bund construction will be fulfilled from Feni river or from the Sand Mohal where sand is accumulated by various dredgers.

Retaining Wall: Retaining wall will be constructed along the Isakhali channel for section running through EZ site.

Sluice Gate: Sluice gate will be constructed at Entry point of canal within EZ from sea side to control the flow of water from Isakhali canal within EZ site.

On-site facilities within economic zone will be developed by the developer at the later stage. Developer will be appointed as per the guidelines mentioned in EZ Act, 2010. Preliminary planning has been made for the economic zone on the basis of market and pre-feasibility study. As per the current planning, land use pattern of the EZ site is given in table 4**.** It is planned to establish majorly textile, food processing and light engineering industries. Developer will carry out separate EIA study for developing the EZ and separate approval will be obtained from DoE, Bangladesh, for developing the EZ, if any modification in master planning will be carried out by developer. Other developments like internal storm water drainage, power distribution, water distribution network, plotting, water treatment plant etc. will be carried out by developer.

Table 4: Preliminary Land Use Planning for the Economic Zone

Land Use Pattern	In Hectare	In%
Processing Area		
Industrial Sector		
Food Processing	40.88	16.39%
Textile	39.70	15.91%
Light Engineering	44.49	17.84%
Total Industrial Area	**125.07**	**50.14%**
Specialized Infrastructure		
Warehouse	4.31	1.73%
Truck lay bay	1.36	0.55%
Q.A & Q.C lab	1.98	0.79%
R&D facility	1.00	0.40%
Training centre	3.04	1.22%
Total Specialized Infrastructure	**11.69**	**4.68%**
Public amenities	5.16	2.07%
Utility	8.08	3.24%
Road	14.52	5.82%
Green & open space	31.44	12.60%
Total processing area	**195.97**	**78.55%**
Non-Processing Area		
Admin block	3.82	1.53%
Guest house	2.51	1.01%
Investor club	4.95	1.98%
Residential	6.38	2.56%
Retail	1.50	0.60%
Place of worship	1.71	0.69%
Road	3.28	1.31%
Green & open space	2.86	1.15%
Total non-processing area	**27.01**	**10.83%**
Isakhali channel	18.19	7.29%
Buffer for water channel	8.30	3.33%
Grand Total	**249.47**	**100.00%**

1.6. Drainage System Development

Storm water drainage system will be developed by developer at the site. Cut-off drain will be provided all along the periphery of the site and will be connected to nearest existing discharge point. Peak-run-off should be considered for designing the drainage system. Stone pitching should be considered for the side walls and PCC for the base. Rain water harvesting structure should be proposed all along the drain. Lined rain water harvesting ponds should also be constructed so that rain water can be utilized for domestic and non-domestic purpose during operation phase of EZ.

Project Schedule

Following table (table 5) presents the implementation schedule of the off-site infrastructure details at the proposed Mirershorai EZ site.

Table 5: Implementation Schedule of Off-site Infrastructural Details

S.No	Offsite infrastructure	Duration in months from start
1	Site Development	12
2	Access road	6
3	Admin building	12
4	Boundary Wall	8

1.7. Resources and Utilities Demand for Off-Site Developments

Construction Materials Sourcing

Construction material like steel, cement, concrete, bricks, aggregates etc. will be required for each of the proposed off-site facility construction. The quantity of each of the raw materials is detailed in Chapter 4 of the EIA Report.

Water

Water requirement during construction phase is estimated to be app. 50 KLD, which includes Domestic water requirement of construction workers. For storing rain water during construction phase, temporary rain water harvesting ponds can be constructed at the site. Water for construction shall be sourced from rain water harvesting ponds, Feni River & Ground water.

The total water requirement for operational phase is estimated at about 7.7 MLD. Source of fresh water in the area is ground water. Water of Feni River in downstream is saline. Desalination of this water can also be taken up in later stage for sourcing the water during operation phase. Rain water harvesting also can be carried out which can supplement the water supply system.

Power Requirement

Power demand during construction phase is insignificant. Power required during operation phase is estimated to be 55.46 MVA. Power supply system will be developed at later stage by developer.

At present total capacity of Rural Electricity Board, Mirershorai is 30 MW (Substation of 20 MW at Mirershorai and 10 at Zorarganj). Out of 30 MW app. 27 MW is utilized. For initial phase of EZ power requirement will be lesser. REB, Mirershorai was approached by BEZA to identify the available power options. REB, Mirershorai suggested that capacity of Mirershorai substation can be increased by 10 MVA and same can be supplied to EZ in future but this depends on the approval from National

Electricity Board. A CPP thus is more viable option for fulfilling electricity requirement. CPP cannot be gas based due to shortage of gas availability in the area. Coal can be transported to the site from deep sea port under consideration at Sonadia near Cox Bazar. A floating jetty is required to be proposed at the site for transportation of coal to the site. Thus a coal based CPP can be an option for fulfillment of electricity requirement. Options for harnessing wind and solar energy can be explored due to its nearness to coast. Similarly fuel for the industries as well can be the coal.

Street Lighting

Street lighting will be provided on the proposed access road. Solar street lights should be proposed in ratio of 1:2. Average illumination of 20 lux should be maintained on the access road.

Telecommunications

Mirershorai has mobile connectivity from almost all mobile companies. There is no fixed network. It is recommended to install BTCL (Bangladesh Telecom Company Limited) network, as fixed Phone Network of BTCL is the only reliable network.

Sewage & Effluent Treatment

All industries should be responsible for treatment of the sewage and effluent generated from their unit so that all industries are zero discharge. Sewage should be treated in the STP and effluent should be treated in the ETP. Treated water should be recycled and re-used within the site.

Green Belt Development

Green buffer of 10 m width will be developed all around the EZ site. Multi-layered plantation will be carried out in the buffer. Peripheral green belt will be developed by the developer. In addition to this all industries will develop green belt all around their respective plots. Native plant species consuming less water and requiring less after care and monitoring should be considered. Such species include Neem, Chambol, Sirish, Palms, Gewa, Mango, Mahagony etc. Green buffer should consist of minimum 3 rows of vegetation. First row of green buffer should be small shrubs and herbs, second row of tall shrubs and small/medium height trees and last row of medium to tall heighted trees. A zone of no development (5 m on either side of Isakhali canal for section running through EZ site) along Isakhali canal will be maintained. This buffer will also be developed as green area,

Solid Waste Generation from Proposed EZ Project

Waste to be generated during construction phase will be left out construction material like metal piece, wood piece, unused concrete, broken bricks, glass, ceramic, demolition waste etc. Quantity of the solid waste to be generated during construction phase may vary from 30-50 kg/day. This waste should be collected and segregated at the site itself. Recyclable and Re-usable waste should be separated and should be sent to recycler. Rejected waste should be disposed off at the designated sites by local authority.

Nature of solid waste generated during the operation phase will be highly variable due to presence of different kind of industries in the EZ. Majorly as per the feasibility study light engineering industries, food processing industries and textile industries may come up in the EZ. These industries are less polluting industries. Solid waste generated by industries should be managed by industries. A site has been designated in layout for storage and disposal of solid waste within EZ site. Solid waste to be generated from EZ can be industrial non-hazardous waste, hazardous waste, bio-degradable, non-biodegradable, e-waste, construction debris, hospital and bio-medical waste. A secured scientific landfill should be developed for disposal of municipal solid waste within the EZ site. Hazardous waste from industries should be disposed off only through authorized hazardous waste handling agencies by DoEB. No TSDF and hazardous waste recycling units exists in Bangladesh. But as the EZ development and coming up of industries may take time of app 3-4 years so by then hazardous waste rules will be formed in Bangladesh (in draft form at present) and some facilities may come up in Bangladesh for

managing hazardous waste. Else all industries should incinerate the hazardous waste generated by them taking the required air pollution control measures.

Transportation System

Road Transportation System and Traffic Survey

Project site is accessible by access road, i.e. Abu Torab Road which is 10 km from Dhaka Chittagong Highway. Abu Torab roab road connects to the highway in East direction and BWDB & CDSP Bund in West direction. Site lies adjacent to the CDSP bund. CDSP bund is covered with sand at some places and brick bed at some places and is non-motorable. Whereas Abu Torab road is motorable but is in a dilapidated condition and presently only 4 wheel drive vehicles can access the site. For movement of heavy traffic like trucks, Lorries, it is required to strengthen the existing Abu Torab road and construction of motorable excess road on existing CDSP bund from Abu Torab junction till project site. Also Dhaka Chittagong highway is one of the busiest highways in the country. Traffic is increasing every year on this highway. Bi-directional traffic volume on the highway n 2009 was recorded to be 5632798 whereas it was 3206277 in 2006. There is huge increment in traffic on this highway. Average traffic growth rate of 21.03% is estimated as per the study carried out by BUET.

Estimated Traffic from EZ

Estimation of the traffic to be generated from EZ site at Mirershorai has been made. It is estimated approx. 96279.6 PCU will be generated from the EZ site after development.

Rail & Air Transportation System for Project Site

Nearest airport is Shah Amanat airport located in Chittagong at distance of 79 km in South direction from site. An unfinished Rampal airport is at 22 km from site in NNE direction. Nearest Railway station is Bartakia & Mirershorai Railway station which is at distance of 9.5 km & 10 kms respectively in East direction from site.

Water Transportation System

Inland water transportation system is well developed. Feni River is located at distance of 800 m from the site in west direction from the project site. Site is located at 4.0 kms from Bay of Bengal in South direction. A jetty should be developed for the transportation of men and material through sea for the EZ project. Chittagong port is deepest sea port of the country and is located at distance of 67 kms from the site (85 kms by sea route).

1.8. Cost of the Project

The total estimated cost of the proposed off-site facilities is about 8562 lakh taka that includes the construction cost of bund, administration building, access road and land development. Details of cost of each component are given in table 6 below.

Table 6: Cost of the Development of Proposed Off-site Facilities

S. No.	Description of work	Amount in Lakh Taka
1	Site development	5792
2	Access Road	1595
3	Administration Building	560
4	Boundary Wall	615
Total		**8562**

1.9. Baseline and Social Environment

The monitoring of the existing environmental conditions of the proposed project site and of its close vicinity have been collected through secondary sources with respect to physical, biological and socio-economic environment. A zone of 10 km area around the EZ site and 100 m on either side of proposed alignments of access road is considered as project influence area.

The project area lies in the South-Eastern climate zone of the country. The climate is tropical in Chittagong. Chittagong has significant rainfall most months, with a short dry season. According to Köppen and Geiger, this climate is classified as Tropical Monsoon Climate (Am). The average temperature in Chittagong is 25.7 °C. In Mirershorai area temperatures vary from 6-90C in winters and 37-410C in summers. Humidity in the Chittagong varies from 40% in day time of February month to 90% in month of July & August. Rainy season is very prominent in this region like other coastal areas of the country. June July and August are month of highest rainfall in the area. Average yearly rainfall of the area is 3215 mm. Average annual rainfall of the Mirershorai region is 2540 mm. As per BMD, windiest month is May with average wind speed of 4 m/s and least windy month is October with average wind speed of 2m/s.

Site is wetland area. As per inundation risk map, inundation depth varies from 5 m to 6 m. Area is highly prone to cyclone and has faced severe cyclones in past. Surface water system of the study area comprise of Feni River, Isakhali Canal & Bamon Sundar Canal. Flow in Feni River varies from 20.5 cu m in February to 164.3 cu m in August. Water level of the river varies from 3.47 m to 4.146 m. Water of Feni River is fresh in upstreams and saline in downstreams. Salinity in downstreams varies with season. Maximum salinity recorded in the River is 21.2 ppt. Ground water in Shallow aquifers in Mirershorai region is also saline. Fresh ground water is available at depth of 700-900 ft.

1.10. Environment and Social Impacts of the Proposed Project

Environmental impacts assessment was carried out considering present environmental setting of the project area, and nature and extent of the proposed activities. Proposed project involves development of upcoming Economic Zone at Mirershorai. Potential environmental impacts associated with each of the proposed facility are classified as: (i) impacts during design and construction phase and ii) impacts during operation phase/Post-construction phase. Sensitive environmental and social components were identified during the site visits and qualitative and quantitative techniques have been applied for direct and indirect assessment of impacts on the identified environmental and social sensitive components. Impacts are classified as being insignificant, minor, moderate and major.

Some of the important impacts associated with the proposed economic zone will be associated with land use (land acquisition), land stability (soil erosion), soil compaction and contamination, water availability, water quality of river/stream/canal, ground water contamination, waste and wastewater disposal, ambient air quality, ambient noise levels, vegetation, tree cutting (including social forestry tree), fauna (terrestrial and aquatic), drainage pattern, hydrology, climate change, socio economic, places of social/cultural importance (religious structures, community structure), construction material sourcing and occupational health and safety. Adequate mitigation measures are devised to mitigate/minimise all likely environmental impacts and the same have been presented along with the impacts.

Impacts due to Development of EZ & Off-site Facilities

Construction Phase: Development of the economic zone and the off-site facilities, i.e. access road, site filling, construction of bund, boundary wall and administration building will involve clearance of site vegetation, leveling of site by filling and cutting, civil construction activities, storage of raw

materials like fuel, sand, aggregates, cement, reinforcement etc., storage of debris, excavation of soil etc. All these activities have potential to impact the environment in one or other way. These activities can directly and indirectly impact the environment. Following environmental attributes will be impacted due to EZ & off-site development during construction. Impacts on these attributes is discussed in detail in sections below

- Impact on air quality
- Impact on water resources
- Impact on surface water quality
- Impact on hydrology & drainage
- Impact on noise environment
- Impact on Migratory Birds
- Impact on Mangroves Plantation
- Impact on flora & fauna
- Impact on Land Use, drainage & hydrology
- Impact on topography, soil quality, soil erosion & geology
- Impact on Socio-Economy
- Impact on marine & riverine Eco-system

Operation Phase: After development of economic zone, it is expected that industries will start coming up in this region and EZ may reach its full capacity in 4-5 years time. Construction and operation of the industries may have impact on the environment and society. Following environmental attributes will be impacted due to EZ & off-site development during operation phase. Impacts on these attributes is discussed in detail in sections below

- Impact on Mangroves
- Impacts on Air Quality
- Impacts on Noise Level
- Impacts on Water Quality
- Impacts on Ground Water Resources
- Impacts on Socio-economy
- Impact on Land Use
- Impact on Agriculture Resources
- Impact on Fisheries

Impact on Air Environment

Pre-construction Phase: Pre-construction phase will involve site clearance, leveling & filling activities for development of EZ, and access road. Clearance of site will involve removal of vegetation, land leveling & filling activities. These activities will lead to dust generation. But these emissions will be limited to the site only and have impact for short duration only during clearance activity. To minimize the dust generation, water should be sprinkled regularly at the site and low sulphur diesel should be used in land leveling equipments to control the SO_2 emissions.

Construction Phase: The proposed project involves construction activities like site development, civil construction, construction material handling and stocking, and construction vehicle movement will generate fugitive dust and vehicular emissions. However, these ground sourced generation will be limited to the construction site and the impact will be short duration that too during construction activities only. The likely emission from construction vehicle, machinery, and generators is likely to be insignificant as the pollutant emission activities (point and area sources) will be limited within the project boundary and the activities will be short term (only for construction period). However, this impact may further be minimized by adopting following mitigation measures.

Mitigation Measures

- Sprinkling of water at construction site and haul roads
- Covering the scaffolding (in case of administration building) to reduce the dust emission in outside environment
- Provision of face mask to workers to minimize inhalation of dust particles
- Construction vehicles and machinery should be regularly serviced and check for pollution control
- Low sulphur diesel should be used for running construction equipment and vehicles
- Adequate parking space should be provided for the construction vehicles so as to prevent idling of the vehicles and the emissions generating from them
- Vehicles carrying construction material and debris should be covered with tarpaulin cover
- Raw materials, excavated soil and other debris should be stored under covered sheds
- Green buffer should be developed all along the EZ boundary
- Plantation should be carried out along the both side of access road

Operation Phase: Development of BT access road will reduce the dust emissions that results from movement on the earthen roads. No adverse impact is anticipated on air quality during operation phase due to development of off-site infrastructure..

Post development of the economic zone & setting up of industries, there could be some impacts on the air quality of the area. Industrial development will involve generation of emissions, and increased vehicular movements. These altogether may have overall negative impact on the air quality of the site and the nearby areas. The industries proposed as per the pre-feasibility study are light engineering, food processing and textile industries.

Significant air emissions result from light-engineering industries. These are particulate matter, sulphur dioxide, metals and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide. Lead may be generated in some of the processes.

Air emissions from food processing industry will contain some volatile organic compounds but do not contain any hazardous compounds. These industries emit low process-air emissions. Most processes uses electrical power and rarely emit harmful compounds to environment. But air emissions from water treatment plant of these industries are a major concern. Mal odour from these water detoriate the air quality and disturbs the living condition in the area. No significant air emissions are generated from textile industries.

Mitigation Measures

Provision shall be made for peripheral green belt all along the EZ boundary. No development zone of 5 m width & retaining wall will be developed all along the EZ zone. Green buffer will be developed in this no development zone. Green belt shall have minimum of three rows of local variety of tree. Tree

species shall be selected such that first inside row is of smaller height, middle row of tree is of medium height and last row of tree is of higher height so that green belt formed appears like a canopy.

- Development of thick green belt (10 m) and organized greens within each industrial plot
- Power Generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission.
- Process emission if any shall be control with the installation of adequate air pollution control systems
- No red category industries should be allowed within industrial zone
- All industries should obtain clearance from DoE, Bangladesh as applicable. Air pollution control measures shall be adopted by respective industries in line with DOE permission
- Air pollution monitoring should be carried out quarterly by all industries to check the air pollution level.
- Preference of usage of clean fuel like LPG, low sulphur diesel should be explored
- Energy conservation should be adopted by adopting the alternate energy options like solar power.
- Odour should be managed at the site using odour suppressant and planting fragrant flowering trees.

Impact on Noise Environment

Pre-construction & Construction Phase:

Pre-construction phase will involve site clearance activity for development of off-site facilities, administration building and site preparation activities. Clearance of site will involve removal of vegetation and land leveling activities. Operation of different machineries and equipments for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period. The produced noise may have impact on existing acoustic environment of rural category defined in ECR, 1997. Local inhabitants may feel disturbed due to noise from line sources (traffic movement).

Mitigation Measures:

- Machinery to be used should comply with the noise standards prescribed by DoE.
- DG set shall be acoustic treated
- Workers shall be given PPE (ear plugs), if working in high noise area
- No noise generating activity shall be carried out in the night.
- No construction activities to be undertaken during night hours to prevent any disturbance to nearby residents and labours in labour camps.
- Acoustic enclosures should be provided with DG sets and machinery to control the noise levels at construction site.
- Temporary noise barriers should be provided near the high noise generating areas

Operation Phase

After construction of the road and upcoming economic zone, traffic in the area will increase which will increase the noise level of the area. Following mitigation measures should be taken to prevent noise pollution during operation phase

Mitigation Measures

- Avenue plantation should be developed along both the side of access road which will act as noise buffer
- Green buffer of 10 m should be developed all along the project boundary. Green buffer should compose of the 2-3 rows of plants of variable height and thick canopy so as to form continuous barrier. This will help in reducing the noise level significantly.

Apart from these after development of economic zone, noise will be generated from the construction of individual industries, operation within in industrial units, running DG sets in each units and traffic movement within EZ zone. Following mitigation measures are required to be taken to minimize noise pollution:

Mitigation Measures

- All industries should obtain clearance from DoEB before establishing industrial unit and should comply with all the conditions mentioned in the letter of environment clearance
- All industries should install the new machinery of modern make which complies with the noise standards prescribed by DoEB in ECA, 1995.
- Acoustic treatment and temporary noise barrier should be provided in area generating higher noise levels
- Job rotations should be practiced for workers in industry to prevent prolonged exposure to high noise level as it may lead to deafness, fatigue, head ache, nausea and drowsiness
- Honking should be prohibited within the economic zone

Impacts on Water Resources

Pre-Construction & Construction Phase:

Impacts on Ground & Surface Water Resources:

Significant quantity of water will be required for various construction activities & domestic purpose. Source of water for these activities will be Feni River, temporary constructed storm water ponds by contractor or ground water. Excess withdrawal of ground water may lead to depletion of aquifers. Shallow water aquifers in the area are saline and fresh water is available at the depth of 210-270 m (700-900 ft). Measures should be taken to minimize the water extraction by reducing water consumption and wastage. Mitigation measures are given below.

Mitigation Measures

- Best management practices for conservation of water will be required to be adopted to minimize water wastage and water loss. Best management practices to be adopted are given below:
    - Temporary storm water drains and rain water harvesting ponds should be constructed so as to store rain water for construction activities.
    - Water for curing can be saved by carrying out curing in early morning or late evening and covering structures with gunny bag so as the moisture can be restored for longer time.
    - Regular inspections at site to monitor leakages in water storage tanks
    - Creating awareness among construction workers about the importance of water conservation

- Adoption of the advance technologies and machinery which helps in minimizing water requirement for construction
- Storing the curing run-off and waste from other construction activity and using the same for sprinkling.
- Covering the water storage tanks at site to prevent evaporation losses.

Impacts on Surface Water Quality

Run-off from the construction site may carry the higher quantity of sediments and oil which may pollute the surface water and impact the aquatic life. Thus measures are required to be taken to minimize the surface water pollution

Mitigation Measures

- To avoid excavation activities during rains
- To prevent piling up of excavated soil, raw material and construction debris at site by proper management and disposal
- Minimize run-off by using sprays for curing
- Maintaining appropriate flow of water sprinklers at site
- Construction of storm water drains along with sedimentation tanks with sand bags as partition as barrier for direct flow of run off to river.
- Collection & Reusing of curing over flow, tyre wash water etc within the site
- Construction of adequate nos. of toilets and proper sanitation system to prevent open defecation along the river banks/water supply lines
- Construction of soak pits/septic tanks to dispose-off the domestic waste water generated from labour camps to prevent disposal of sewage in surface water bodies
- Proper collection, management and disposal of construction and municipal waste from site to prevent mixing of the waste in run-off and entering the water bodies
- No debris/construction material should enter the aquaculture ponds and other waterbody in the area

Impacts on Ground Water Quality

Ground water is saline in shallow aquifers of the study area. No significant impacts are anticipated on the ground water quality due to development of the off-site facilities for economic zone.

Mitigation Measures

- No sewage or waste water should be accumulated in any unlined structure
- Timely disposal of the construction/chemical/haz. waste so as to prevent leaching of any pollutant to ground

Impacts on Drainage Pattern & Hydrology

EZ site is bounded by CDSP bund in North & NE direction. Thus storm water from villages in up streams is drained only through Isakhali canal and Bamon Sundar canal. These canals will not be impacted due to development of EZ zone. However a sluice gate is proposed to be developed at Isakhali canal at point of entry of canal in EZ site from sea side. This gate will control level of water entering Isakhali canal and will be closed only during high tide and high flow times and allowing the water movement in rest of the time.

EZ site is wetland and is trisected by Isakhali canal. Site is connected with Feni River & Sea through Isakhali canal and Bamon Sundar canal. Dense drainage of Isakhali canal runs through the EZ site. Construction of EZ site will disrupt this natural drainage pattern on EZ site. However 5 m wide zone of no development and retention wall will be developed along the Isakhali canal. Canal will be retained and will not be disturbed either during construction or operation phase. One drain connecting Isakhali canal and Mangrove forest in east direction will also be retained so as the water supply to Mangrove forest is not affected. Peripheral drains will be provided around the EZ site to drain off the storm water. These drains will be connected to Isakhali canal. Wastewater streams will not be allowed to mix with Isakhali canal and other storm water drains. Thus no significant impact on drainage is anticipated due to development of the off-site development.

Aquaculture ponds exist all along the proposed access road/existing CDSP bund. Thus storm water from access road will flow into these ponds. Following mitigation measures shall be taken to prevent impact of off-site development of EZ on natural drainage pattern.

Mitigation Measures

- Natural drainage pattern should be maintained. Run-off assessment shall be made of catchment area and peripheral/garland drains shall be constructed around EZ site based on the assessment of catchment area (frequency, and storage area).
- Storm water drain shall have the provision of di-siltation before discharge to river.

Operation Phase:

Impacts on Ground & Surface Water Resources:

Expected population for administration building is 112 Nos. Water requirement of 5.04 KLD has been calculated for administration building during operation phase considering criteria of 45 LPCD for staff members. This demand can be fulfilled by withdrawing water through water supply system developed for the project.

It is estimated app. 7.7 MLD of water will be required during operation phase after development of economic zone at Mirershorai. Source of water can be either water of Feni River which can be used only after desalination and ground water which is available at greater depths (700-900 ft) and is source of water for whole village. Water supply can be supplemented with rain water as annual rainfall in the area is very high. Rain water harvesting is practiced by all villagers to fulfill their daily water demand. Rain water can be harvested by constructing rain water harvesting ponds. Following Measures should be taken to minimize the impacts on water resources

Mitigation Measures

- Feasibility shall be explored by BEZA of installing the desalination plant for the use of surface water.
- Rain water harvesting system and storage should be developed to minimize ground water construction
- Adoption of best management practices to prevent water wastage and minimize water loss
    - Usage of water conservation fixtures to minimize water consumption
    - Installation of leakage detection system to minimize the water loss
- Ground water aquifer assessment studies may be undertaken to assess the ground water potential. Piezometer shall be installed to monitor variation in ground water level in the area.

Impacts on Surface Water Quality

Industries are likely to generate domestic and industrial effluent. Liquid waste which can be generated from light engineering industries will include waste acid, waste alkali, grease, used/spent oil, liquid

metal, spent solvents etc. Wastewater is not generated in significant amount from these industries. Majorly domestic and cleaning waste is likely to be generated. No significant liquid waste is generated from textile industry.

Food processing industries similarly generate both liquid and solid waste. Concern with wastewater from the food processing industry is high BOD levels, high TSS, excessive nutrient loading like nitrogen and phosphorus compounds and pathogens. This water is to be treated essentially to achieve DoEB standards to prevent the soil, water and air quality pollution. Discharge of wastewater in soil will degrade its fertility and increase the toxicity which will make it unsuitable or growth of plants and survival of micro/macro organisms. If this water is discharge into water system, will pollute the water quality and have potential to threat the aquatic life. Uncontrolled discharge of these effleunt to river may severally pollute the river water quality.

Pollutants from these industries may be discharged into Isakhali cannal and may be carried away to Feni river estuary system which supports diverse variety of fish. Run-off may significantly increase post development of economic zone. It is required to manage storm water which will be generated from EZ site post development. Measures should also be taken to prevent contamination of storm water with any industrial pollutant. Following measures should be adopted during operation phase to minimize impacts of development of Economic zone on surface water quality:

Mitigation Measures

- Each industry should obtain consent of DoE Bangladesh before construction and operation and should comply to the conditions laid by them
- Each industry should treat the effluent and sewage generated by them so as to achieve zero discharge and no untreated effluent should be discharged into any water body
- Provision shall be made for Common Effluent Treatment Plant (CETP) if required.
- Common STP (in modules) should be constructed within the EZ to treat sewage from residential and commercial areas
- Proper management of waste should be done to prevent any contact between the waste and storm water
- Common waste disposal sites should also be developed within EZ site as per the standards and prior permission of DoE should be taken before development.
- Each industry should practice rain water harvesting to minimize the water consumption and reduce run-off from the site
- Storm water drains should be lined separate from effluent drains
- Storm water system should be inspected & cleaned before monsoon every year
- Peripheral drain shall also be lined and shall not be connected to internal storm water drainage system.
- The top soil shall be preserved and used for covering the sand layer at EZ site. Vegetation turffing shall be made at the side slops of the EZ areas to prevent erosion and siltation in the river.
- River water quality shall be monitored periodically.

Impacts on Ground Water Quality

No impact on ground water quality is anticipated during operation phase due to off-site developments. After development of economic zone there may be some ground water pollution due to industrial activities. Following measures should be taken to minimize the ground water pollution.

Mitigation Measures

- Each industry should treat the effluents and sewage and should not discharge into ground.
- No leachate, waste water and waste material should be stored in pervious unlined area/pond.
- Ground water quality shall be monitored periodically.

Impacts on Land resources

Pre-construction & Construction Phase:

Impact on Land Use

EZ site is spread over an area of 610 acres (development aea 550 acres) and access road to be developed will be 6 km long and 5 m wide. Efforts have been made to minimize the change in land use and acquisition of agriculture land by making use of Government/Khas land. EZ site is Govt. land classified as Char/Wetland. Land use of this land will be change after development of EZ. Land has now been transferred to BEZA and land documents are attached as Annexure II. Access road will be developed on existing CDSP bund. Thus no land acquisition is involved for the project. Administration building will be developed within the economic zone site. Economic zone will be developed after appointing the developer by BEZA and obtaining permission from DoEB. Some of the measures are taken to prevent any impact on change in land use

Mitigation Measures

- Tree cutting will be avoided while constructing access road and development of EZ
- If any tree cutting is undertaken then compensatory plantation should be done in minimum ratio of 1:2
- Measures will be taken that no structure along the access road should be affected due to development of EZ

Impact on Topography & Geology

Site will be filled with deep sea sand to level of 75 cm from existing level. This will impact the topography of the site by raising its existing level. Impact will be not be significant as the impact is restricted to EZ zone.

Impact on Top Soil & Soil Quality

Development of the structures and construction of the access road may disturb the soil profile of the area. Site will be filled to level of 75 cm with deep sea sand. Land will be filled and compacted after filling. Also sand will be required for construction of bund, access road and administration building which will be sources from nearby markets or Sand Mohal of Mirershorai. Sand should be purchased from authorized vendors only to minimize the illegal mining and dredging activities

Storage of raw material, fuel and construction debris may contaminate the soil thus measures should be taken to prevent the soil pollution. Mitigation measures to be adopted are mentioned below. Contractors are required to take all the proposed mitigation measures. PMC and BEZA will ensure that all the proposed mitigation measures are being incorporated in the bid document issued to the contractor and the implementation of the same during construction.

Mitigation Measures

- No piling of raw material at site
- Raw material will be stored under covered sheds and paved surface
- Fuel storage area should be paved
- Adoption of best management practices to prevent any spillage of raw materials

- Construction debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites
- Waste from labour camps can be segregated at site. Food waste/wet waste should be composted in pits within the camp site. Recyclable waste should be sold to the authorized dealers and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area.

Impact on landscape and scenic beauty

All construction activities for administration building, bund, land filling & boundary wall will be carried out within economic zone site and will not cause any impact on landscape and scenic beauty. A green buffer of 10 m (minimum three rows of trees) will be developed all around the project site which will enhance the scenic beauty of the area

Constructions activities involved in construction of access road may change the visual landscape of the project area. Site clearance activities and piled construction materials, machinery and camp establishment on green field site may impact the scenic beauty. Nevertheless, the impact is for a short duration, and reversible as the project plan includes landscape planning, green belt development as well.

Operation Phase

Impact on Soil Quality

No impact due to off-site developments is anticipated on soil quality of the project site during operation phase.

After development of economic zone, disposal of industrial domestic and process waste may contaminate land and soil quality of the area. The impact can be significant and long term in case of uncontrolled discharges. Improper disposal of waste (hazardous and non-hazardous waste) may degrade soil, water, noise, air quality and ecology of the area. As per the preliminary planning, it is planned that industries like light engineering, textile and food processing will come up in the EZ zone. These industries are not heavily polluting like tanneries, distilleries etc but generate significant waste both hazardous and non-hazardous in nature, which can pollute the environment if not managed properly. Nature of the waste which can be generated from these industries are discussed below.

Waste to be generated from the light engineering industries can be solid and liquid in nature. Solid waste will include packaging waste, metal pieces, damaged electrodes, ends of coils, wires and spools, flux cored electrodes, greased clothes/cotton, damaged rods, burnt rods, scrap flux, slag (residue from flux reaction and composed of metal and non-metal oxides), Dross (oxidized metal expelled during thermal cutting and gouging operations), metal dust, dust collected in filter ventilation systems/air pollution control devices, floor sweepings, coal ash (if coal used as fuel), solid waste recovered from treatment of wastewater like sludge etc.

Solid waste from the food processing industries includes both organic and packaging waste. Organic waste, that is, the rinds, seeds, skin, and bones from raw materials, results from processing operations. Inorganic wastes typically include excessive packaging items that are, plastic, glass, and metal. Solid waste from textiles majorly composed of resins, fabric, apparel, dye, discarded machinery and fibers. These waste required to be collected and disposed off periodically. Lub. oil/waste oil is generated from the machineries as hazardous waste. Mitigation measures are required to be adopted to prevent soil pollution of the area.

Mitigation Measures

- Provision shall be made for proper storage and disposal of industrial waste by receptive industries.
- Common waste storage areas shall be designated for industrial domestic waste.

- Waste should be segregated at source into hazardous and non hazardous waste. Further the waste should be segregated into recyclable and rejected waste. Recyclable waste should be sent to authorize vendors for recycling and rejected waste should be disposed off as per the norms specified by DoEB for the particular waste.
- Industrial waste generated should be stored on sealed surfaces and should be disposed off as per guidelines of DoE, Bangladesh.
- No chemical/hazardous raw material should be allowed to spill over the land and should be operated in covered systems
- Excessive packaging should be reduced and recyclable products such as aluminum, glass, and high-density polyethylene (HDPE) are being used where applicable.
- Organic waste should be resold to value addition industries or can be feeded to live stock.
- Advanced wastewater treatment should be adopted by industries
- Use of advanced techniques to control specific portions of the manufacturing process to reduce wastes and increase productivity.
- Use of radiation to kill pathogenic microorganisms.
- Reduction or total elimination of effluent from the manufacturing process
- At present no common hazardous waste handling and disposal unit exists in Bangladesh. Industries thus have to install the incinerators in the unit to dispose hazardous waste. The incinerator further should use the clean fuel and required air quality management measures should be adopted.
- A site for disposal of hazardous waste can be identified within the EZ and it should be developed as per the norms of DoEB and upcoming Hazardous Waste Management rules of Bangladesh.

Impact on Land Use

Land use of EZ site is wetland which will be changed to industrial land use after development of EZ site. No major change in land use is associated with the development of the EZ zone and other off-site facilities. No impact due to off-site developments is anticipated on land use of the study area during operation phase.

However, post development of economic zone significant change in land use is anticipated in the near-by area. At present there is no significant infrastructure at the EZ site and nearby areas. Majorly land use is agricultural land, wetland and Mangrove plantation area. Development of EZ will attract more infrastructural development around the project site to facilitate industrial growth changing the land use area from agriculture to industrial land use. Some of the other developments including construction of roads, housing facility, commercial areas including hotels, hospital, restraunts, schools, ancillary industries, cottage industries, etc may also occur in nearby areas. This will lead to change in land use but will lead to significant development of the area.

Impacts on Agriculture resources

Pre-construction & Construction Phase

No agriculture land is proposed to be acquired for development of proposed off-site activities as well the economic zone. Thus no significant impact on agriculture activities/resources is anticipated due to the project development.

Operation Phase

No impact on agriculture resources is anticipated from off-site infrastructure during operation phase. Some agro based or aquaculture based industries may come up in proposed economic zone. These industries will have positive impacts favouring the growth of agriculture and aqua culture.

Impacts on Fisheries

Pre-Construction & Construction Phase:

Spillage or disposal of waste or wastewater in the canals and river may significantly impact the aquatic life of the area. Thus adequate measures should be taken to prevent any impact on fisheries which are listed below. No impacts on fisheries due to off-site developments are anticipated during the pre-construction phase. No significant impacts on fisheries are anticipated during construction of the proposed off-site developments.

Mitigation Measures

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

Operation Phase:

Sluice gate will be developed on Isakhali canal to regulate flow of sea water in canal. This may impact the movement of fishes while gates are closed. Gates will be closed only during high tide and flood season thus no significant impacts are anticipated on fisheries due to development of off-site development during operation phase.

After development of economic zone, some of the aquaculture based industries may come up. This will help in boosting the aquaculture activities & fisheries development in the region.

The fisheries may get severely impacted if untreated industrial effluent or hazardous waste is discharged to river. Therefore effluent management system shall be implemented strictly. Fish kill may happen due to contamination of water due to discharge of untreated effluent. Effluent may contain toxic compmenents like heavy metals etc which leads to fish poisoning and may lead to large scale fish death. Also fishes contaminated with these pollutants if consumed may affect the consumer health (birds/biger fishes/humans).

Mitigation Measures

- Adoption of adequate wastewater and industrial effluent management technology so no untreated sewage is discharged into surface waterbody
- Industrial, municipal and hazardous waste should be managed such that no waste is dumped or disposed in surface water body

Impacts on Eco-system

Pre-construction & Construction Phase:

Impact on Terrestrial Flora & Fauna at EZ Site

There is no significant vegetation at the economic zone site. Thus no vegetation removal will be required for construction of administration building, bund and boundary wall. ***Mud crabs were observed at the site during visit along the canal area.*** Site filling may have impact on existence of these mud crabs. However a zone of 5 m will be left undeveloped along the Isakhali canal which will minimize the impact on habitat of these mud crabs.

Impact on Avifauna (Migratory Birds at EZ Site)

During FGDs it was learned that migratory birds are seen on EZ site areas especially along the canal during winter season. After development of EZ zone, migratory birds will not be able to use the EZ site. However various water bodies and large wetland area is available in surroundings which can continue to serve as habitat for these birds. Within 10 kms radius area around EZ site, app. 35 sq km area is under wetland. EZ site measures only 2.5 sq km. Thus only small fraction of the wetland area is getting impacted due to EZ development. Migratory birds will shift to these neighbouring sites without being impacted significantly. Impact on the loss of wetland and habitat for migratory birds has also been assessed on the district level.

As per District gazetteer Chittagong, total geographical area of Chittagong district is 5282.98 sq km. Out of this 1159 sq km area is wetland area, which means 21.9% area of district area is wetland which is quite a large proportion. Wetland areas provides home to various migratory birds especially during winter season. Project site comprises of 610 acres area, i.e 2.5 sq km, which is 0.2% of the total wetland area of the district. Thus large wetland area is available in the district which provides habitat to the migratory birds.

Mitigation Measures:

- Twice the nos. of trees to be cut should be planted as compensatory plantation in affected areas to minimize the impact on the eco-system.
- Tree cutting should be minimized
- No development zone of 5 m should be maintained throughout the length of the canal within EZ site
- No development zone should be planted with Mangroves and other native species

Impact on Aquatic Flora & Fauna of EZ Site

Run-off from construction site may contain sediments or contaminant which may pollute water quality of Isakhali canal which will impact the aquatic life of Isakhali canal.

Mitigation Measures:

- No solid or liquid waste shall be discharged in water bodies
- Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal in water body
- Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas.
- Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose

- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration
- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off
- Diesel, paints, cements etc should not be stored near the canal/water bodies

Impact on Mangroves Plantation in Buffer Area (Bund Construction)

Project boundary has been designed so as to bypass all the Mangroves in the adjacent areas. No Mangrove tree cutting will be undertaken for development of EZ. Mangroves are developed all along the coastline of Chittagong district and along the canals by forest department to protect the inland area. These mangroves will not be disturbed for development of the project. ***However after development of bund, there may be few mangrove planted area adjacent to the EZ site may become water deficient.*** This area may not receive the amount of water it is currently receiving due to construction of bund and development of EZ site.

Area circled in orange currently receives water from streams within the EZ site which drains into Isakhali canal. Mangroves in this area may be impacted due to reduction in amount of water reaching this area. This may lead to drying up of these trees. Following mitigation measures should be taken to prevent damage to the neighboring Mangrove area.

Mitigation Measures:

- Connectivity of minimum one drain should be retained to connect Isakhali Canal to the Mangrove Area in the East direction of the EZ site. Water level in this drain should be controlled through sluice gate. This drain will ensure entry of water in the Mangrove area which may become water deficient after development of EZ site.
- No Mangrove cutting should be undertaken without prior permission of forest department
- No wastewater, construction waste and municipal waste should be dumped within the Mangrove area or nearby areas. Sewage generated should be treated through septic tank/soak pits, wastewater from construction site should be collected & re-used within the site. Construction & other waste should be disposed off to the site identified for waste disposal

Impact on Nearby River & Marine Eco-System

Development of off-site facilities and EZ site will involve excavation, filling, storage of raw material, storage of debris, establishment of site for machinery and equipment etc. These activities may lead to contamination of rainfall run-off due to mixing with excavated material, debris, raw materials like paints, fuel, rusting of iron etc. Site being in close vicinity to river and sea, rainfall-runoff water from site will directly enter to river & sea. This may impact the quality of the river & sea water and thus supported aquatic life. Thus it is required to minimize contamination of rainfall run-off to minimize impact on water quality & aquatic life supported by the water bodies. There are no marine protected areas within 10 km radius area of EZ site. No sensitive aquatic species like dolphins are also reported in the Feni River stretch within 10 kms radius of the EZ site.

Mitigation Measures:

- No solid or liquid waste shall be discharged in river, sea and any other water body

- Septic tanks/soak pit should be provided at construction site & labour camp to treat sewage to be generated from labour camps and prevent its disposal in water body
- Toilets should be provided at construction site & labour camp to prevent contamination of water due to open defecation in nearby areas.
- Vehicle washing/equipment cleaning should not be allowed near water bodies
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose and should not be allowed to enter the water bodies
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration
- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off

Impact Due to Deep Sea Dredging

Site is intersected by various streams and small channels draining into the Isakhali Canal. These small drains are to be filled up so as to achieve a constant level of the site. It has been estimated that average filling of 0.75 m will be required for the whole development area, i.e. 550 acres for which app. 16 lakh cum of sand will be required. Being large amount of sand requirement, it is difficult to obtain the sand from dredging the river & other water bodies and excavation of land. Thus deep sea dredging has been opted to obtain this large amount of sand. Deep sea dredging can significantly impact the marine eco-system by disturbing the benthos (dwelling on sea floor) especially to sessile organisms attached to sea floor/other physical structures and the submerged vegetation. Also deep sea dredging may release large amount of sediments causing high turbidity in the surrounding waters. High turbidity will impact the visibility of marine organisms, may choke gills of fishes and other aquatic organisms and significantly impacts the oxygen level of surface layers by forming barrier between the water and the atmosphere.

Locations for deep sea dredging have not been finalized yet by BEZA. Thus site specific assessment of sensitivity and impacts cannot be taken in detail at present. Thus it is recommended to carry out detailed marine environmental study to assess the environmental sensitivity of the location decided for dredging and the sand transportation path after finalization of the locations for dredging.

Operation Phase:

Green buffer of 10 m all around the project site will include most of the native plant species, which will significantly improve the ecology of the area. This green buffer will provide habitat for the avifauna, reptiles and small mammals and will enhance ecology of the area. Twice the number of trees fell, if any should be planted.

Post development of the economic zone & setting up of industries, there could be some impacts on the ecosystem of the area. Industrial development will involve generation of emissions, effluents and increased vehicular movements. These altogether may have overall negative impact on the eco-system of the site and the nearby areas as the air pollutant will impact the existing vegetation and avifauna in the area. But the industries proposed as per the pre-feasibility study are light engineering, food processing and textile. These industries are not heavily polluting. If appropriate measures for preventing air, water, soil and noise pollution are taken there will be no significant impact on the eco-system of the area.

Mitigation Measures:

- Periodic monitoring shall be carried out as per the monitoring plan for air, water, noise and soil and ensure that no impact
- No waste shall be discharged in water bodies.
- Tree survival rate shall be monitored
- Native species should only be planted in the region
- Minimum twice the no. of tree fell (if any) should be planted

Impacts on Socio-Economy

Pre-construction & Construction Phase

Loss of Livelihood & Displacement of Families

No Resettlement and rehabilitation or land acquisition is involved for development of off-site facilities and EZ development. Thus no displacement of families is involved with the project development. EZ site is seasonally used by locals for agricultural and aquaculture purpose. Fishing activities will be restricted in Isakhali canal within EZ after development of EZ. However various canals and river exists within study area thus there will not be any significant impact on livelihood of people.

Impact on Health, Aesthetics and Hygiene

Construction activities lead to generation of dust, unpleasant view, obstruction in access of public properties due to excavation etc which may impact the society significantly. Adequate waste management plan, air, soil, noise and water pollution controls are required to be adopted to prevent any impact on society. Also various health hazards are associated with construction activity which may significantly impact the workers if not taken care.

Impact on Infrastructure & Utilities

No sensitive feature like religious structures, school, hospital etc are located along the proposed access road. No impact is anticipated on social sensitive receptors due to construction of access road. Development of EZ will increase pressure on existing facilities and utilities. Traffic on village road will increase during construction phase so it should be ensured that construction vehicle should move only during non-peak hours. Ground water should not be used for construction phase as villagers are dependent on ground water for fulfilment of daily water demand.

Impact on Demographic structure

The demographic profile of Mirershorai Upzila would not undergo any changes during the construction phase of the EZ, because the inflow of daily labourers would be mainly be from Mirershorai Upzila or from some other nearby areas. However, during the commissioning phase, a large number of inward migrations are expected. The inward migration along with the infrastructure development in Mirershorai Upzila may lead to changes in the demographic profile of Mirershorai upzila

Generation of Employment

Employment opportunities will be ensured through three channels (i) direct employment for unskilled labour, (ii) indirect employment to the local community; and (iii) employment of women workers. Direct employment includes site clearance, excavation, loading and offloading of materials and deliveries, mason and construction works. Further, the construction labour force will be requiring food and other items, which is expected to be supplied by the local eateries, retail shops and the local community. The local community members can take advantage of these opportunities. Employment generation benefits improve the quality of life of the labourers and enhance their productivity and

living standards. Employment generation, both direct and indirect, through Mirershorai EZ will have a tremendous impact on human development and poverty reduction in the Mirershorai area.

Furthermore, as an enhancement measure, it is recommended that equal employment opportunities should be given to women in the EZ, especially those who are now unemployed or are working in the service sector as daily wage workers. These recommendations should be included as a requirement in the contract to be prepared by BEZA for the construction works related to the proposed EZ. EZs further create an important avenue for young women to become part of the formal economy at better wages compared to agriculture and domestic services. Employment opportunities within the EZ will increase their employability and position in the household. In addition, Mirershorai EZ is expected to assist women in changing their occupation pattern and accessing better job opportunities and wages. But the child labour should not be encouraged in the area. Thus BEZA should make strict rules for industries and contractor for not employing child labour and there should be imposition of heavy fine, if anybody is found guilty.

Skill Enhancement of Local people

As the both skilled and un-skilled labour will be required during both construction and operation phase of the EZ, but Mirershorai and nearby area lack the skilled labour due to low literacy rate. BEZA should provide the skill enhancement training to locals to carry out specific tasks and enhance the skill of local people so that they can be given employment.

Mitigation measures are required to be taken to minimize the impact of projects on the society and they are given below:

Mitigation Measures

- Provision of proper training to all workers for handling the construction equipment
- Provision of cautionary and guiding signage in local and English language indicating the hazard associated with the site
- Employment should be provided preferable to local & affected people
- Entry to the fuel storage area and construction equipment rooms should be restricted and should be allowed for trained personnel
- Wastewater from the toilet should be disposed off in septic tanks and soak pits and should not be allowed to accumulate at labour camp site or construction site
- Dustbins should be provided at labour camps for collection of waste and waste should be regularly disposed off through the concerned agency
- Temporary storm water drainage system should also be provided at camp site so as to drain the storm water and prevent accumulation of storm water at site and thus breeding of mosquitoes/flies
- Arrangement of fire-fighting should be made at site and workers should be trained to use the system in case of fire
- Provision of personal protective equipment like safety jackets, helmets, gumboots, gloves, face mask, ear buds, goggles, safety shoes etc as per requirement and nature of job in which they are involved
- Job rotation should be carried out for workers exposed to high noise and dust areas
- Provision of First aid facility at the site and the labour camp
- Labour camps should be located at neat and clean location with no water logging issues

- Proper sanitation facility including toilets, bathing facility and washing facility should be provided at site and at labour camps for workers
- Clean drinking water supply should be provided to labour
- Crèche facility should be provided for kids if female workers are employed
- Regular inspection for hygiene and safety in labour camps should be done
- Compensation should be given to the people as per the policy for the planted tress
- Construction debris should not be allowed to enter into aquaculture ponds located along the road
- Entrance to any road/structure should not be blocked for laying pipeline and construction of access road
- A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people.

Operation Phase

Impact on Health

Post development of the economic zone & setting up of industries, there could be some impacts on the Socio-economic conditions of the area. Industrial development will involve generation of emissions, effluents, waste and increased vehicular movements. These altogether may have overall negative impact on the health of the people and aesthetics of area. But the industries proposed as per the pre-feasibility study are light engineering, food processing and textile industries.. These industries are not heavily polluting. If appropriate measures for preventing air, water, soil and noise pollution are taken there will be no significant impact on the society.

Poverty alleviation and diversification in livelihood

Vast employment opportunities potentially created by the EZ will reduce poverty via increased income through various livelihood options. By means of industrialization and related trades, diversification of livelihood will occur for all strata of people. Diverse livelihood options for the locals and better wages for the employees of the industrial zone will reduce poverty for many poor households and will contribute to reducing the poverty level in the locality. So, this will enormously benefit cross section of population and both gender.

The investments required in the commissioning of Mirershorai EZ will directly enhance the local economy of the area by increasing cash flow which in turn will increase the purchasing power of the local population. Increased cash flow will create more employment opportunities for the local communities in Mirershorai EZ

Employment opportunities are expected to increase throughout the region during the commissioning phas. This will provide employment to high unemployed population of the area.

Education for children including Girls' Education

Due to the establishment of the EZ and better economic changes in the locality, the child education rate is likely to increase leading to a reduction in children's informal or agriculture-based labour.

Women's empowerment

Women are mostly in household work category. Thus, employment opportunities for women created by the proposed EZ directly or indirectly are expected to provide them better socioeconomic status.

Through employment women will be empowered economically by being self-reliant and may become more socially aware. This could lead to their having more decision making power in their respective families and communities. This will also encourage the parents to send their children to schools and withdraw them from wage earning activities. At the same time girl's education due to parents' better economic condition and awareness will prevent early and child marriage as girls' education will automatically retain them in school and will make social awareness and pressure of not marrying them off at early age and drop out for that.

Access to civic amenities and communication

The households that will be settled adjacent to the EZ area will access better civic amenities. However, due to the EZ construction overall traffic may be congested over the years. But industrialization will ensure better livelihood and increase ability to access better civic facilities.

Social mobility

With improved employment opportunities and higher and secured income, impoverished people will be able to move up the social ladder.

Environmental Management Plan

The Environmental Management Plan (EMP) is the synthesis of all proposed mitigation and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. EMP is a plan of actions for avoidance, mitigation and management of the negative impacts of the project. Environmental enhancement is also an important component of EMP. A detailed set of mitigation measures have been compiled in view of the likely impacts associated with the proposed off-site development in Mirershorai EZ.

The EMP consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction and operation (post-construction) stages of the project. The EMP has been designed keeping in view the regulatory and other requirements to ensure the following:

- Minimum disturbance to the native flora and fauna
- Compliance with the air, water, soil and noise quality norms.
- Conservation of water to the extent possible through rain water harvesting, wastewater recycling

The detailed EMP is provided in Chapter 9.

Enhancement Plan

As enhancement plan, it is proposed that BEZA should develop a thick green belt all around the EZ site, proper storm water drainage to prevent flooding and rain water harvesting system to harvest rain water and use it to meet daily water demand and reduce pressure on ground water resources. A no development zone will be developed along the Isakhali canal. This zone will be site for migratory birds during winter season.

Contingency Plan

In order to be in a state of readiness to face adverse effects of accidents, a Contingency Plan is required to be prepared which includes on-site and off-site emergency plan by the individual industry and industrial estate. BEZA is committed to develop a Contingency Plan in consultation with district authorities and industry association. The Contingency Plan will have the following minimal components:

- Accidents preventions procedures/ measures
- Fire prevention planning and measures
- Fire water storage and foam system
- Accident/emergency response planning procedure

- Communication
- Emergency control centre
- Emergency information system with role & responsibility and command structure
- Recovery procedure
- Assessment of damages and rectification
- Evaluation of functioning of disaster management plan
- Accident investigation
- Clean-up and restoration

Compensation Plan

No families are being affected and displaced due to development of EZ & off-site facilities at present. Thus no compensation is required to be given to any person. If any, land is required to be acquired in future then it should be done as per the law of land and resettlement action plan should be developed for that. Compensation should be given to affected people as per the RAP.

Monitoring Plan

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. A monitoring schedule has been sketched based on the environmental components that may be affected during the construction and operation of the project. Table 7 presents the Environmental Monitoring Plan for the proposed project.

Table 7: Environmental Monitoring Plan

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
1.0	**Construction Phase**					
1.1	Local Manpower Absorption	Construction Works	Contractor's report No. of people working in the project	Monthly	Civil Contract Awardees	BEZA & PMC
1.2	Soil Erosion	Excavation, disposal, cut & fill and land clearing activities for site levelling and internal roads, disposal	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	During Rainy Season	Contractor	BEZA & PMC
1.3	Greenbelt Development	-	Survival rate of species planted; Density of vegetation	Half Yearly	Contractor/BEZA	BEZA & PMC
1.4	Air Quality	Transportation of construction materials, road construction, construction of utilities	Survey & observations; Levels of PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO	Once in each season for twice a week for two weeks at 3 locations		BEZA & PMC
1.5	Waste Management	Restoration of disposal sites and construction	Status of protection measures	Quarterly	Contractors	BEZA & PMC

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
		areas				
1.6	Noise Level	Noise levels compliance with respect to industrial standards	Ambient Equivalent continuous Sound Pressure Levels (L_{eq}) at day and Night time at 6 to 8 locations	Daily	Contractors	BEZA & PMC
1,7	Drinking Water	Contamination	All physio-chemical & biological parameters	Once in month	Contractor	BEZA & PMC
2.0	**Operation Phase**					
2.1	Noise Levels	Noise levels compliance with respect to industrial standards	Ambient Equivalent continuous Sound Pressure Levels (L_{eq}) at day and Night time at 6 to 8 locations	Once in every month		BEZA & PMC
			Plant periphery and near noise generation sources	Monthly	Individual Industrial Units	BEZA & PMC
2.2	Biological Environment	Horticulture/ Greenbelt Development	Survival rate of plants and shrubs	Quarterly	BEZA	BEZA & PMC
			Survival rate of plants and shrubs at individual unit	Quarterly	Individual unit	BEZA & PMC

2. Introduction

2.1. Prelude

The Bangladesh Economic Zone Act, 2010, was passed by Government of Bangladesh to make provisions for the establishment of Economic Zones (EZs) in all the potential areas with an ambit to encourage rapid economic development and to instil confidence in investors.

To meet the above objective of rapid economic development, Government of Bangladesh with support from World Bank and the Department for International Development, United Kingdom (UK-DFID) has proposed to develop EZs at various potential locations in Bangladesh as Private Sector Development Support Project (PSDSP). The PSDSP design consists of the public sector portion of investment in land, infrastructure and services for a number of pilot EZs, selected to implement new approaches to EZs in Bangladesh. EZs identified under PSDSP will be developed on Public Private Partnership (PPP basis).

Bangladesh Economic Zone Authority (BEZA) is the overall agency responsible for establishments of EZs in all the potential areas including the backward and undeveloped regions. BEZA has identified various locations for development of EZs. One of the potential sites is located at Mirershorai Upzila and has an approximate area of 610 acres (246.85 ha).

Taking into consideration the site location, available infrastructure, existing industries, investors interest and infrastructure & logistic requirement of the proposed industries, Mirershorai Economic Zone planned targeting non polluting industries primarily light engineering, textile & food processing industries. Options for other industries can also be explored by the developer at the time of development of EZ depending on the investor's interest and availability of resources. BEZA is carrying out EIA study for the proposed EZ Zone. EIA report covers in detail the environmental and social aspects of the proposed Mirershorai EZ. Developer will carry out separate EIA study for developing the EZ and separate approval will be obtained from DoE, Bangladesh, for developing the EZ, if any modification in master planning will be carried out by developer.

2.2. Project Background

BEZA shall develop the land and the following off-site infrastructure development:

- Construction of Administration building
- Access road of 6 km length and 5 m width
- Site Preparation which includes
    - Boundary wall
    - Landfilling and construction of bund for 610 acres
    - Retaining wall around Isakhali channel
    - Sluice Gate for managing flow of Isakhali Channel (Entry point of canal at site)

On-site facilities and Industrial area development will be planned by prospective PP developers on later stage.

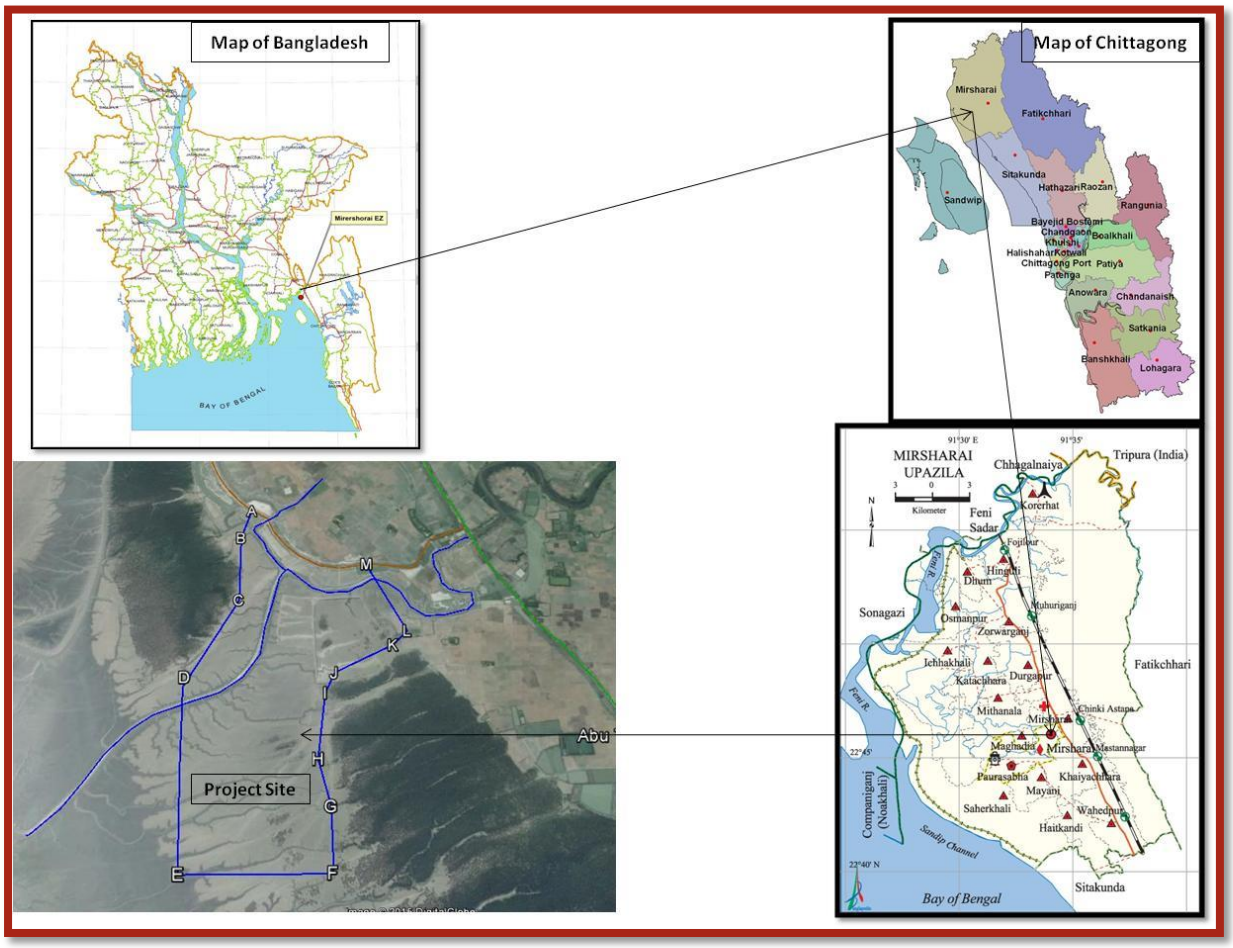
BEZA has appointed M/s Price Water Coopers Pvt. Ltd. to provide transaction advisory services for development of EZs in Bangladesh which also includes Environment Impact Assessment (EIA) study of the upcoming projects.

As per the procedure, an Initial Environment Examination (IEE) Report for development of Mirershorai EZ along with proposed Terms of Reference (ToR) was submitted to DOE on 04.05.2015.

Approved ToR was granted by DoE vide Memo No. DoE/Clearance/5341/2014/201 dated 14th May, 2015. Copy of the approved ToR by DoEB is attached as Annexure I. The EIA study for the development of proposed Mirershorai EZ has been carried out as per the ToR issued by DoEB, World Bank's requirements and Environmental Management Framework of PSDSP.

2.3. Project Description

Mirershorai EZ is proposed to be located in Mirershorai Upzila of Chittagong district, Bangladesh near Abu Torab Village. Upcoming EZ covers area of 610 acres (246.85 ha). Out of 610 developments will be carried out within 550 acres only and remaining 60 acres is covered by Isakhali canal. Project land is Government Land and land use is Char land (Wetland). The proposed Mirershorai EZ site is located at the end of the eastern side of the Bay of Bengal, surrounded by the coast and Mirershorai Town. The location map of the proposed EZ site is presented in Figure 2. Geographical coordinates of the corners and centre of the project site is given in table 8. Map showing geographical coordinates & boundary of EZ site is given in Figure 3.



Source: Google Earth

Figure 2: Location Map of Mirershorai EZ

Table 8: Coordinates of the EZ Site

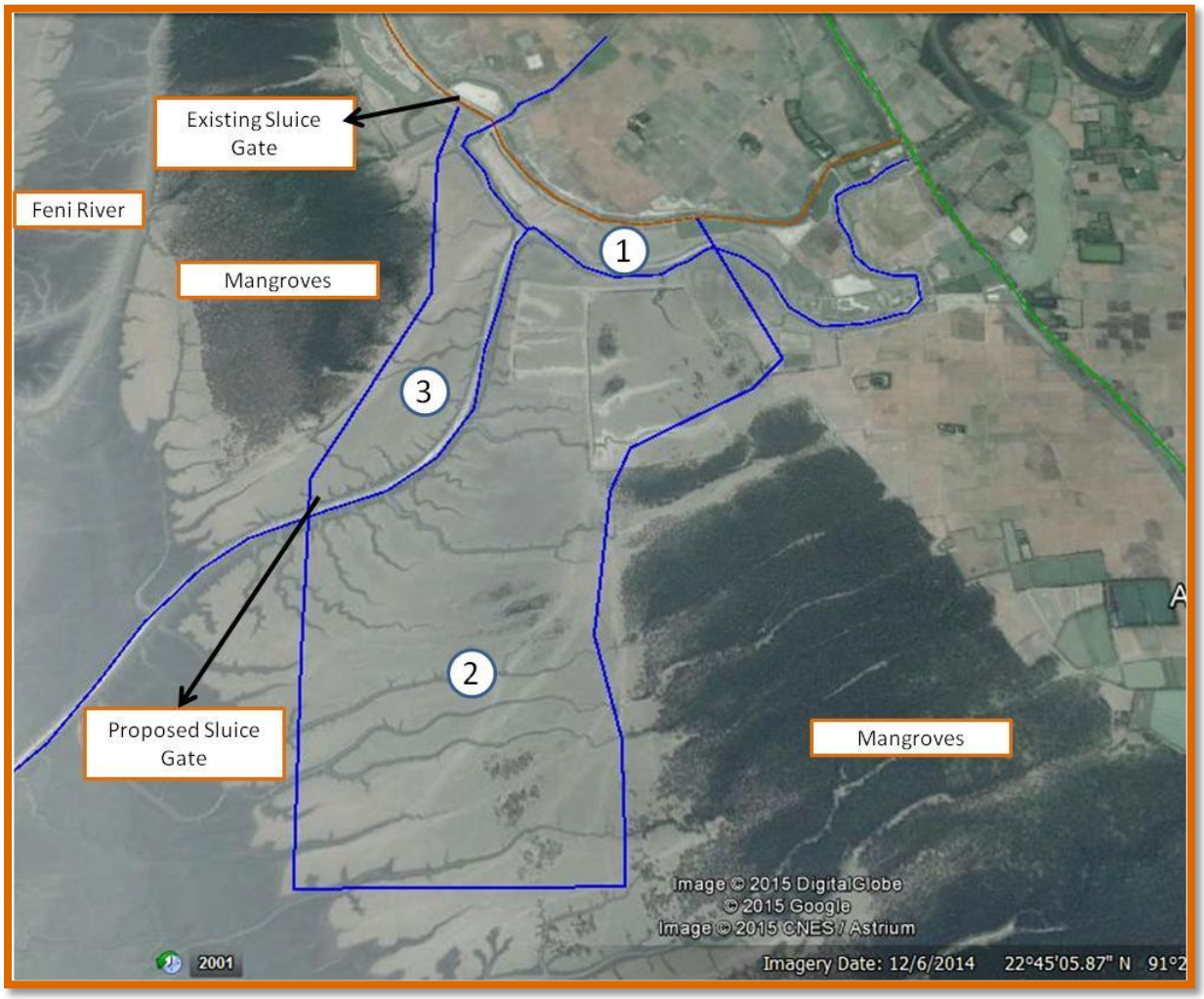
Points	Latitude	Longitude
A	22°45'58.93"N	91°27'43.15"E
B	22°45'50.14"N	91°27'41.21"E
C	22°45'31.34"N	91°27'42.80"E
D	22°45'7.78"N	91°27'31.08"E
E	22°44'26.12"N	91°27'37.43"E
F	22°44'26.34"N	91°28'9.91"E
G	22°44'40.11"N	91°28'8.81"E
H	22°44'50.59"N	91°28'5.29"E
I	22°45'6.41"N	91°28'6.07"E
J	22°45'11.49"N	91°28'8.00"E
K	22°45'18.85"N	91°28'21.90"E
L	22°45'22.73"N	91°28'25.37"E
M	22°45'42.01"N	91°28'14.77"E

Source: Google Earth

Figure 3: Map Showing

2.4. Description of Project Site

Project site is divided into three parts by Isakhali Canal. Isakhali canal enters the project site from SW direction (refer Figure 4). Water level in Isakhali canal is controlled by an existing sluice gate which is located in North direction at entry point of canal within EZ site. One more sluice gate is proposed to be constructed at entry point of Isakhali channel in SW direction of EZ site (sea side) to control flow in Isakhali channel. Feni River is located at distance of 800 m in West direction from project site and Bay of Bengal is located at distance of 4.0 km in South direction from project site. To protect the inland area, forest department has carried out Mangrove plantation along the coast boundary. Mangrove plantation is present in NW & SE direction by this mangrove forest. Mangroves plantation consists of plantation of three major species, i.e. Bain, Gewa and Kewda. Map showing these features of the project site is given in Figure 4.



Source: Google Earth

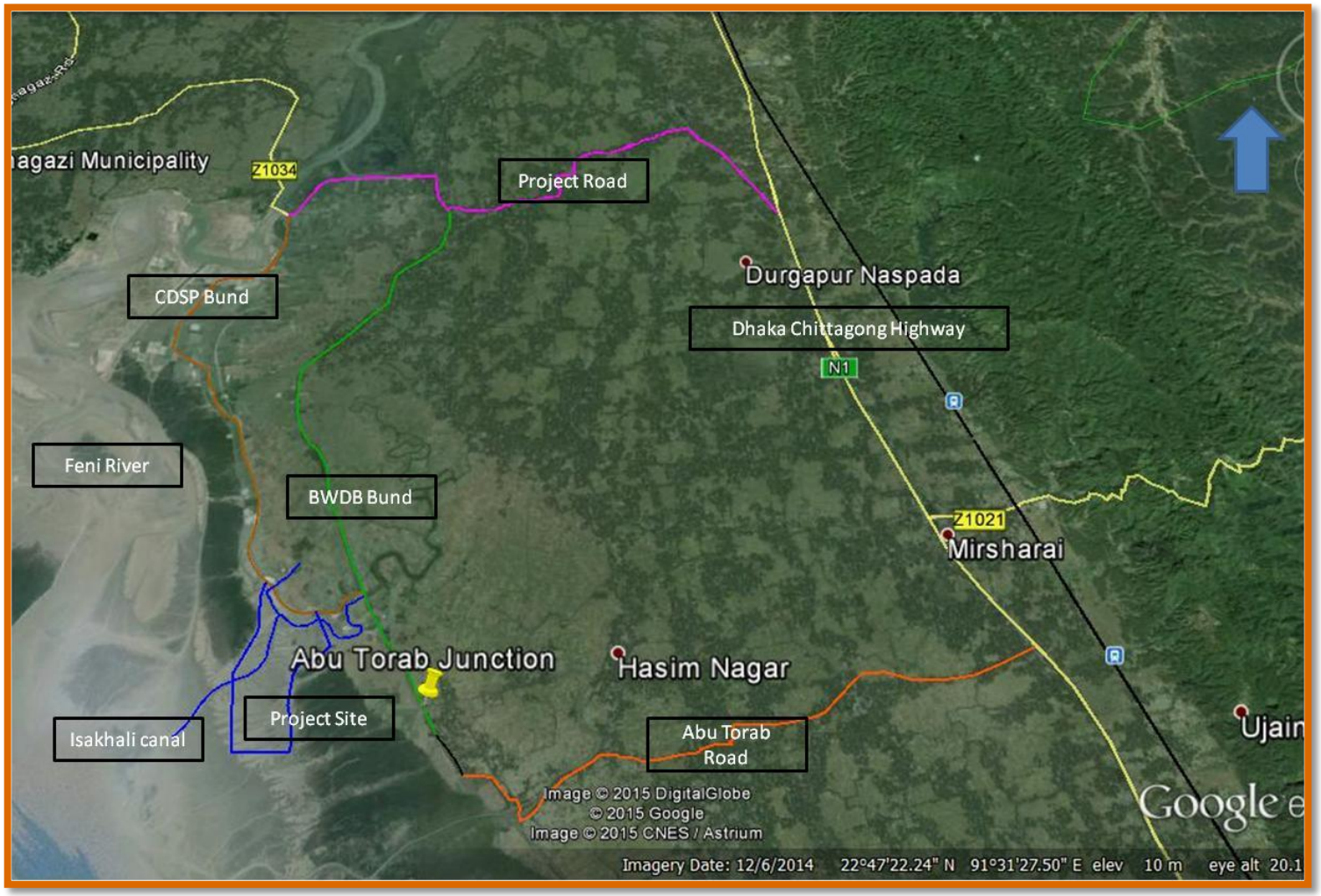
Figure 4: Map Showing Settings of project Site

Connectivity

Site is at 10 Km west of the national Highway (Dhaka-Chittagong Highway) with Chittagong City 60 Km south of this location. Bartakia Railway station and Mirershorai Railway station is at distance of 9.5 & 10.0 km respectively in East direction to the site. The Shah Amanat International Airport at

Chittagong is located south of the site at a distance of 79 Km, and, the seaport is 67 Km south of the site. Azampur Bazar, the nearest market, is only 2 Km north from the site.

Site is accessible through two roads/bunds constructed by CDSP & BWDB to protect inland area from flooding. These two bunds are connected to two roads namely; project road in North of direction and Abu Torab Beri Bandh Road in South direction of project site. These two roads further connect the Dhaka Chittagong highway. Access road of 5 m width and 6 km length will be constructed on the existing bund from Abu Torab Junction to project site to make site easily accessible. Map showing the connectivity of the project site is given below in Figure 5.



Source: Google Earth

Figure 5: Map Showing Connectivity of the EZ site

2.5. Need for the Proposed Project

Bangladesh is primarily an agricultural economy with close to 50% of the labour force employed in agriculture. Industry sector contribution to Gross Domestic Product (GDP) has hovered around 25-30% only for past few years. Manufacturing sector of Industry shows predominance of export led garments and textile industries and comprise of 52% share of total exports in Bangladesh making it the world's second largest garment manufacturer.

But it also reveals relatively low emphasis and export competitiveness of its other items. Therefore, the country needs to bolster exports of other indigenous products, which will happen through enhanced industrial infrastructure, capacity building, and policy initiatives. Similarly, the country may choose to substitute imports of capital goods and other items of domestic consumption, provided there is adequate investment in industrial infrastructure to enable domestic manufacturing.

The Government of Bangladesh has, in the past, successfully provided tailored infrastructure services and business environment conditions through EPZs. EPZs were used as a strategic instrument for attracting Foreign Direct Investment (FDI) and dealing with the shortcomings of the overall investment climate, business registration, licensing, etc. which were restricting investments in the Domestic Tariff Area (DTA).

To overcome the limitations of EPZ model, new EZ regime has been adopted by the Government of Bangladesh so as more spill-over can be harnessed by local firms from FDI , additional investments can be encouraged within value chains, more local produce can be procured and better linkages can be established between manufacturing firms and educational institutions.

The EZ development, a zoned industrialization, is required in Bangladesh to maximize the growth benefits of agglomeration and ease the increasing urban congestion. More importantly, the project will enable new sources of growth, where investor will show their interest.

Mirershorai is one of the backward areas of Chittagong district. Development of EZ in such a backward area will boost not only the industrial development in the area but also the infrastructural facilities like improved power supply, roads, drainage etc.. Employment generation for local people will enhance their living standard and quality of life. EZ development will lead to development of allied facilities and related developments in the nearby area. Also as per requirement for EZ development, location of Mirershorai is suitable. Adequate land is available for development of EZ. The land is government land and no further land acquisition is required for EZ development. Its location on the coast where draft in sea never exceeds 1 m, proximity to Chittagong-Dhaka Highway and Railway line makes it suitable location for development of EZ.

2.6. Need of Study

The proposed project comprises of development of land and off-site facilities for the upcoming Mirershorai EZ with an approximate area of 610 acres. Net development area for EZ is 550 acres. Off-site facilities will include construction of administration building at selected EZ site, access road of 6 km and 5 m width on existing CDSP bund from Abu Torab junction to project site, development of land by land filling and levelling, boundary wall, bund in seaward side, development of retaining wall along the Isakhali canal and new sluice gate at entry point of canal within the site.

The project attracts the applicability of Environment Conservation Act (ECA), 1995 & Environmental Conservation Rules, 1997. The proposed project component is classified under red category as per Environmental Conservation Rules, 1997. Thus it is required to carry out EIA study for the proposed project as per ECA, 1995 & Environmental Conservation Rules (ECR), 1997 and obtain approval of DoEB before taking up any construction activity for the project.

Project is being implemented with the financial support of World Bank. As per the World Bank Policy O.P.4.01, development of the economic zone is classified as Category A project which requires a

detailed environment assessment study prior development of zone to identify the potential threats of project to environment and to frame mitigation and environment management plan to reduce the negative impact of the project. EIA study is required to be carried out as per the ToR issued by DoE, EMF for PSDSP and World Bank Policies.

2.7. Scope and Methodology of the Study

For the purpose of environmental assessment, area within 10 km radial zone of the proposed project have been studied and classified as Study Area. Following methodology has been adopted for the EIA study:

- Collection of primary and secondary baseline information
- Analysis of project component and its activities with respect to environmental aspects
- Public consultation to identify their concern and acceptance to the project
- Analysis of Alternatives
- Impact assessment and identification of mitigation measures for elimination, or minimisation of impacts
- Assessment of institutional aspects, and development of Environmental Management and Monitoring Plan.
- Identification of sources of pollution during construction and operation phases of the project at the proposed site
- Identification of utilisation of resources obtained during construction and operation phases of the project
- Assessment of extent of pollution and resource utilisation in the proposed area
- Recommend measures to optimise resource utilisation
- Develop an environmental monitoring plan to ensure effective implementation of the environmental management plan

The board diagram for impact identification and mitigation and management is shown below in Figure 6.

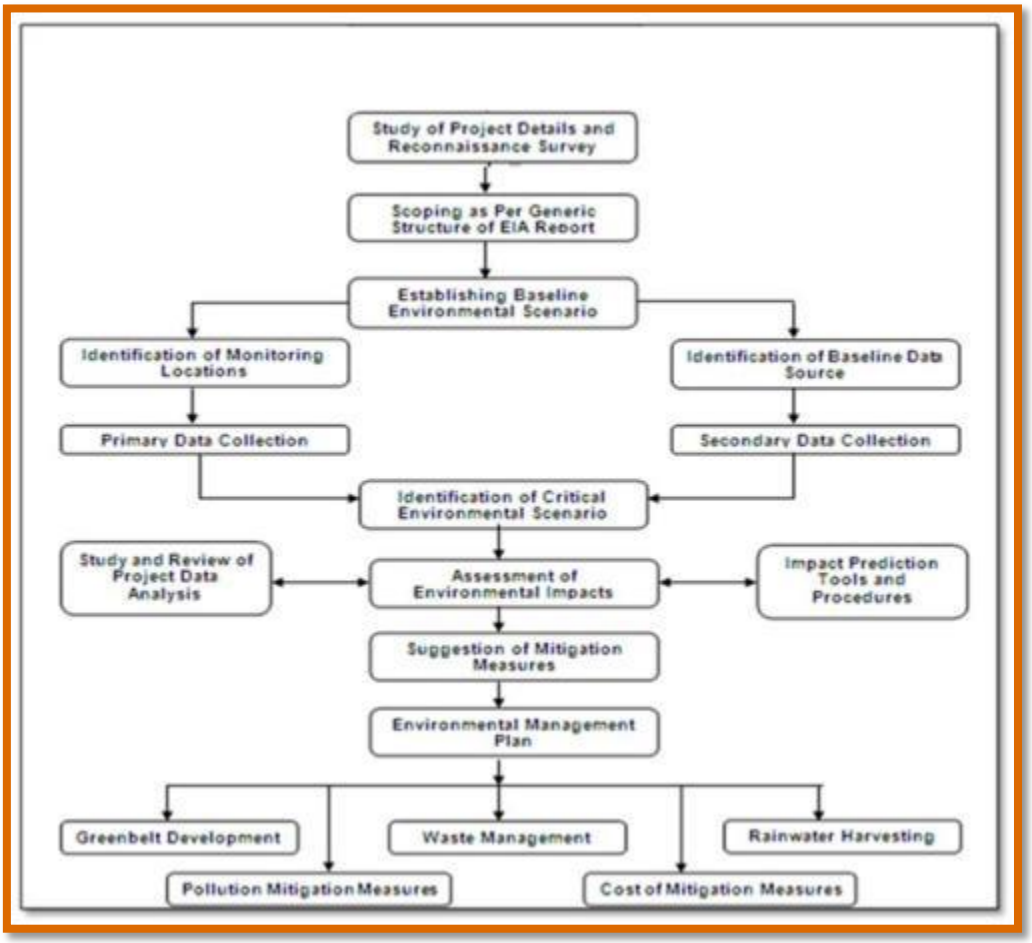


Figure 6: Methodology of EIA Study

2.8. Limitation of the Study

The present EIA Report has been prepared based on the Primary field investigations / assessment, and secondary data from data collected from Department of Public Health and Engineering (DPHE), Bangladesh Meteorological Department (BMD), Department of Environment, Bangladesh (DoEB) and published journals, and books, public consultation and site observations. The environmental and social assessment is based on the information collected from the various Agencies, community consultations and observations. Professional judgement and subjective interpretation of facts and observations has been applied for the preparation of the EIA Report.

Additionally offsite facilities, sources and alignments are not fixed till date, thus assessment is made on the basis of preliminary information available from BEZA and for all the options which could be explored. The onsite (industrial area detailed planning will be carried out by prospective private developer) information are available limited to feasibility assessment.

2.9. EIA Team

A multidisciplinary team of professionals having experience of conducting Environment & Social Impact Assessment Studies for Industrial Parks, Industrial Areas, Special Economic Zones, DTA, Economic Zones, Area development, Industrial Corridors etc was involved in carrying out EIA study for this project. Details of the professionals are given in the table 9 below and Annexure IV.

Table 9: EIA Team

Name of Professional	Area of Expertise	Position Assigned
Sanjay Kumar Jain	Environment Impact Assessment, Environmental Management Plan and Environmental & Social management framework	Team Leader & Sr. Env. & EIA Specialist
Nisha Singhal	Environment Impact Assessment & Environment Management Plan	Support Environmentalist
Ratnesh Kotiyal	Aquatic Ecology	Aquatic ecologist
Anil Kumar	Land Use Land cover & Remote Sensing	GIS & Land Use Specialist
Manoj Sharma	Soil Resources & Quality Assessment, Agricultural Resource Assessment	Soil Expert
K. Manivanan	Architecture & planning	Urban Planner

2.10. ToR Compliance Matrix

The EIA study has been conducted in accordance with the approved ToR issued by DOE (ToR letter is attached as Annexure I) and the Terms of Reference included in the EMF for the PSDSP. Table 10 presents the point-wise compliance of the issued ToR.

Table 10: Compliance of TOR Points

S. No.	ToR Point	Compliance
I	The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said project in accordance with this ToR and following additional suggestions	EIA study has been carried out in line with the ToR Approved by DoE, WB guidelines & EMF of PSDSP
II	The EIA Report should be prepared in accordance with following indicative outlines:	Agreed
1	Executive Summary	Refer Chapter 1
2	Introduction: (background, brief description, rationale of the project, scope of study, methodology, limitation, EIA team, references)	Refer Chapter 2
3	Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)	Refer Chapter 3
4	Project Description	Refer Chapter 4
i.	Introduction	Section 4.1
ii.	Project objective	Section 4.2
iii.	Project options	Section 4.2
iv.	Interventions under selected options	Section 4.3
v.	Project activities: A list of the main project activities to be undertaken during site clearing, construction as well as operation	Section 4.5
vi.	Project schedule: The phase and timing for development of the project	Section 4.6
vii.	Resources and utilities demand: Resources required to	Section 4.7

S. No.	ToR Point	Compliance
	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	
viii.	Map and survey information Location map, cadastral map showing land plots (project and adjacent area), geological map showing geological units, fault zone, and other natural features	Section 4.8
ix.	Project plan, Design, Standard, Specification, Quantification, etc.	Section 4.5
5	Environmental and Social Baseline	Refer Chapter 5
5.1	Meteorology	Section 5.4
5.1.1	Temperature	Section 5.4.1
5.1.2	Humidity	Section 5.4.2
5.1.3	Rainfall	Section 5.4.3
5.1.4	Evaporation	Section 5.4.4
5.1.5	Wind Speed	Section 5.4.5
5.1.6	Sunshine hours	Section 5.4.6
5.2	Water Resources	Section 5.5
5.2.1	Surface Water System	Section 5.5.1
5.2.2	Tropical cyclones and Tidal Flooding	Section 5.5.2
5.2.3	Salinity	Section 5.5.3
5.2.4	Drainage Congestion and Water Logging	Section 5.5.4
5.2.5	Erosion and Sedimentation	Section 5.5.5
5.2.6	River Morphology	Section 5.5.6
5.2.7	Navigation	Section 5.5.7
5.2.8	Ground Water System	Section 5.5.9
5.3	Land Resources	Section 5.6
5.3.1	Archaeological Regions	Section 5.6.1
5.3.2	Land Types	Section 5.6.3
5.3.3	Soil Texture	Section 5.6.4
5.3.4	Land Use	Section 5.6.5
5.4	Agriculture Resources	Section 5.7
5.4.1	Farming Practice	Section 5.7.1
5.4.2	Cropping Pattern and Intensity	Section 5.7.2
5.4.3	Cropped Area	Section 5.7.3
5.4.4	Crop Production	Section 5.7.4
5.4.5	Crop Damage	Section 5.7.4
5.4.6	Main Constraints of Crop Production	Section 5.7.4
5.5	Livestock and Poultry	Section 5.8
5.5.1	Feed and Fodder Shortage	Section 5.8.1
5.5.2	Livestock/Poultry Diseases	Section 5.8.2
5.6	Fisheries	Section 5.9
5.6.1	Introduction	Section 5.9.1
5.6.2	Problem and Issues	Section 5.9.5
5.6.3	Habitat Description	Section 5.9.2
5.6.4	Fish Production and Effort	Section 5.9.4
5.6.5	Fish Migration	Section 5.9.3
5.6.6	Fish Biodiversity	Section 5.9.3
5.6.7	Fisheries Management	Section 5.9.5
5.7	Ecological Resources	Section 5.10
5.7.1	Bio-ecological Zone	Section 5.10.1
5.7.2	Common Flora and Fauna	Section 5.10.2 & 5.10.3
5.7.3	Ecosystem Services and Function	Section 5.10.4
5.8	Socio Economic Condition	Section 5.11

S. No.	ToR Point	Compliance
5.8.1	Socio Economic Condition	Section 5.11.1
5.8.2	Quality of Life Indicators	Section 5.11.2
5.8.3	Income and Poverty	Section 5.11.3
5.8.4	Gender and Women	Section 5.11.5
5.8.5	Common Property Resources	Section 5.11.6
5.8.6	Conflict of Interest and Law and Order Situation	Section 5.11.7
5.8.7	Historical, Cultural and Archaeological Sites	Section 5.11.8
6	Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)	Refer Chapter 6
6.1	Environmental Sensitivity Investigation	Section 6.1
6.2	Environmental Aspect	Section 6.2
6.1	Environmental Hot Spots	Section 6.3
6.1	Likely Beneficial Impacts	Section 6.4
6.1	Community Recommendations	Section 6.5
6.1	Alternate Analysis	Section 6.6
7	Environmental and Social Impacts	Refer Chapter 7
7.1	Introduction	Section 7.1
7.2	Impact on Water Resources	Section 7.5
7.2.1	Pre-construction Phase	Section 7.5.1
7.2.2	Construction Phase	Section 7.5.1
7.2.3	Post-construction Phase	Section 7.5.2
7.3	Impact on Land Resources	Section 7.6
7.3.1	Pre-construction Phase	Section 7.6.1
7.3.2	Construction Phase	Section 7.6.1
7.3.3	Post-construction Phase	Section 7.6.2
7.4	Impact on Agriculture Resources	Section 7.7
7.4.1	Pre-construction Phase	Section 7.7.1
7.4.2	Construction Phase	Section 7.7.1
7.4.3	Post-construction Phase	Section 7.7.2
7.5	Impact on Fisheries	Section 7.8
7.5.1	Pre-construction Phase	Section 7.8.1
7.5.2	Construction Phase	Section 7.8.1
7.5.3	Post-construction Phase	Section 7.8.2
7.6	Impact on Ecosystem	Section 7.9
7.6.1	Pre-construction Phase	Section 7.9.1
7.6.2	Construction Phase	Section 7.9.1
7.6.3	Post-construction Phase	Section 7.9.2
7.7	Socio Economic Impact	Section 7.10
7.7.1	Pre-construction Phase	Section 7.10.1
7.7.2	Construction Phase	Section 7.10.1
7.7.3	Post-construction Phase	Section 7.10.2
8.	Public Consultation and Disclosure	Refer Chapter 8
8.1	Introduction	Section 8.1
8.2	Objectives of Public Consultation and Disclosure Meeting	Section 8.1
8.3	Approach and Methodology of Public Consultation and Disclosure Meeting	Section 8.2
8.4	Public Consultation Meetings (PCMs)	Section 8.4
8.5	Public Disclosure Meetings (PDMs)	Section 8.4
9.	Environmental Management Plan and Monitoring Indicators	Refer Chapter 9
9.1	Introduction	Section 9.1
9.2	Mitigation Plan	Section 9.3

S. No.	ToR Point	Compliance
9.3	Enhancement Plan	Section 9.4
9.4	Contingency Plan	Section 9.5
9.5	Compensation Plan	Section 9.6
9.6	Monitoring Plan	Section 9.7
9.7	Monitoring Indicators	Section 9.8
10	Cost Estimation for Environmental Mitigation Measures and Monitoring	Refer Chapter 10
11.	Conclusions and Recommendations	Refer Chapter 11
III	Without obtaining approval of EIA report by the Department of Environment, the Project authority shall not be allowed to conduct earth filling or any kind of physical intervention in the proposed project site and also not be able to start the physical activity of the project.	Agreed
IV	This approval of the Terms of Reference (ToR) would not mean any acceptance or site clearance of the Project.	Agreed
V	The proposed EIA study would not establish any claim, right in favour of the proponent for getting site clearance or environmental clearance.	Agreed
VI.	Without obtaining Environmental Clearance, the project authority shall not be able to start the operation of the project.	Agreed
VII.	The project authority shall submit the EIA along with the No Objection Certificate (NOC) from the 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 Chittagong District Office of DOE with a copy to the Head Office of DOE in Dhaka.	Agreed

2.11. Structure of the Report

This EIA report has been prepared strictly following the report structure desired by DOE as per TOR. The EIA report contains project features, baseline environmental conditions, assessment of environmental impacts, and formulation of mitigation measures along with environmental management and monitoring plan.

The report includes the following chapters:

Chapter 1: Executive Summary

The executive summary gives the synopsis of the EIA Report.

Chapter 2: Introduction

This chapter provides background information of the project proponent, need for the EIA study as per prevailing legislation, Location and brief description of the project, methodology adopted for EIA study and structure of the report.

Chapter 3: Legislative, regulation and policy consideration

This chapter deals with the details of the potential legal, administrative, planning and policy framework which have beed used in the preparation of the EIA Report.

Chapter 4: Project Description

This chapter deals with the details of the proposed EZ such as location, connectivity, project requirements, Infrastructure development, environmental consideration, project cost, implementation schedule, etc.

Chapter 5: Environmental and Social Baseline

This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, viz. physical, biological and socio-economic, within the 10 km radial zone, which is termed as the study area. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the information collected from the various agencies and the secondary data collected from published sources.

Chapter 6: Identification and Analysis of Key Environmental Issues

This chapter details the analysis of the key environmental issues.

Chapter 7: Environmental and Social Impacts

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

Chapter 8: Public Consultation and Disclosure Meeting

This Chapter provides an insight into the process & methodology followed for carrying out the public consultation meetings in study area and proceedings of pubic consultations

Chapter 9: Environmental Management Plan and Monitoring Indicators

This Chapter provides mitigation and control measures to attenuate and/or eliminate environmental impacts, which are likely to be caused by the proposed project. An Environmental Management Plan (EMP) has been developed to mitigate the potential adverse impacts and to strengthen the beneficial impacts. This chapter also provides the environmental monitoring plan proposed for the project.

Chapter 10: Cost Estimation for Environmental Mitigation Measures and Monitoring

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

Chapter 11: Conclusions and Recommendations

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

2.12. References

List of secondary data used for carrying out EIA study and preparation of EIA report is given at the table 11 below.

Table 11 Reference Used for EIA Study

S. No.	Reference
Government Departments	
1.	Bangladesh Economic Zone Authority
2.	Bangladesh Water Development Board
3.	Department of Environment
4.	Bangladesh Meteorological Department
5.	Bangladesh Forest Department, Forest Department Mirershorai (I & II)

6.	Bangladesh Bureau of Statistics
7.	Bangladesh Food & Agriculture Department (FAO, Bangladesh)
8.	Geological survey of Bangladesh
9.	Disaster Management Bureau (DMB)
10.	Department of Disaster Management (DDM)
11.	Department of Agriculture Extension
12.	Bangladesh Rice Research Institute
13.	Department of Fisheries
14.	Rural Electricity Board, Mirershorai
15.	Land & Revenue Department, Mirershorai
Journals, Books & Existing Studies	
1.	Alam, M.; Ahsan, H. M., Identification & Characterization of hazardous Road Locations on Dhaka Chittagong National Highway, 2013, University of Information Technology & Sciences, Bangladesh
2.	Dasgupta, S; Kamal, F.A.; Khan., Z, H; Choudhury, S., Nishat, River Salinity and Climate Change, evidence from coastal Bangladesh, The World Bank Development Research Group, Environment & Energy Team, March, 2014
3.	Akter, S; Rahman, S & Al-Amin, Chittagong University Campus: Rich in Forest Growing Stock of Valuable Timber Species in Bangladesh, journal of Forest Science, may, 2013
4.	Ullah, M. A; Hoque S & Nikraz, H, Department of Civil Engineering, Traffic Growth Rate and Composition of Dhaka Chittagong (N-1) of Bangladesh: The Actual suituation
5.	Hossain, S; Das, N. G.; Sarker, S; Rahaman, Z, National Institute of Oceanography and Fisheries (Egyptial Journal of Aquatic Research), Fish Diversity and Habitat Relationship with Environmental Variables at Meghna River Estuary, Bangladesh, December, 2012
1.	Upazila Disaster Management Plan, Upzila Mirershorai District Chittagong, by Upzila Disaster Management Committee, Miursharai, Chittagong, July, 2014
2.	Maps from Bangladesh Agriculture Research Council
3.	Community Report, Chittagong Zila, June, 2012, Population & Housing Census, 2011, Bangladesh Bureau of Statistics, Statistics & Information Division, Ministry of Planning
4.	Air Quality Management in Chittagong, Bangladesh by Air Quality Management Project, Air Quality Management Project, DoE, Govt. of People's Republic of Bangladesh, June, 2003
5.	Common Names of plants growing in Bangladesh and West Bengal (Bengali), Govt. of Bangladesh
6.	District Statistics, 2011, Chittagong, December, 2013, BBS, Statistics and Information Division, Ministry of Planning, Govt. of the people's republic of Bangladesh
7.	Fisheries Statistical Yearbook of Bangladesh, 2012-2013, department of Fisheries, Bangladesh, Ministry of Fisheries and Livestock
8.	Mahmood, N; Chowdhury, J. U; Hossain, M; Haider, S. M.; Chowdhury, S, R, Institute of Marine Sciences, University of Chittagong, Chittagong, Bangladesh
9.	Islam, R; Rahman, T; Das S; Sinan S; Lopa, F, G, R, Department of Urban and Regonal Planning Chittagong University of Engineering and Technology, Chittagong, Natural resources and Environment Planning in Chittagong District of Bangladesh
10.	Ahmed, J; Haque R; Rahman M, Laboratory of Analytical Chemistry, Department of Chemistry, University of Chittagong, Chittagong, Bangladesh, Physio-chemical Assessment of Surface and Ground Water Resources of Noakhali Region of Bangladesh, 2011
11.	Sengupta, S; Kang, A; Jacob, September, 2012, Water Wealth-A Briefing Paper on the State of Ground Water Management in Bangladesh
12.	Sarker, S, U& Sarker, N, J, Department of Zoology, University of Dhaka, 1985, Migratory Raptorial Birds of Bangladesh
13.	Islam, I, 2012, Temporal pattern of Fish Assemblage of Feni River, Feni, Bangladesh-Fish Bio-diversity of Feni River
14.	Amin, S, M, N; Ara, B; Rahman, M, A; Nahar, S; Haldar, G, C & Mazid, M, A, 2006, Catch Per Unit Effort (Cpue) and Hydrological Aspect of Major Spawning Site of Hilsa, Tenualosa Ilisha in bangladesh
15.	IEE Report, BAN: Irrigation Management Improvement Project, Muhuri Irrigation Project, Chittagong
16.	Support to Sustainable Management to the Bay of Bengal Large Marine Ecosystem (BOBLME) Project, Bangladesh Fisheries Research Institute, Mymensingh

17.	Annual Report 2010-2011, Bangladesh Agriculture Development Corporation Monitoring Division
18.	Chowdhury, A, H, September, 2012, Wind Power Prospects in Bangladesh, Department of EEE, Bangladesh University of Engineering and Technology
19.	Chowdhury, S, J, Department of Geology anb Mining, University of Raishahi, Mapping of Ground Water Recharge Potential Bangladesh
20.	Ahsan, D, A & Del Valls, T, A, Impact of Arsenic Contaminated Irrigation Water in Food Chain: An Overview From Bangladesh, Nov, 2011
21.	Stroeve, Report of Final Thesis "The Feni River Closure Dam Reviewed", August, 1993
22.	Ullah, M, A; Dr. Hoque, S; Dr. Nikraz, H, Traffic Growth Rate and Composition of Dhaka Chittagong Highway (N-1) of Bangladesh: The Actual Situation
Website	
1.	Wikipedia
2.	Google maps
3.	http://www.bangladeshtourismdirectory.com/bangladesh-archaeological-sites-list.html
4.	Google earth imageries
5.	http://www.saarc-sadkn.org/countries/bangladesh/disaster_mgt.aspx (Bangladesh Disaster Knowledge Network)
6.	http://www.livingwiththejamuna.com/essayintroduction.html
7.	http://www.fao.org/docrep/field/003/AC360E/AC360E03.htm#anxA
Others	
1.	Site visits
2.	Pre-feasibility reports & Soil Analysis report from BEZA, PWC and Mahindra

3. Legislative, Regulation and Policy Consideration

3.1. Regulatory Requirements for the Proposed Project

The Government of Bangladesh has framed various laws and regulation for protection and conservation of natural environment. These legislations with applicability to this project are summarized below in the table 12 below.

Table 12: Applicability of Key Environmental Legislation at a Glance

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
Bangladesh Environmental Conservation Act, 1995 (ECA, 1995) and Environment Conservation Rules 1997 (ECR, 1997) ECA & ECR amendment 2000 ECA & ECR amendment 2002	Mandatory requirement of prior environment clearance for certain category of project for conservation and improvement of environment and control and mitigation of pollution of the environment. Standards are described under ECR, 1997 To ascertain responsibility for compensation in case of damage to ecosystem Restriction on polluting automobiles, sale and production of environmental harmful items.	Applicable. Project classified under red category. EIA study required to be undertaken	Site approval certificate is to be obtained from DoE prior carrying out EIA study. EIA study is carried out on basis of ToR approved by DoE.
Environment Court Act, 2000 and subsequent amendments in 2002	To give high priority to environment pollution prevention	Applicable, for all projects have potential of environmental threat	All the developments to be carried it as per ECA, 1995 & ECR, 1997 and amendments. Regulatory authority is Judiciary and Ministry of Environment & Forest
Bangladesh Wildlife Preservation Act, 1974 and Revision 2008 (Draft)	No person shall damage or destroy any vegetation in any wild life sanctuary & the wild Animals shall not be hunted or captured. For preservation of Wildlife Sanctuaries, parks, reserves.	Not Applicable. Project site is not located within any wildlife sanctuary/national park or any other protected area under this act.	Development activity will not have any interface with wildlife or wild habitat at any stage. Regulatory authority is Ministry of Environment and Forest Bangladesh Wild Life Advisory Board
The Forest Act 1927,Amendment 2000 (Protected, village Forests and Social Forestry)	Declare any forests land or waste land as protected forests. May stop public or private way or watercourse in the interest of preservation of the forest	Not Applicable. No forest land diversion is involved.	No forest land will required to be diverted

Name	Key Requirement	Applicability	Remarks
	Declare a reserved forest area as Village Forests Declare an area as Social forests or launch a social forestry programme in Govt. land or private land with permission		
The Private Forests Ordinance Act, 1959	Conservation of private forests and for the afforestation on wastelands.	Not applicable	No tree cutting will be carried out
The Penal Code	Chapter XIV of the Penal Code provides offences affective public health, safety, convenience, decency and morals; Section 277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; Section 284: Negligent Conduct with Respect to Poisonous Substance; Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; Section 286: Negligent Conduct with Respect to Explosive Substance. 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. 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 Neighbourhood or passing along a public way will get punishment.	Applicable.	It is required to take all the measures proposed and suggested by DoE, Bangladesh during both construction an operation phase to minimize the environmental pollution
The Protection and Conservation of Fish Act, 1950 and The Protection and Conservation of Fish Rules, 1985	Prohibit or regulate the construction, temporary or permanent of weirs, dams, bunds, embankment and other structures	Applicable.	Necessary permission would need to be taken for road construction crossing water bodies. Regulatory authority is Ministry of Fishery
The Explosive Act, 1884	To prevent any accident due to explosive storage, use or transportation due to careless handling/management	May be Applicable depending on quantity of fuel storage	Fuel will be stored and used at site for running various construction machinery and equipment
Water Pollution Control Ordinance 1970	Prevention of water pollution	Applicable from the prospective of prevention of pollution	Applicable primarily during construction stage (e.g. sewage and equipment washing and maintenance liquid waste discharges at construction camps)

Name	Key Requirement	Applicability	Remarks
Water Supply and Sanitation Act, 1996	Management and Control of water supply and sanitation in urban areas.	Applicable for all development projects	Regulatory authority is Ministry of Local Government, Rural Development and Cooperatives
The ground Water Management Ordinance 1985	Management of Ground Water Resources. Tube well shall not be dug in nay place without permission from Upzila Parishad.	Applicable, if tube wells will be dug to develop water supply system during operation phase	Permission should be taken if ground water is used, before digging tube wells
Natural Water Bodies Protection Act 2000	The character of water bodies i.e. rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry.	Not applicable. No water body identified as water bodies in the master plans will be filled up	Regulatory authority is RAJUK/Town Development Authority/Municipalities
The Embankment and Drainage Act 1952	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water.	Not applicable as project will not interfere with any surface water body and its embankment	Regulatory authority Ministry of Water Resources and FCD
Wetland Protection Act 2000	Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects or related to alteration of natural drainage. No construction of roads if likely to effect the flow of navigable water ways without clearance from concerned authorities Upland flow in water channels to preserve eco-system Protection against degradation and resuscitation of natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes. Completely stop the filling of publicly-owned water bodies and depressions in urban areas	Applicable, Site is wetland area.	Permission to be taken from the Ministry of Water Resources and DOE

Name	Key Requirement	Applicability	Remarks
	for preservation of the natural aquifers and environment. Stop unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.		
Antiquities Act 1968	Governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and excavation of archaeological sites.	Not applicable as no structure of national cultural heritage will be affected due to project development	Regulatory authority is Ministry of cultural Affairs
The Building Construction Act 1952 (with amendments)	An Act to provide for the prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh	Applicable as the project involves development of infrastructure	Regulatory authority is Ministry of Works
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940	To regulate vehicular exhaust emissions	Applicable as heavy vehicle movement is involved both during construction and operation phase	Regular maintenance and up keeping of the vehicles should be carried out. Regulatory authority is Bangladesh Road Transport Authority
The Land Acquisition Act, 1894 The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995, 2004	To provide appropriate compensation for the land acquired	Applicable as the project requires small piece of land acquisition	Regulatory authority is Revenue Department
The Factories Act, 1965 Bangladesh Labour Law, 2006	This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions.	Applicable as the workers will be employed during construction and operation phase of EZ	Regulatory authority is Ministry of labour
Policies			
National Environment Policy, 1992	For sustainable development	Applicable for all development projects	Usage of energy efficient building material, fuel etc. should be encouraged
National Environment Management Action Plan 1995	Conservation of natural habitats, bio-diversity, energy, sustainable development and improvement of life of people	Applicable for all development projects	Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.

Name	Key Requirement	Applicability	Remarks
National Conservation Stratergy	Sustainable development of Industrial Sector	Applicable for all development projects	Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.
The National Forest Policy (1994)	conserve the existing forest areas and to increase forest cover of country and increase the reserve forest	Not Applicable, no diversion of forest land is involved	Not applicable
The National Energy Policy, 1995	Protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology.	Not Applicable. EIA study is to be carried out	Energy efficient materials and techniques should be explored
The National Water Policy, 2000	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	Applicable. Ground water is required to be withdrawn for fulfilling water requirement during operation phase	Conjunctive use of water should be explored
The National Water Management Plan, 2001	Addresses options for water quality, considerations behind measures to clean up industrial pollution, where effluent discharge monitoring and zoning regulations for new industries are emphasized	Applicable as it is industrial project and will involve generation of effluent and sewage	Installation of effluent treatment facility within the premises
World Bank's Safeguards			
OP 4.01 Environmental Assessment	Ensures sustainability and environmental feasibility of the project. Projects are classified into A, B & C category depending on the nature and extent of the impact.	Triggers	EZ development is classified as Category A as per this policy which requires detailed EIA study. Off-ste development is classified as Category B considering nature of activities and impacts and requires site-specific EIA study
OP 4.04 Natural habitats	Ensures conservation of natural habitats and discourages disturbance of nay natural habitat due to project development by recommending adoption of alternative method/route/approach or adopting management measures	Triggered	Applicable for projects lying in close vicinity to eco-sensitive zones like wildlife sanctuary, wetlands under Ramsar convention, mangroves, national parks bird sanctuary, turtle breeding grounds etc. No such natural habitat is located in close vicinity of the projects.
OP 4.36 Forests	Ensures that project activities does not disturbs/interfere with the forest, forest dwellers activities, fauna and flora of the forest. Prevents and discourages deforestation and impacts on	Not Triggered	No diversion of forest land is involved

Name	Key Requirement	Applicability	Remarks
	rights of forest dependant people.		
OP 4.12 Involuntary Resettlement	Ensures minimal involuntary resettlement by considering feasible alternatives project design, assisting displaced people to improve their former living standard.	Not Triggers	No R & R is involved in the project as EZ site is Government land
OP 4.10 Indigenous people	Ensures protection of the dignity, right and cultural uniqueness of indigenous people and ensures they receive social and economic benefits	Not Triggers	No indigenous group of people will be affected
OP 4.11 Physical Cultural Resources	Ensures preservation of property of cultural and religious importance, heritage and property of natural importance and enhancement of cultural properties	Not Triggers	No property of cultural and religious importance, heritage and property of natural importance will be impacted
Private Sector Development Support Project			
Environment Management Framework	Describes all the mandatory environmental and social clearances and purpose of the same required to be taken before development of the project	Triggers	EIA report is prepared referring to the guidelines mentioned in EMF
Social Management framework	Enhances positive social development outcomes of PSDSP with economic activities undertaken in the EZ, mitigating adverse social impacts, ensures participation of stakeholders and compliance to GoB policies	Triggers	EIA report is prepared referring to the guidelines mentioned in SMF

3.2. Procedure for Obtaining Environmental Clearance from DoE, Bangladesh

Bangladesh has very simple administrative framework regarding environmental aspect. It has strong interface between local government and federal Government. Department of Environment is responsible for grant of environmental clearance to a project. In addition to three are other ministries to deal with specific area of importance to the country like Forests, Water.

According to the Section 12 of the Environment Conservation Act 1995 no project will be established or undertaken without obtaining permission, 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. According to the Rule 7 (1) of the Environment Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every projects, in consideration of their site and impact on the environment and will be classified into the four categories, i.e. green, orange A, orange B and red. Development of economic zone will fall under red category. Thus EIA study is required to be carried out for the project. The present EIA study has been conducted for the proposed project complying with the ToR issued vide Memo No.

DoE/Clearance/5341/2014/201 dated 14th May, 2015, EMF of PSDS project and applicable World Bank guidelines. Focused group stakeholder consultation has also been conducted to discuss the environmental issues associated with the project. Proceedings of stakeholder consultation have also been included in the report. A schematic representation of the various steps involved in obtaining the Environment Clearance certificate from DoEB for red category projects is given in Figure 7 below.

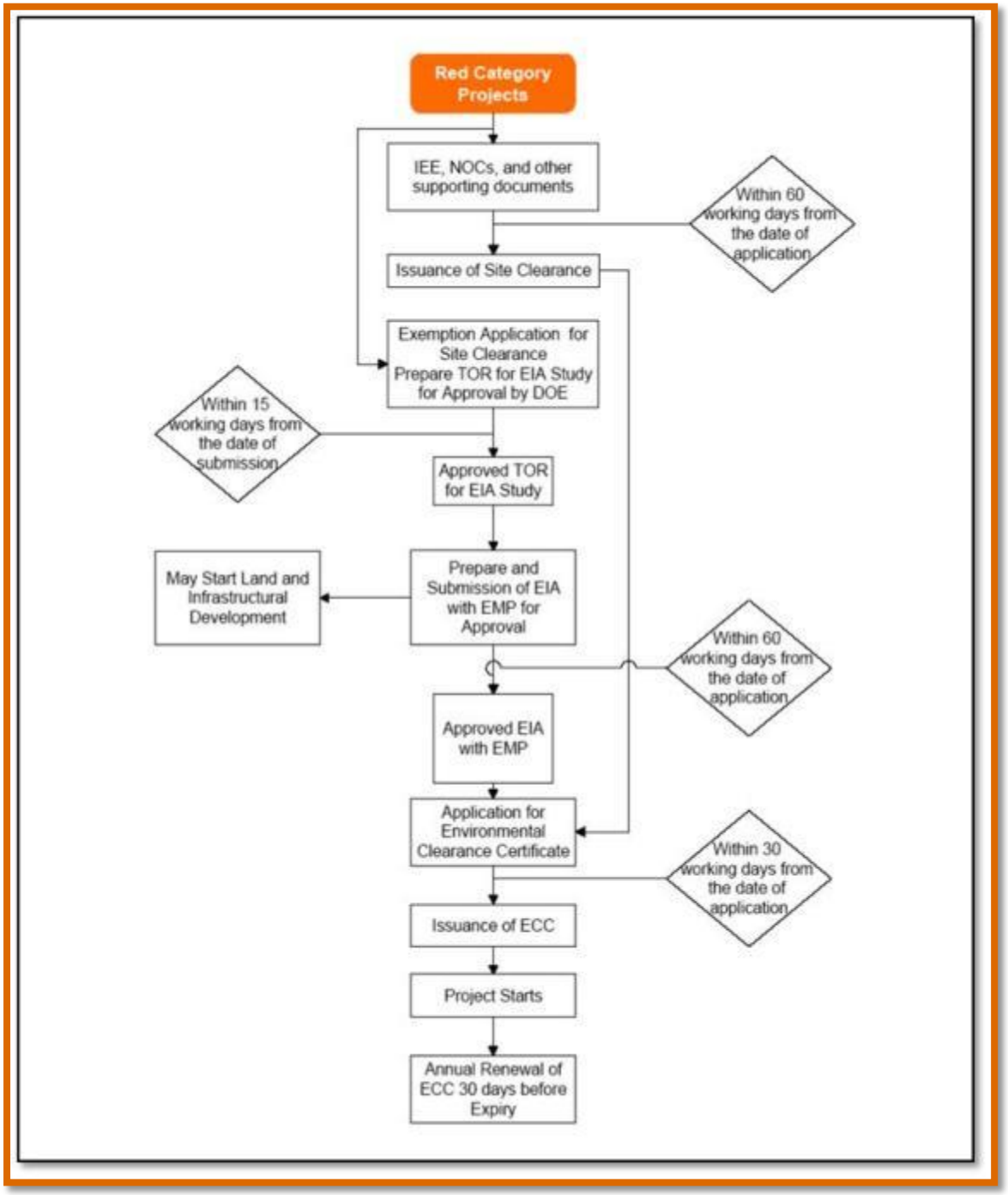


Figure 7: Steps for Obtaining Environment Clearance from DoEB

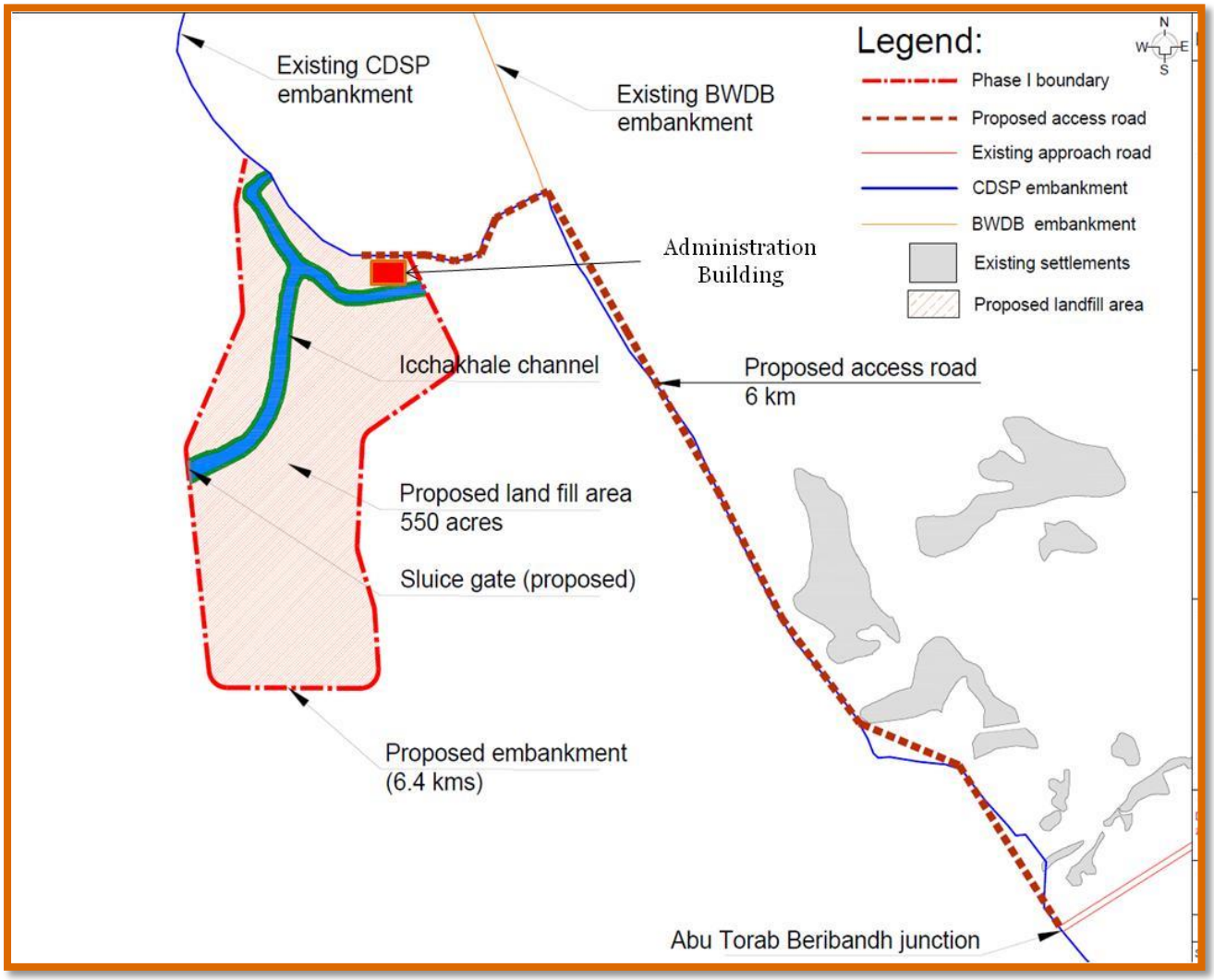
4. Project Description

4.1. Introduction

The proposed project involves development of EZ and associated off-site facilities for the upcoming Mirershorai EZ. At present off-site facilities will be constructed for the project site. EZ will be developed at later stage by the developer. The off-site development will include the following:

- Construction of Administration building
- Access road of 6 km length and 5 m width
- Site Preparation which includes
    - Boundary wall
    - Landfilling and construction of bund for 610 acres
    - Retaining wall around Isakhali channel
    - Sluice Gate for managing flow of Isakhali Channel (Entry point of canal at site)

Map showing location of EZ site and off-site facilities is given in Figure 8 below



Source: Mahindra

Figure 8: Map Showing Location of Site and Off-site facilities

The total area of the upcoming Mirershorai EZ is about 610 acres (246.85 ha) out of which the development area is 550 acres (222.58 ha) and rest 60 acre is under Isakhali channel. EZ can have following components as per EZ Act, 2010:

- Economic Processing Zone (EPZ), (It is proposed to have textile, light engineering & food processing industries. This area will be developed by prospective developer and with the aim targeting non-polluting industries.)
- Domestic processing area,
- Commercial area and
- Non processing area. The off-site components (administrative buildings) will be part of non-processing areas.

EZ development will be carried out by the developer at later stage. As per the preliminary planning, industries like textile, food processing & light engineering will come up within EZ. A separate detailed environment impact assessment study will be carried out by developer before development of EZ.

4.2. Project Objective and Options

The project is aimed to develop economic zone of international standards with the support of the World Bank. The EIA study is also being undertaken with the intent of integrating best environmental management practices in the project design.

BEZA, the overall agency responsible for establishment of EZs in all the potential areas of Bangladesh including the backward and undeveloped regions, has identified four potential sites, i.e. Anwara, Mirershorai, Sherpur and Mongla, for development of EZs. These areas has been identified considering factors such as land use, land ownership, accessibility & connectivity, linkage to economically important towns/cities, infrastructure availability and engineering, environmental and social feasibility of the site.

The proposed project site (610 acres) identified for the upcoming Mirershorai EZ is a continuous section of land but is dissected by Isakhali channel into three parts. All the three portions will be connected in later stage through bridges. This proposed land site is Government land and registered land use is Char land (Wetland). The proposed land site does not lie within any city Corporation, Municipality and Cantonment Board Area as per requirement of sub-section 3 of section 5 of Economic Zone Act, 2010.

A site suitability analysis was carried out for the development of EZ for assessing environment and social feasibility of the proposed project. As per the analysis, both limitations and benefits are associated with the land for developing EZ at the proposed site location. However, identified weakness and threats can be overcome by adopting alternative technologies and preventive measures.

Identified strength and weakness of the site as carried out by BEZA are given in the table 13 below.

Table 1310: Strength and Weakness of Site (as per BEZA)

Parameters	Strength	Weakness
Location, Contiguity & surroundings	• Land area measuring 550 acres is available which is sufficient for development of EZ • Does not lies within any city Corporation, Municipality and Cantonment Board Area as per requirement of sub-section 3 of section 5 of Economic Zone Act, 2010 • Location within coastal area,	• Region prone to flooding due to presence of Feni river • Threats of cyclones associated due to the close proximity to Bay of Bengal (4 km from site) • Requirement of high dikes and strong storm water management system • Due to water logging, deep piling will be required which is a cost intensive

Parameters	Strength	Weakness
	proximity Dhaka Chittagong Highway and the railway line • Close proximity to Feni River & Isakhali channel & Bamon Sundar channel so well-developed inland water transport • Agro based and marine culture industry can flourish well in this area as most of people are engaged in agriculture and aquaculture activities • Availability of the waterfront for industrial operations • Site is currently protected by earthen embankment in East direction, forest in North and SE direction. Bund proposed to be constructed in West direction, will protect the site from sea	
Accessibility	• Site is well connected through roads (Project road & Abu Torab Roads) • Chittagong port is app. 67 km from the site • Dhaka Chittagong highway is at 10 km distance from the site • Shah Amanat International Airport is at distance of 79 km • Bartakia Railway station is at distance of 9.5 km • Proposed access road will improve the connectivity of the area • Well-developed inland water transport	• Site is accessible only through the narrow bund roads (unpaved) which is not motorable presently
Proximity to urban hubs & industrial areas	• Site is located along the strategic Dhaka-Chittagong industrial corridor and at the end of the eastern side of the Bay of Bengal.	• Competition from existing Dhaka and Chittagong industrial area
Available Infrastructure Facility	• Availability of Government land • Land is flat and can be filled using sea sand • Nearness to highway • Easy transportation of goods due to nearness to sea and Feni River • No utility displacement like HT/LT line, religious structure, school etc is associated with the site • Setting up of all infrastructure facilities will induce setting up of new townships and other developments • Creation of flood protection infrastructure and EZ will protect the whole inland area of Mirershorai EZ.	• Existing drainage pattern may be affected as the site gets fully inundated during monsoon although peripheral drains will be developed all around the EZ site to collect & drain the storm water from site • If land filled with sea sand, then time requirement for compaction will be high • Tidal effect of the canals at site may hamper the drainage system • Busy Dhaka-Chittagong Highway will increase time to bring construction materials to the site and hence increase the construction time. • Absence of urban living and recreational facilities in nearby areas.
Availability of Raw Material	• Strong production of cash crops such as jute, cotton, rice, etc.	• Rivers are saline and ground water is available at deeper levels say at 700-

Parameters	Strength	Weakness
	• Fishing is a major activity in the region, hence availability of raw material • Large nos. of unskilled and semi-skilled labour available	900 ft. Locals highly dependant on ground water for domestic purpose and irrigation. Thus no firm source of water in the area • No source of gas & insufficient power supply • Shortage of skilled labour • Raw material can be supplied at present only from Dhaka or through Chittagong port • Unavailability of fresh water as the fresh water in Feni river is used up in Muhuri irrigation scheme
Eco-sensitivity and threat to bio-diversity	• No significant flora and fauna at site • No eco-sensitivity associated with the site	• Area near the canal is full of the mud crabs, habitat of cranes will be affected after development of EZ • Migratory birds are seen at site during Winters (December-January) • Mangroves located close to the site may be affected due to development of EZ zone
Quality of life & Employment generation	• Creation of large nos. of direct and indirect jobs for skilled, semi-skilled and un-skilled labour • Enhanced infrastructure facilities • No land acquisition required and no displacement of families associated • Developments in nearby area after development of EZ	• Unavailability of adequate skilled labour • Seasonal aqua culture and agriculture practice at site

4.3. Interventions under selected options and Project Activities

Mirershorai site has been selected for development of economic zone. Scope of the proposed project is to develop off-site facilities for upcoming EZ zone. These EZ facilities will be developed by BEZA. The EZ area will be developed by prospective developer who will also undertake detailed planning for the same. Proposed off-site facilities will help in improving the infrastructure of the area and will attract developers. Proposed interventions at the selected site are given below:

- Construction of Administration building
- Access road of 6 km length and 5 m width
- Site Preparation which includes
    - Boundary wall
    - Landfilling and construction of bund for 610 acres
    - Retaining wall around Isakhali channel
    - Sluice Gate for managing flow of Isakhali Channel (Entry point of canal at site)

Total area of selected site is 610 acres out of which development area is 550 acres. Isakhali runs through project site dividing it into three parts. Isakhali canal covers area of 60 acres. A green buffer of 10 m all around the EZ site and buffer of 5 m on either side of the Isakhali canal will be developed to protect the surrounding Mangrove plantation and Isakhali canal from direct exposure to industrial units.

4.4. Existing Infrastructure in and around the Project Site

The site has no infrastructure development at present and requires development of access roads and drainage. The project land is low and flat and gets inundated during monsoon season especially. Isakhali canal runs through the site and divides the project site is divided into three parts by. Isakhali canal covers area of 60 acres. There is presence of intensive drainage network at the site. Water level in isakhali channel rises during high tides and during monsoon. Fishing is practiced in Isakhali channel during high water season.

Site is required to be filled to level of minimum 75 cm for achieving uniform level and sand required for filling will be 16,69,316 cum. Sand for filling the site will be procured from sea. Site is bounded in east direction by CDSP bund (land ward side) and by Mangroves in North & SE direction. One more bund is proposed to protect the site from sea. No development zone of 5 m on either side will be developed all along the canal within the project site. The proposed project site is surrounded by a mix of wetland, and agricultural & aquaculture land. Surroundings details of project site are given in table 14 below. Photographs of the proposed EZ site and proposed off-site facility locations are given in Figure 9 below. Map showing EZ sites and existing facilities at site is given in Figure 10 below

Table 14: Existing Features surrounding the project site

Direction	Features
North	Bamon Sundar Forest, agriculture and aqua culture land
East	Agriculture and aqua culture land
SE	Bamon Sundar Forest
South	Wetland
West	Wetland

Access Road to Site/CDSP Bund


View of Bamon Sundar Forest

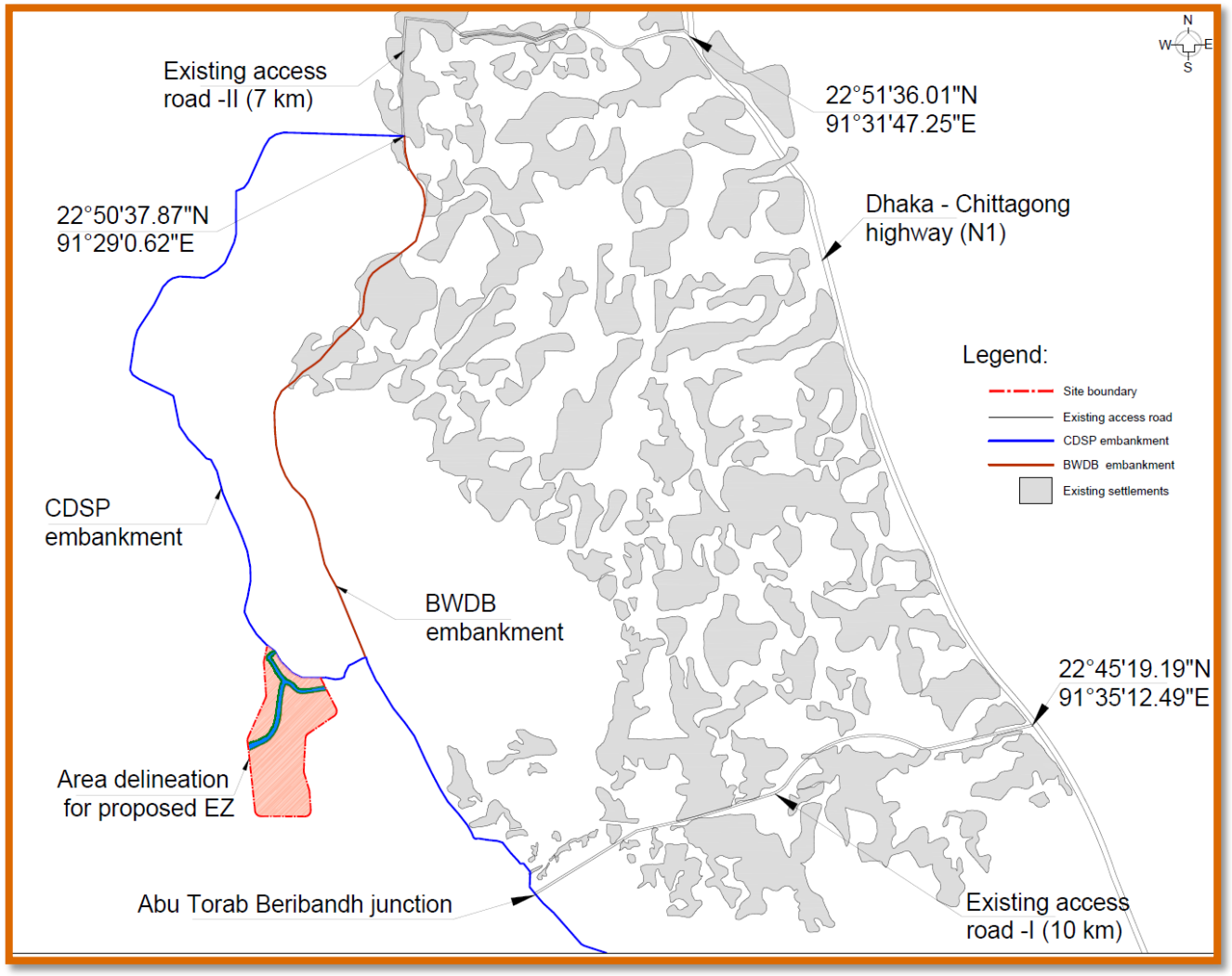

Existing Sluice Gate at Site


Bamon Sundar canal


Isakhali Canal Within the EZ Site

Mirershorai EZ Site

Figure 9: Photographs of the project site



Source: Mahindra

Figure 10: Map showing location of site and existing facilities

4.5. Project Activities and Area Statement

Total area of the proposed EZ is approximately 610 acres (246.85 ha). At present only off-site developments will be carried out by BEZA. Details of off-site facilities are given in table 15 below

Table 15: Details of Off-site facilities

S. No.	Proposed Infrastructure	Details
1	Administration building	Administration building will be constructed within EZ site. Building will have ground coverage of 3600 sq. m and built up area of 1680 sq. m. It will consist of 3 floors (G+2). Site plan of the administration building is given in figure 11.
2	Access Road	Access road of 6 km length and 5 m width will be constructed from Abu Torab junction to the project site as shown in Figure 10 above. Access road will be constructed over the existing CDSP bund. CDSP bund at some portion is kaccha land and in some portion covered with brick bed. Same bund will be strengthened and black top will be laid over it. TCS of Access road is given in Figure 12
3	Boundary Wall	A compound wall all along the EZ boundary to a height of 2.1 m above NGL is proposed to be constructed and provided with 0.9 m height barbed wire fencing on top. The total length of the compound wall is estimated to be 6500 m. Area covered by boundary wall will be 650 sq. m. Section and elevation of boundary wall are given in figure 13 & 14 below
4	Landfilling & Construction of Bund	Site is flat land with various drainage channels in it. Site will be leveled and filled to height of 0.75 m. Sand of 16,69,316 cum will be required for filling the land. Sand for filling will be sourced from deep sea. A bund will be constructed all along the EZ boundary except in North direction to protect the site from the water ingress from Sea during high tide and monsoon. North direction is already protected by existing CDSP bund. Height of the proposed bund will be +8m amsl. Total length of the bund will be 6.5 kms. Cross section of bund is shown in figure 15. Sand requirement for bund construction will be fulfilled from Feni river or from the Sand Mohal where sand is accumulated by various dredgers.
5	Retaining Wall	Retaining wall will be constructed along the Isakhali channel. Structural details of the retaining wall of the bund protection around the Isakhali channel are provided in figure 16 & 17
6	Sluice Gate	Sluice gate will be constructed at Entry point of canal within EZ from sea side to control the flow of water from Isakhali canal within EZ site.

Planning for EZ Development

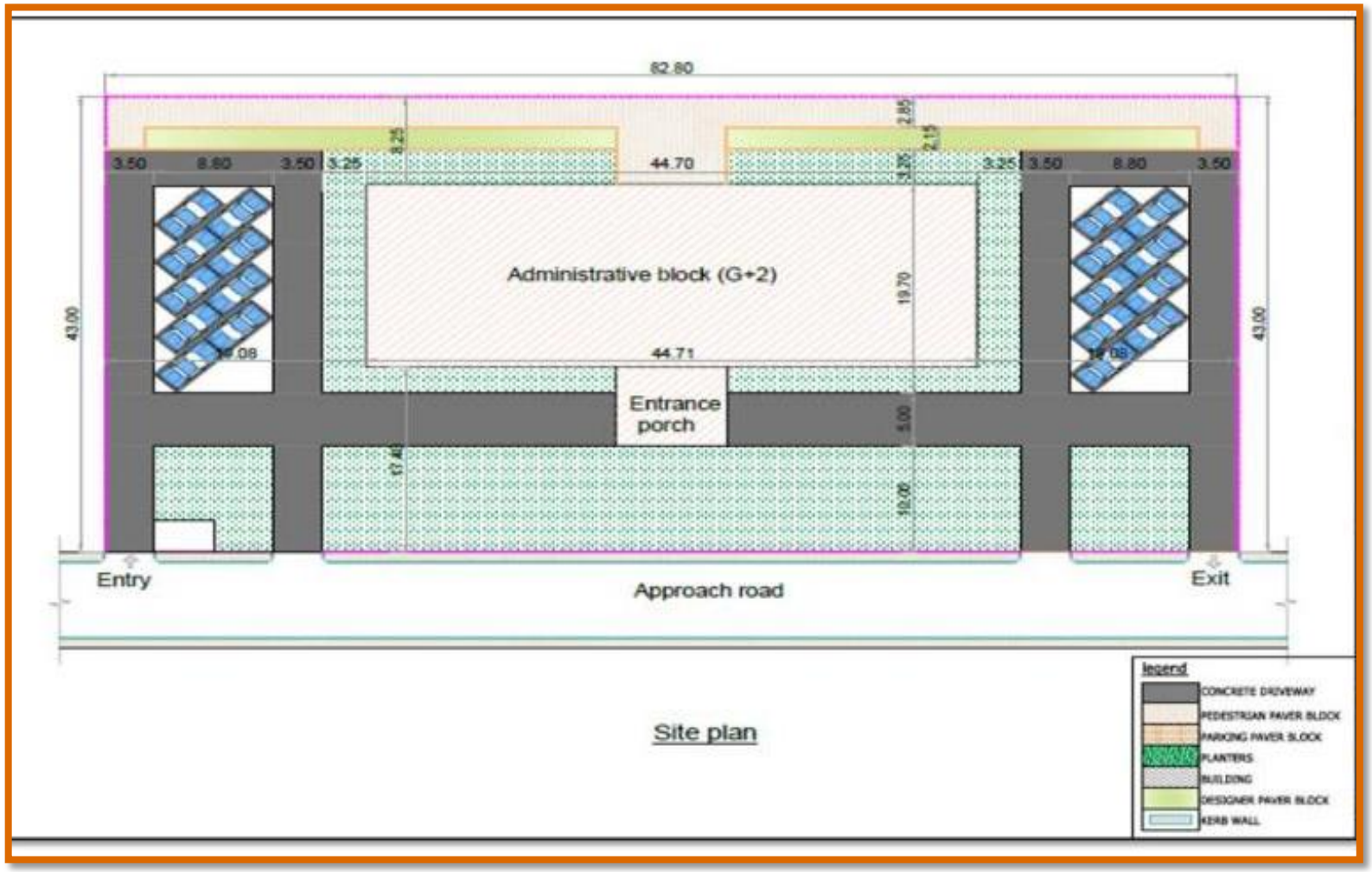
Preliminary planning has been made for the economic zone on the basis of market and pre-feasibility study. As per the current planning, land use pattern of the EZ site is given in table below. Light engineering, food processing and textile industry are planned to be proposed within EZ. No dyeing industry will be allowed within EZ site. However, provision of CETP is kept within Area of 1.5 ha is reserved for development of CETP. EZ will be developed by the developer on the basis of the planning carried out by BEZA, however option for other industries can be explored by developer, depending on the interest of investors.

BEZA is carrying out EIA study for proposed EZ zone covering all possible environment & social impacts of proposed EZ. Developer will carry out separate EIA study, in case any major revision in planning will be carried out by developer.

All onsite developments like internal storm water drainage, power distribution, water distribution network, plotting, water treatment plant etc. will be carried out by developer. Preliminary land use planning for EZ zone is given below in table 16 below. Layout map for EZ as per preliminary planning is given in figure 18.

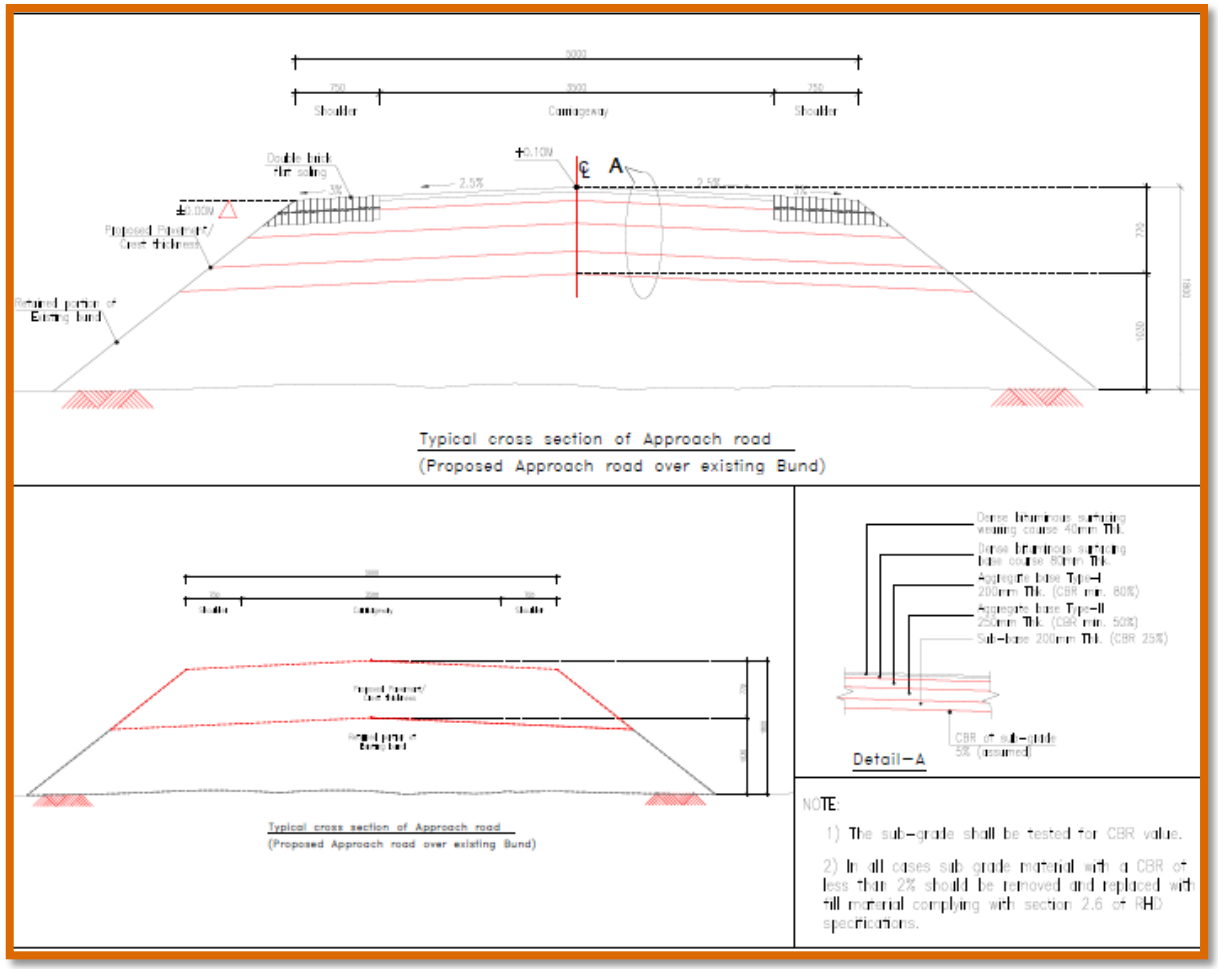
Table 11: Preliminary Land Use Planning for the Economic Zone

Land Use Pattern	In Hectare	In%
Processing Area		
Industrial Sector		
Food Processing	40.88	16.39%
Textile	39.70	15.91%
Light Engineering	44.49	17.84%
Total Industrial Area	**125.07**	**50.14%**
Specialized Infrastructure		
Warehouse	4.31	1.73%
Truck lay bay	1.36	0.55%
Q.A & Q.C lab	1.98	0.79%
R&D facility	1.00	0.40%
Training centre	3.04	1.22%
Total Specialized Infrastructure	**11.69**	**4.68%**
Public amenities	5.16	2.07%
Utility	8.08	3.24%
Road	14.52	5.82%
Green & open space	31.44	12.60%
Total processing area	**195.97**	**78.55%**
Non-Processing Area		
Admin block	3.82	1.53%
Guest house	2.51	1.01%
Investor club	4.95	1.98%
Residential	6.38	2.56%
Retail	1.50	0.60%
Place of worship	1.71	0.69%
Road	3.28	1.31%
Green & open space	2.86	1.15%
Total non-processing area	**27.01**	**10.83%**
Isakhali channel	18.19	7.29%
Buffer for water channel	8.30	3.33%
Grand Total	**249.47**	**100.00%**



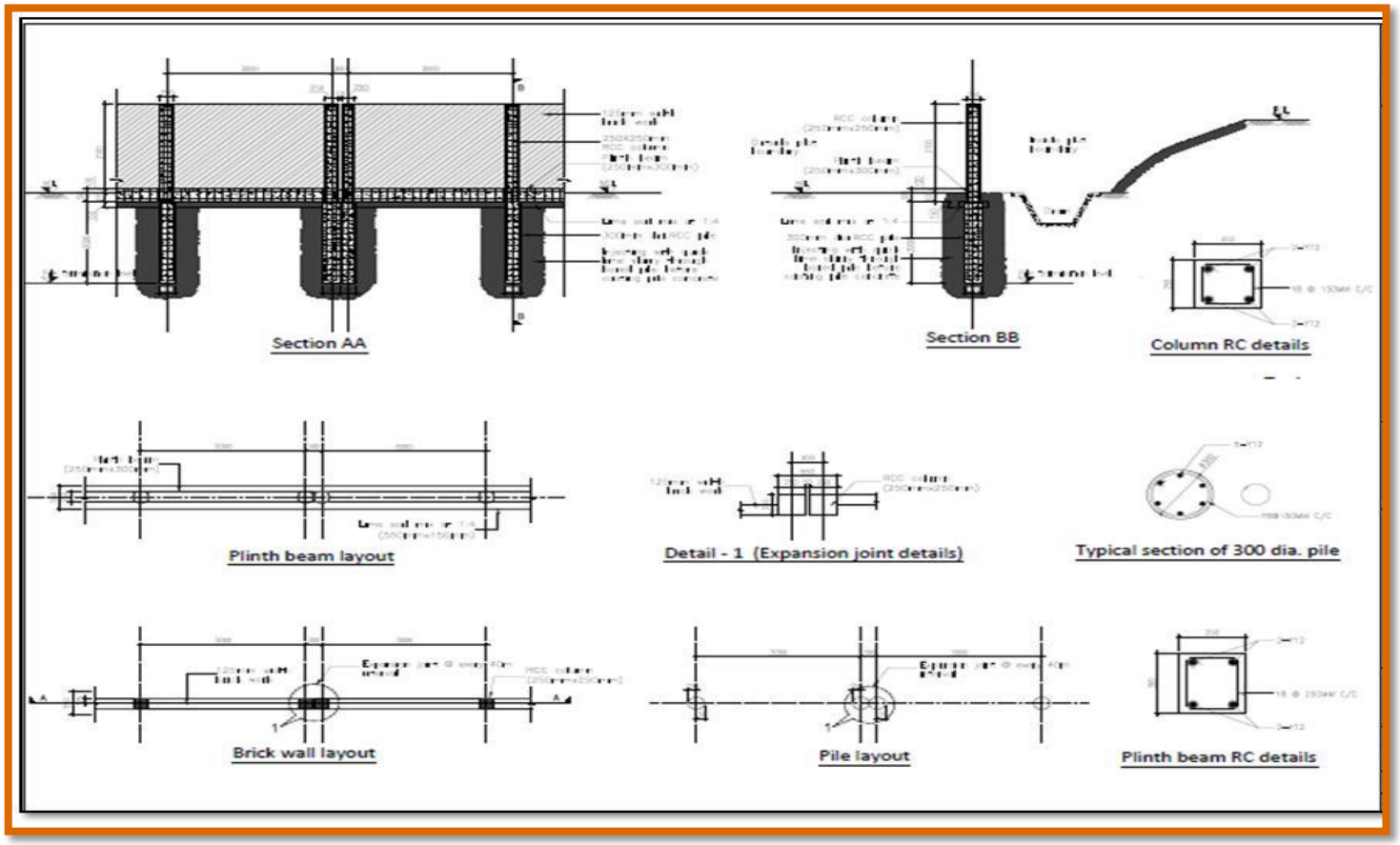
Source: Mahindra

Figure 11: Site plan of administration building



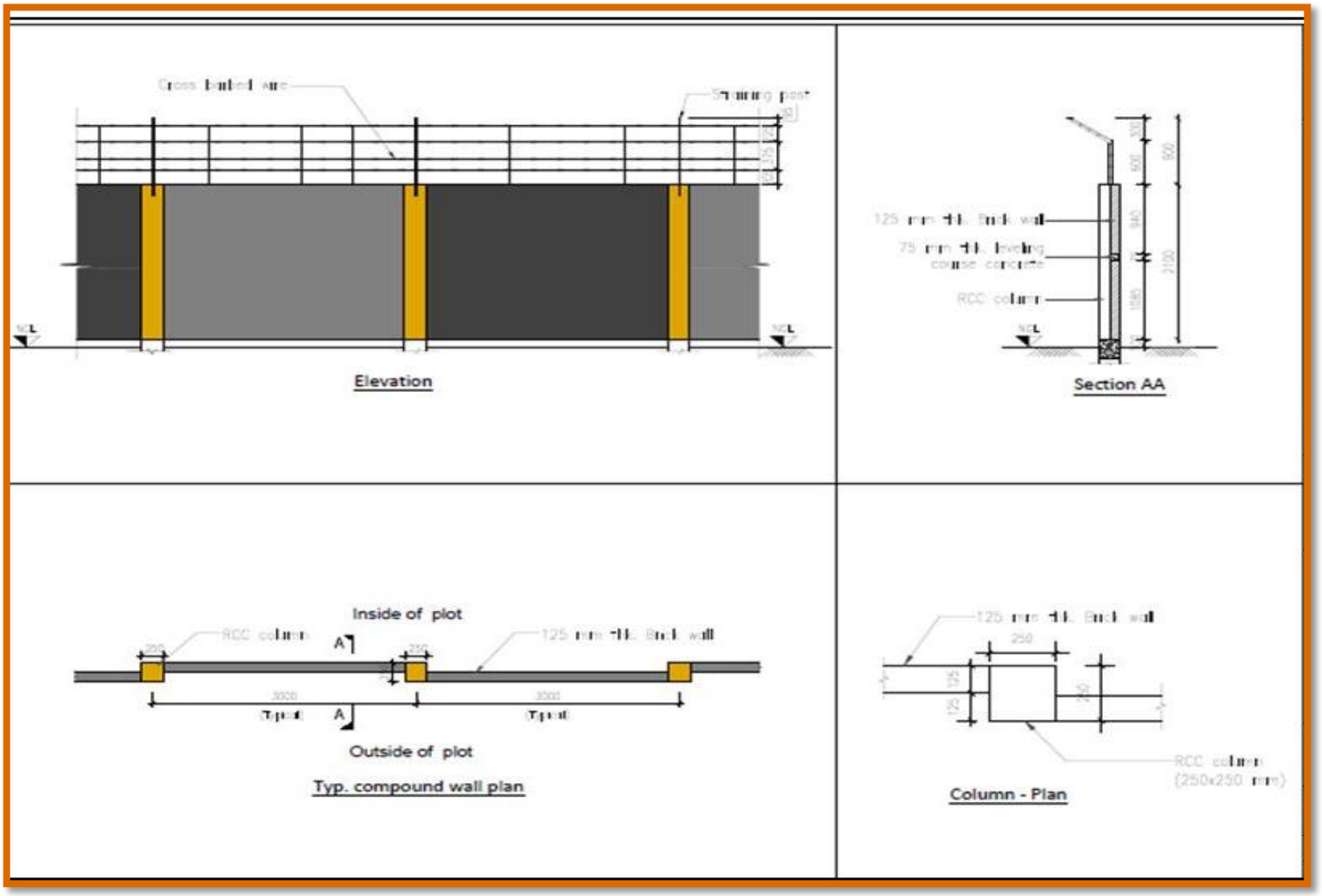
Source: Mahindra

Figure 12: TCS of Access Road



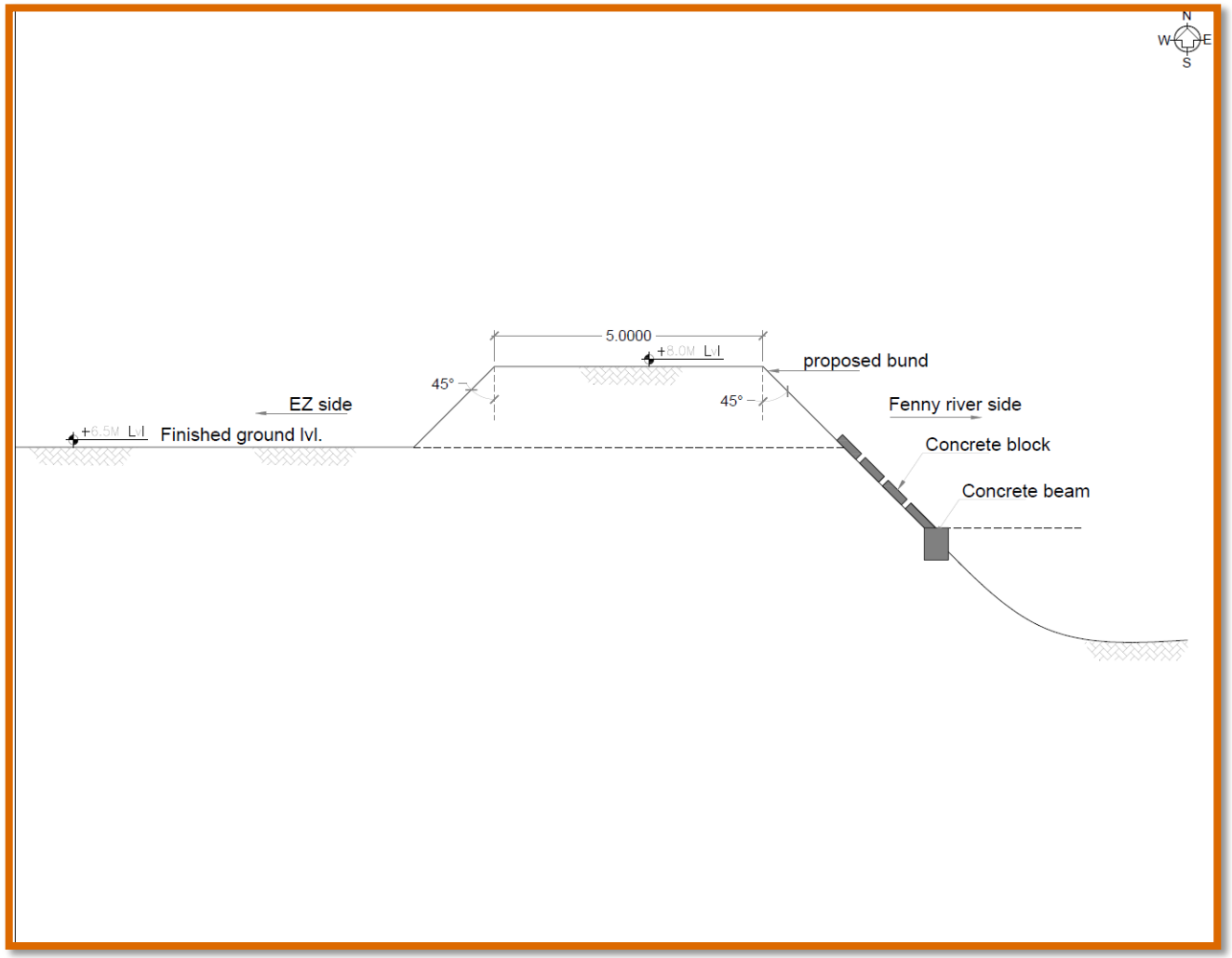
Source: Mahindra

Figure 13: Section of the proposed boundary wall



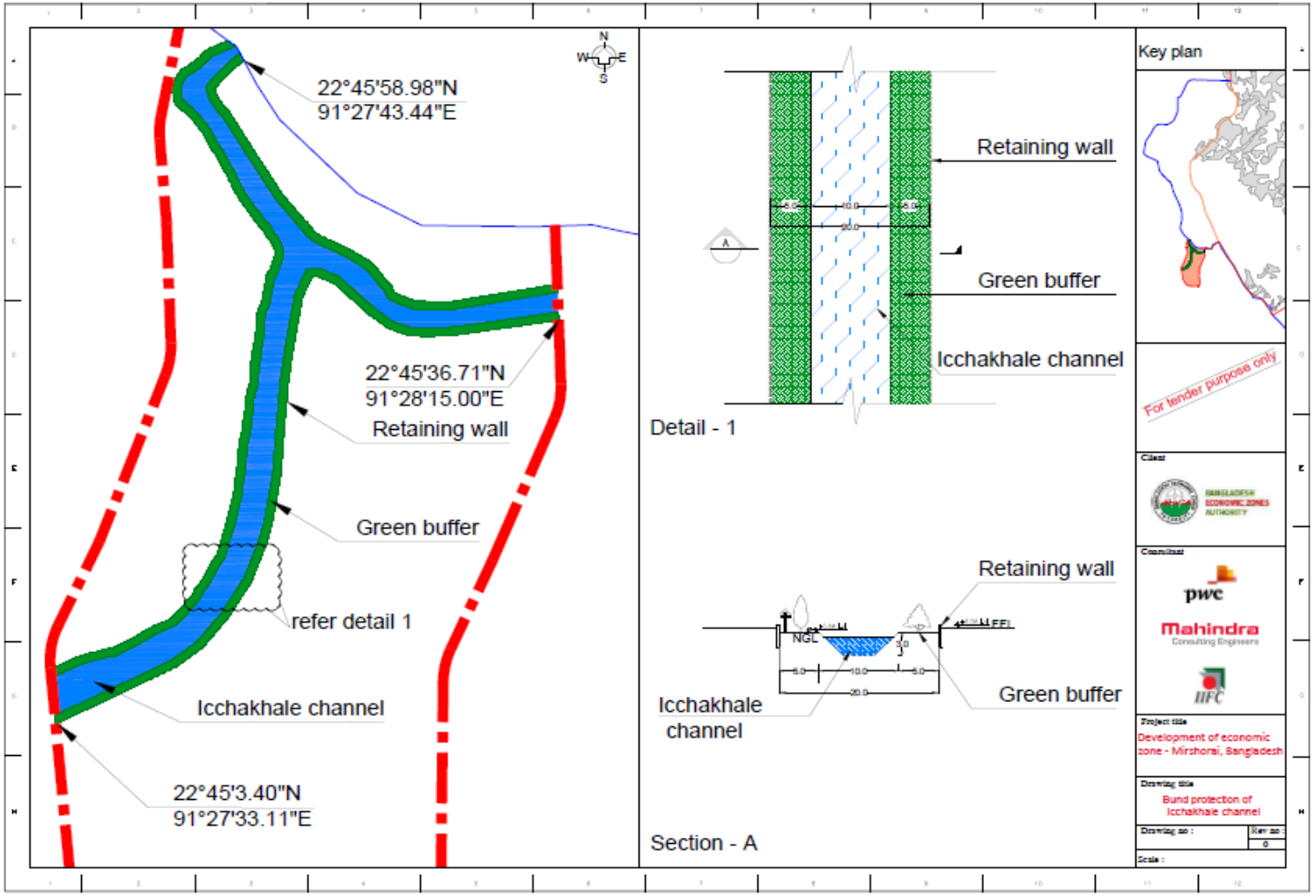
Source: Mahindra

Figure 14: Elevation of the proposed boundary wall



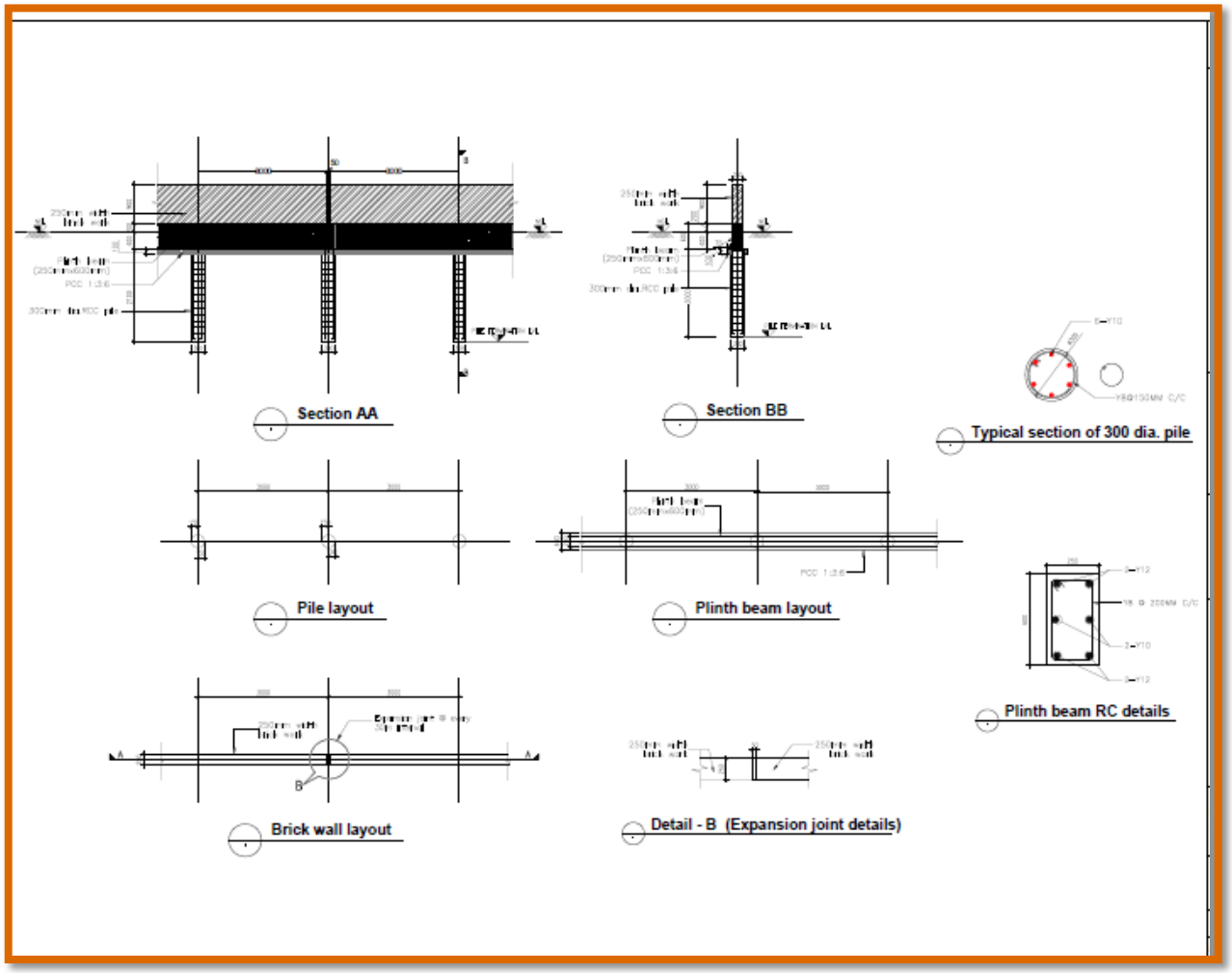
Source: Mahindra

Figure 155: Cross Section of Bund



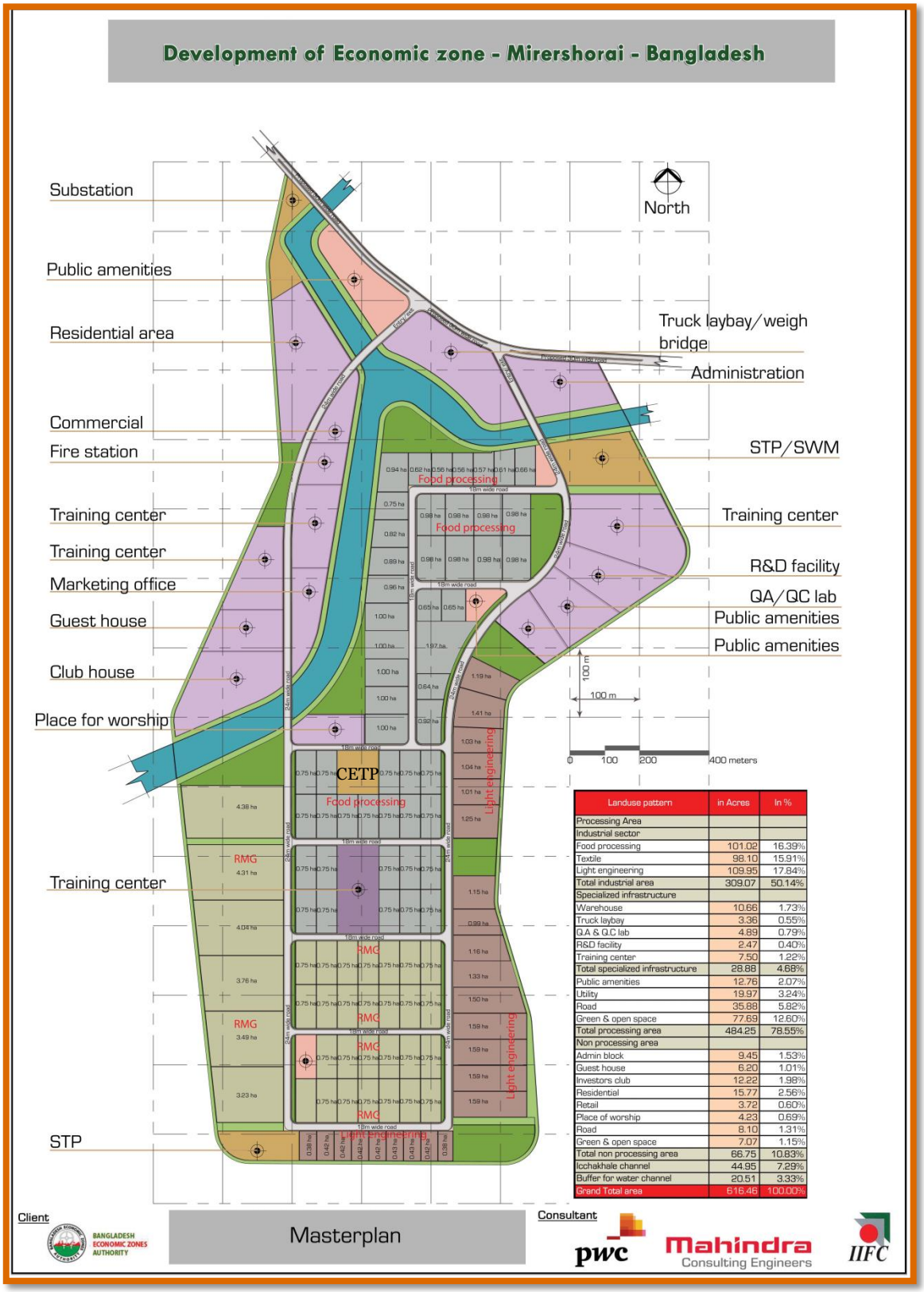
Source: Mahindra

Figure 16: Cross Section of Retaining Wall



Source: Mahindra

Figure 17: Retaining Wall- Structural details



Landuse pattern	in Acres	In %
Processing Area		
Industrial sector		
Food processing	101.02	16.39%
Textile	98.10	15.91%
Light engineering	109.95	17.84%
Total industrial area	309.07	50.14%
Specialized infrastructure		
Warehouse	10.66	1.73%
Truck laybay	3.36	0.55%
Q.A & Q.C lab	4.89	0.79%
R&D facility	2.47	0.40%
Training center	7.50	1.22%
Total specialized infrastructure	28.88	4.68%
Public amenities	12.76	2.07%
Utility	19.97	3.24%
Road	35.88	5.82%
Green & open space	77.69	12.60%
Total processing area	484.25	78.55%
Non processing area		
Admin block	9.45	1.53%
Guest house	6.20	1.01%
Investors club	12.22	1.98%
Residential	15.77	2.56%
Retail	3.72	0.60%
Place of worship	4.23	0.69%
Road	8.10	1.31%
Green & open space	7.07	1.15%
Total non processing area	66.75	10.83%
Icchakhale channel	44.95	7.29%
Buffer for water channel	20.51	3.33%
Grand Total area	616.46	100.00%

Source: Mahindra

Figure 18: EZ Site Layout

4.6. Project Schedule

Table 17 presents the implementation schedule of the off-site infrastructure details at the proposed Mirershorai EZ site.

Table 12: Implementation Schedule of Off-site Infrastructural Details

S.No	Offsite infrastructure	Duration in months from start
1	Site Development	12
2	Access road	6
3	Admin building	12
4	Boundary Wall	8

BEZA targets to start the work from October, 2015. The EZ development activities could be undertaken by the prospective developer following the off-site infrastructure development.

4.7. Resources and Utilities Demand

Construction Materials Sourcing

Construction material like steel, cement, concrete, bricks, aggregates etc. will be required for each of the proposed off-site facilities and EZ development. Since the planning has been carried out for offsite development, the detail provided below pertains to off-site facilities. The EZ development requirement though will remain similar in nature but these details for EZ shall be available after the master developer is appointed and his plan is finalized. Raw material requirement for the off-site facilities is given in the table 18.

Table 13: Construction Material Requirement for Off-site facilities

S. No.	Material	Quantity
Bund		
1	Sand	472867 cum
Sluice gate		
1	Concrete	5875.8 cu m
2	Steel	1212.5 cu m
3	Sand	66 cu m
Access Road		
1.	Sub base	6000 cum
2.	Aggregate base type II	7500 cum
3.	Aggregate base type I	6000 cum
4.	Bituminous prime coat	21000 sqm
5.	Bituminous tack coat	42000 sqm
6.	Dense bituminous surfacing base course	1680 cum
7.	Dense bituminous surfacing wearing course	840 cum
8.	Double Brick	4500 sqm
9.	Road marking-thermoplastic material	1200 sqm
Administration Building		
1.	Sand	1098 cum
2.	Mass concrete	139.20 cum
3.	Polyethene sheet	84.5 kg
4.	RCC	777.0 cum
5.	Concrete	256 cum
6.	Steel	174674.30 kg
7.	Bricks (1.5 brick thickness)	557.00 cum

S. No.	Material	Quantity
8.	Bricks (1 brick)	213 sqm
9.	Cement sand (6 mm thick plaster)	2514 sqm
10.	Cement sand (12 mm thick plaster)	4092.00 sqm
11.	Cement sand (12 mm thick plaster)	1178.00 sqm
12.	Plastic emulsion paint	6606.0 sqm
13.	Weather Coat Paint	589 sqm
14.	Textured Paint	589 sq. m
15.	Paint for door & windows	165.50 sqm
16.	Polish for door & windows	156.00 sqm
Site Preparation		
1.	Sand	1669316.00 cum
Retaining Wall		
1.	RCC	249.25 cum
2.	Concrete	1003.2 cum
3.	Brick (one brick wall)	1188 cum
4.	Cement Sand Plaster	9504 sqm
5.	Cement paint	9504 sqm

These materials are available locally or from the nearby area.

Water

Water requirement during construction phase is estimated to be app. 50 KLD, which includes Domestic water requirement of construction workers. For storing rain water during construction phase, temporary rain water harvesting ponds can be constructed at the site. Water for construction shall be sourced from rain water harvesting ponds, Feni River & Ground water.

The total water requirement for operational phase is estimated at about 7.7 MLD. Detailed calculations are given in table 19 below. Source of fresh water in the area is ground water. Water of Feni River in downstream is saline. Desalination of this water can also be taken up in later stage for sourcing the water during operation phase. Rain water harvesting also can be carried out which can supplement the water supply system.

Table 14: Estimated Water Demand

Description	Area in percentage of total area	Total area - Ha	Unit demand cum/ha	Total water demand cum/day
Industrial area	65%	125.0734	70	8755.138
Amenities	5%	36.3678	36	1309.241
Utilities	5%	8.0822	45	363.699
Road	15%	17.7948	1.8	32.03064
Greenery	10%	34.2999	1.8	61.73982
Total	**100%**	221.6181		10521.85
Total Water Demand(MLD)				**10.52**

Power Requirement

Power demand during construction phase is insignificant. Power required during operation phase is estimated to be 55.46 MVA. Power requirement calculations are given in table 20 below. Power supply system will be developed at later stage by developer.

At present total capacity of Rural Electricity Board, Mirershorai is 30 MW (Substation of 20 MW at Mirershorai and 10 at Zorarganj). Out of 30 MW app. 27 MW is utilized. For initial phase of EZ power requirement will be lesser. REB, Mirershorai was approached by BEZA to identify the available power options. REB, Mirershorai suggested that capacity of Mirershorai substation can be increased by 10 MVA

and same can be supplied to EZ in future but this depends on the approval from National Electricity Board. A CPP thus is more viable option for fulfilling electricity requirement. CPP cannot be gas based due to shortage of gas availability in the area. Coal can be transported to the site from deep sea port under consideration at Sonadia near Cox Bazar. A floating jetty is required to be proposed at the site for transportation of coal to the site. Thus a coal based CPP can be an option for fulfillment of electricity requirement. Options for harnessing wind and solar energy can be explored due to its nearness to coast. Similarly fuel for the industries as well can be the coal.

Table 15: Estimated Power Demand

Land use pattern	Total Area (Hectares)	FSI	Floor Area (Sq.m)	Load in KVA/Ha & KVA/Sqm of BUA	Plot Area	Simultaneously Factor	Loss Factor	Load in kVA
Processing area								
Industrial area								
Food processing	40.88	--	--	300.00	50%	70%	1.1	12743.46
Textile	39.70	--	--	300.00	50%	70%	1.1	12375.49
Light engineering	44.49	--	--	300.00	50%	70%	1.1	13870.18
Warehouse	4.31	--	--	300.00	50%	70%	1.1	1344.43
Q.A & Q.C lab	1.98	--	--	239.20	40%	50%	1.1	388.03
R&D facility	1.00	--	--	239.20	30%	50%	1.1	180.07
Training center	3.04	--	--	239.20	40%	50%	1.1	595.49
Public amenities	5.16	--	--	239.20	50%	50%	1.1	1096.44
Utility	8.08	--	--	239.20	40%	50%	1.1	425.32
Road	14.52	--	--	478.40	30%	50%	1.1	1146.06
Green & open space	31.44	--	--	478.40	20%	40%	1.1	1323.59
Total processing area	**195.97**							**45.49**
Non processing area								
Admin block	3.82	2.0	76466.00	0.18	60%	70%	1.1	6337.72
Guest house	2.51	1.5	37660.50	0.14	60%	60%	1.1	2140.39
Investors club	4.95	1.0	49461.00	0.14	40%	40%	1.1	1249.36
Residential	6.38		0.00	179.40	30%	40%	1.1	151.12
Retail	1.50			119.60	30%	40%	1.1	23.74
Place of worship	1.71			478.40	20%	40%	1.1	71.99
Road	3.28				10%	40%	1.1	0.00
Green & open space	2.86				10%	40%	1.1	0.00
Total non processing area	**27.01**							**9.97**
Total	**222.98**							**55.46**

Street Lighting

Street lighting will be provided on the proposed access road. Solar street lights should be proposed in ratio of 1:2. Average illumination of 20 lux should be maintained on the access road.

Telecommunications

Mirershorai has mobile connectivity from almost all mobile companies. There is no fixed network. It is recommended to install BTCL (Bangladesh Telecom Company Limited) network, as fixed Phone Network of BTCL is the only reliable network.

Sewage & Effluent Treatment

All industries should be responsible for treatment of the sewage and effluent generated from their unit so that all industries are zero discharge. Sewage should be treated in the STP and effluent should be treated in the ETP. Treated water should be recycled and re-used within the site.

Green Belt Development

Green buffer of 10 m width will be developed all around the EZ site. Multi-layered plantation will be carried out in the buffer. Peripheral green belt will be developed by the developer. In addition to this all industries will develop green belt all around their respective plots. Native plant species consuming less water and requiring less after care and monitoring should be considered. Such species include Neem, Chambol, Sirish, Palms, Gewa, Mango, Mahagony etc. Green buffer should consist of minimum 3 rows of vegetation. First row of green buffer should be small shrubs and herbs, second row of tall shrubs and small/medium height trees and last row of medium to tall heighted trees.

Solid Waste Generation from Proposed EZ Project

Waste to be generated during construction phase will be left out construction material like metal piece, wood piece, unused concrete, broken bricks, glass, ceramic, demolition waste etc. Quantity of the solid waste to be generated during construction phase may vary from 30-50 kg/day. This waste should be collected and segregated at the site itself. Recyclable and Re-usable waste should be separated and should be sent to recycler. Rejected waste should be disposed off at the designated sites by local authority.

Nature of solid waste generated during the operation phase will be highly variable due to presence of different kind of industries in the EZ. Majorly as per the feasibility study light engineering industries, food processing industries and textile industries may come up in the EZ. These industries are less polluting industries. Solid waste generated by industries should be managed by industries. Solid waste to be generated from EZ can be industrial non-hazardous waste, hazardous waste, bio-degradable, non-biodegradable, e-waste, construction debris, hospital and bio-medical waste. A secured scientific landfill should be developed for disposal of municipal solid waste within the EZ site. Hazardous waste from industries should be disposed off only through authorized hazardous waste handling agencies by DoEB. No TSDF and hazardous waste recycling units exists in Bangladesh. But as the EZ development and coming up of industries may take time of app 3-4 years so by then hazardous waste rules will be formed in Bangladesh (in draft form at present) and some facilities may come up in Bangladesh for managing hazardous waste. Else all industries should incinerate the hazardous waste generated by them taking the required air pollution control measures.

4.8. Map and Survey Information

Project Location

Mirershorai EZ is proposed to be located in Mirershorai Upzila of Chittagong district, Bangladesh near Abu Torab Village. Mirershorai Upzila map showing location of the proposed project site is shown in figure 19 below. The project surrounding within 10 kms region is shown in figure 20 below.

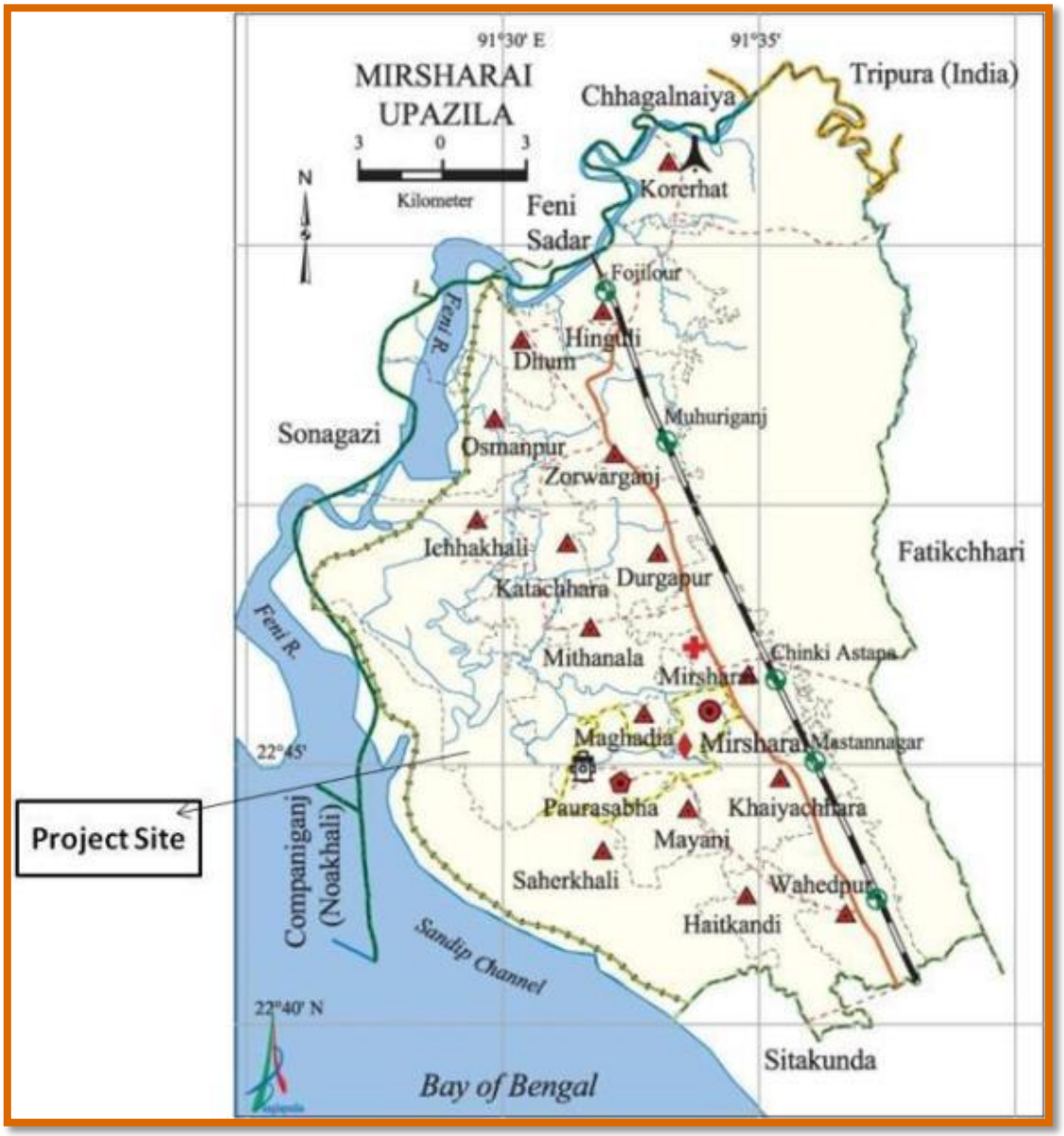
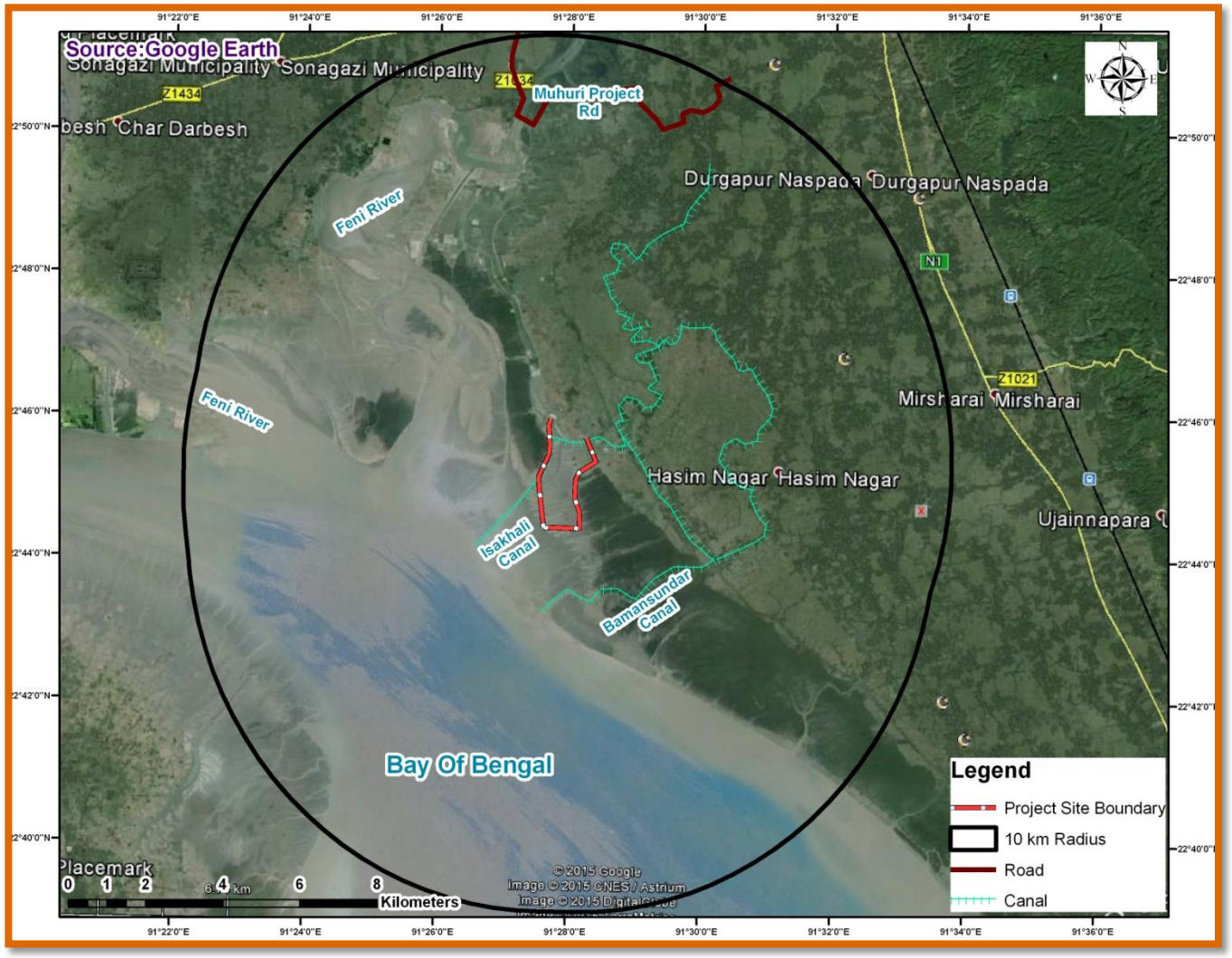


Figure 19: EZ location on Mirershorai Upzila Map



Source: Google Earth

Figure 20: Project site and surroundings within 10 km radius

Topography of the Project Site

EZ site is generally flat . The land use of the project site is wetland. Area is classified as coastal plains of Chittagong. Network of deep channels, drains and streams is present at the site which gets flooded during the monsoon. Physiographic map of Bangladesh is given in figure 21 below. Site is required to be leveled and raised to a level of 0.75 m. At present elevation of the site varies from 5-7 m amsl. The elevation of the land within the 10 km radius area varies from 0 m to 11 m. The area is covered by clayey deposits. Seasonal flooding of the site is observed due to stagnation of rain water and flooding of river and canal passing through the site. Soil is uniform at whole site and has low permeability. Contour map of the project site & 10 km radius area are given in figure 22 & 23 below. Photographs showing the site conditions is given in figure 24 below.

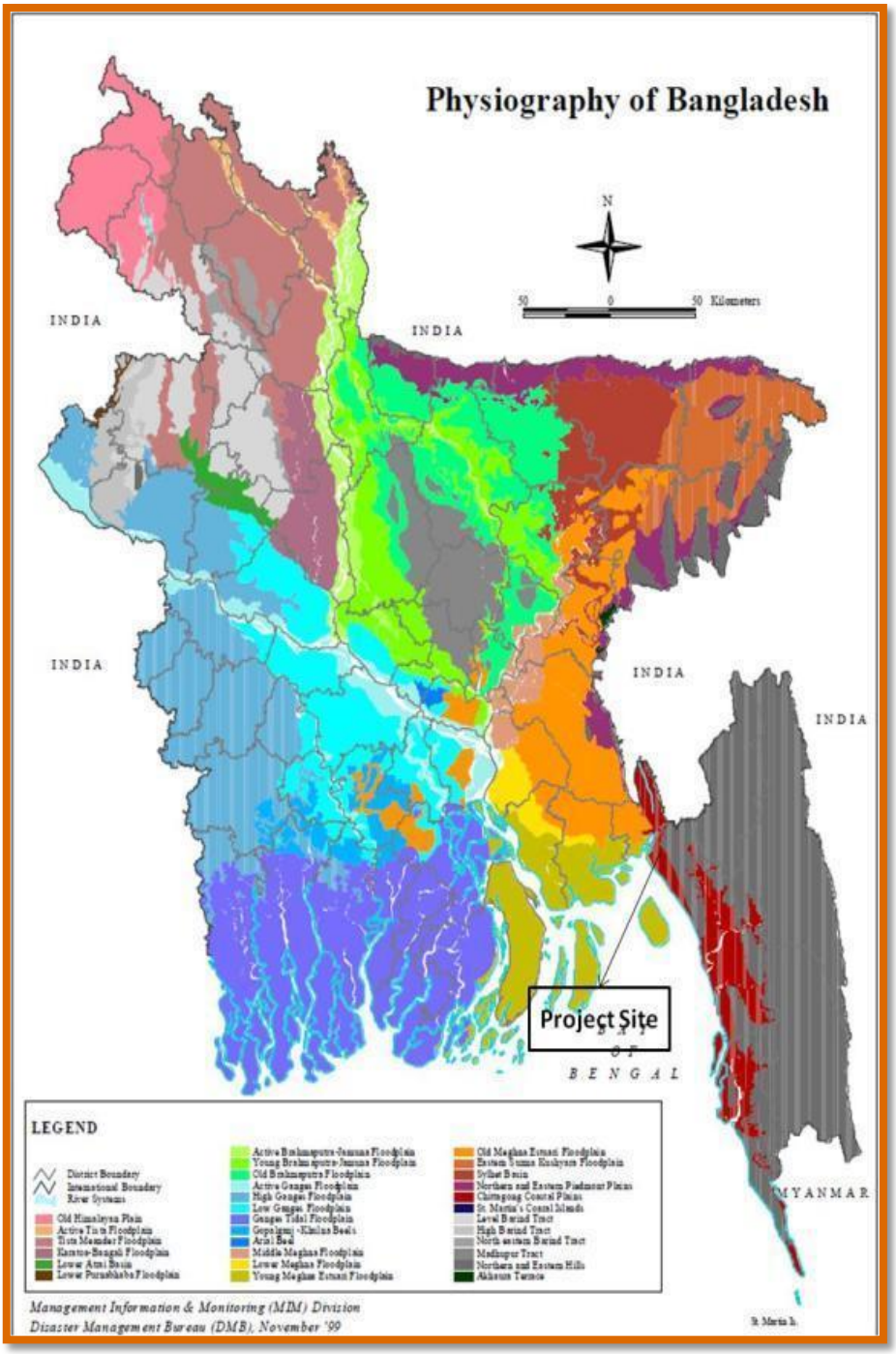
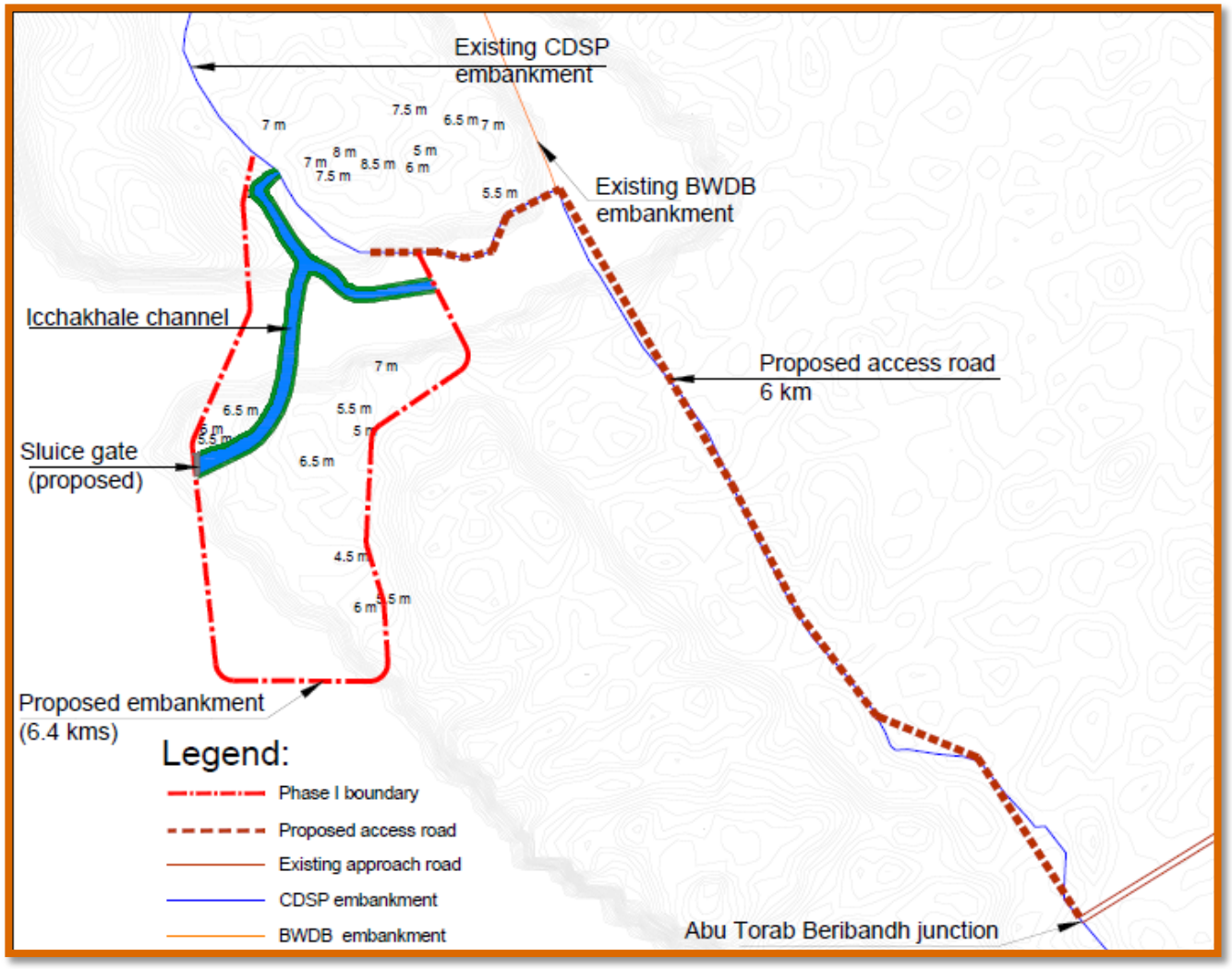
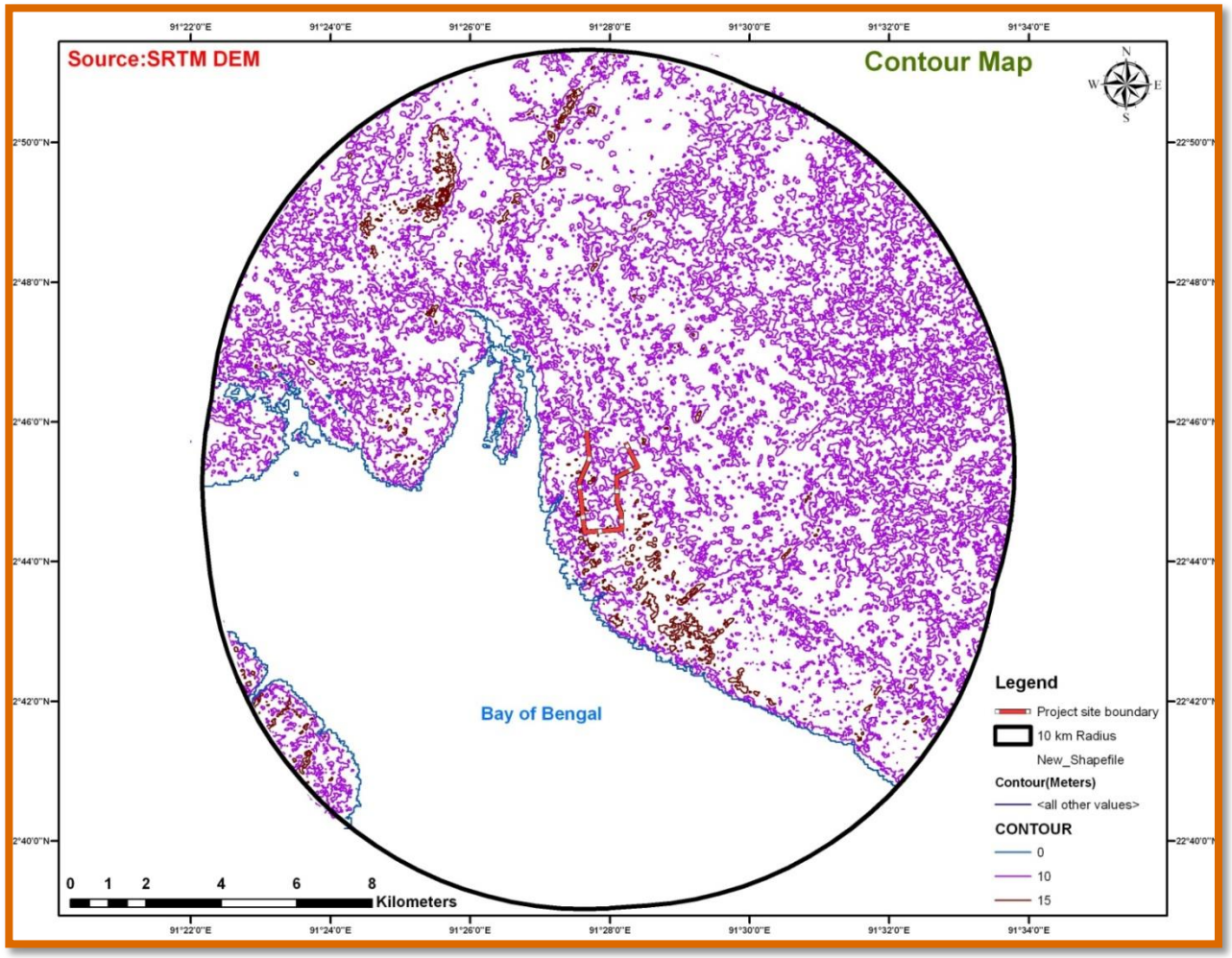


Figure 21: Physiographic Map of Bangladesh



Source: Mahindra

Figure 22: Contour Map of the Mirershorai EZ Area



Source: Mahindra

Figure 23: Contour Map of the 10 kmradius of Mirershorai EZ

CDSP Bund

Isakhali Canal

EZ Site

Figure 24: Topography of the Site

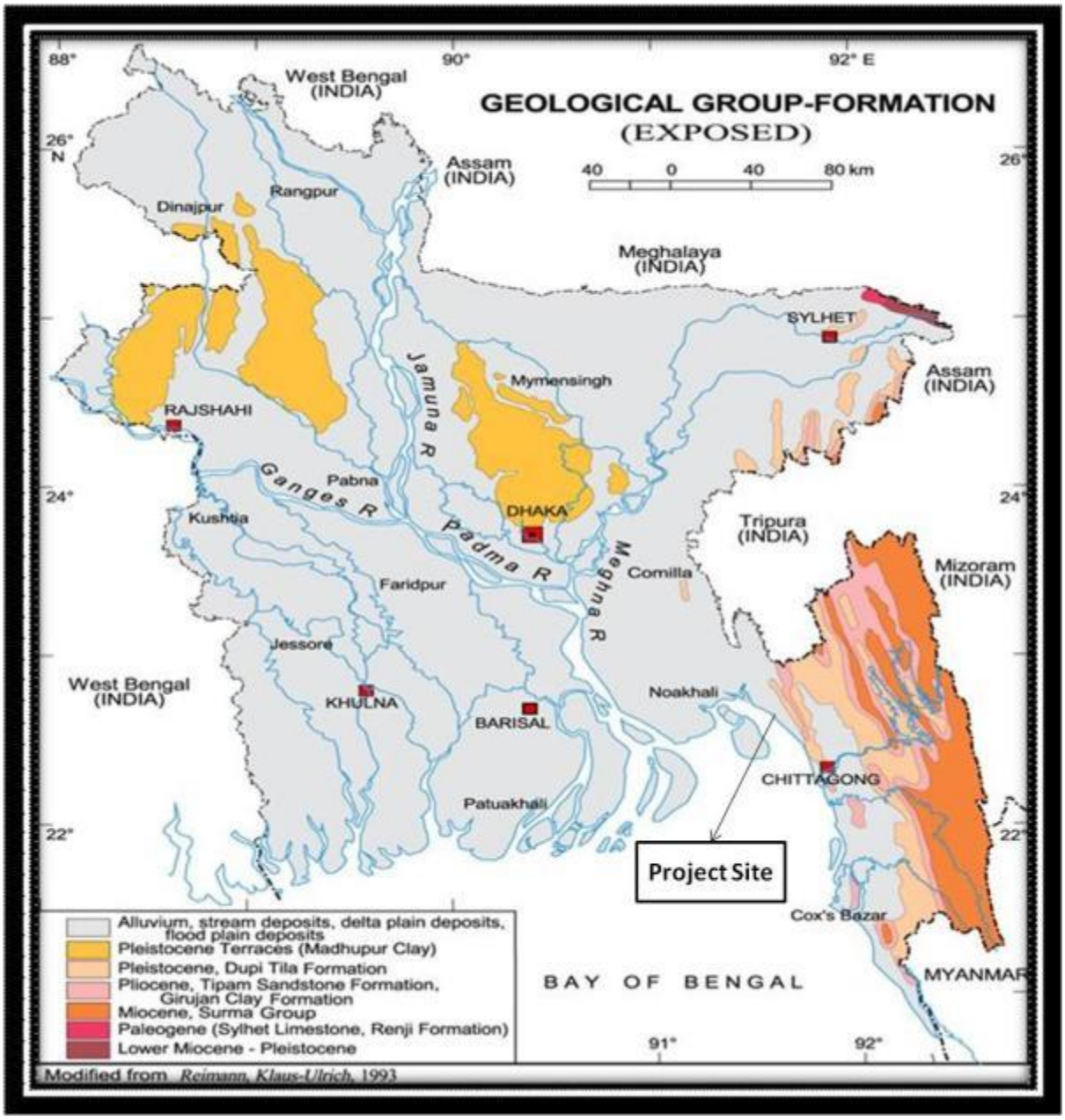
Eco Sensitivity

There are no ecological sensitive locations such as National Park, Sanctuary, Elephant/Tiger Reserve, Migratory routes and wetlands within the 10 km radius of the study area. Forests within 10 km radius area of project site are Bamon Sundar Forest (abuts project site), Domkhali Forest (9.0 kms, SE) and Mogadia forest (8.0 kms, NE). These are mainly planted Mangrove plantations by Forest Department to protect the inland areas from action of sea. Ramgarh Sitakund Reserve Forest is located at distance of 15 km in East direction. Mangrove plantation is carried out in Bamon Sundar Forest by forest department to protect inland area from cyclones and floods. Photographs of Bamon Sundar Forest are given below in figure 25.

Figure 25: Photographs of Bamon Sundar Forest

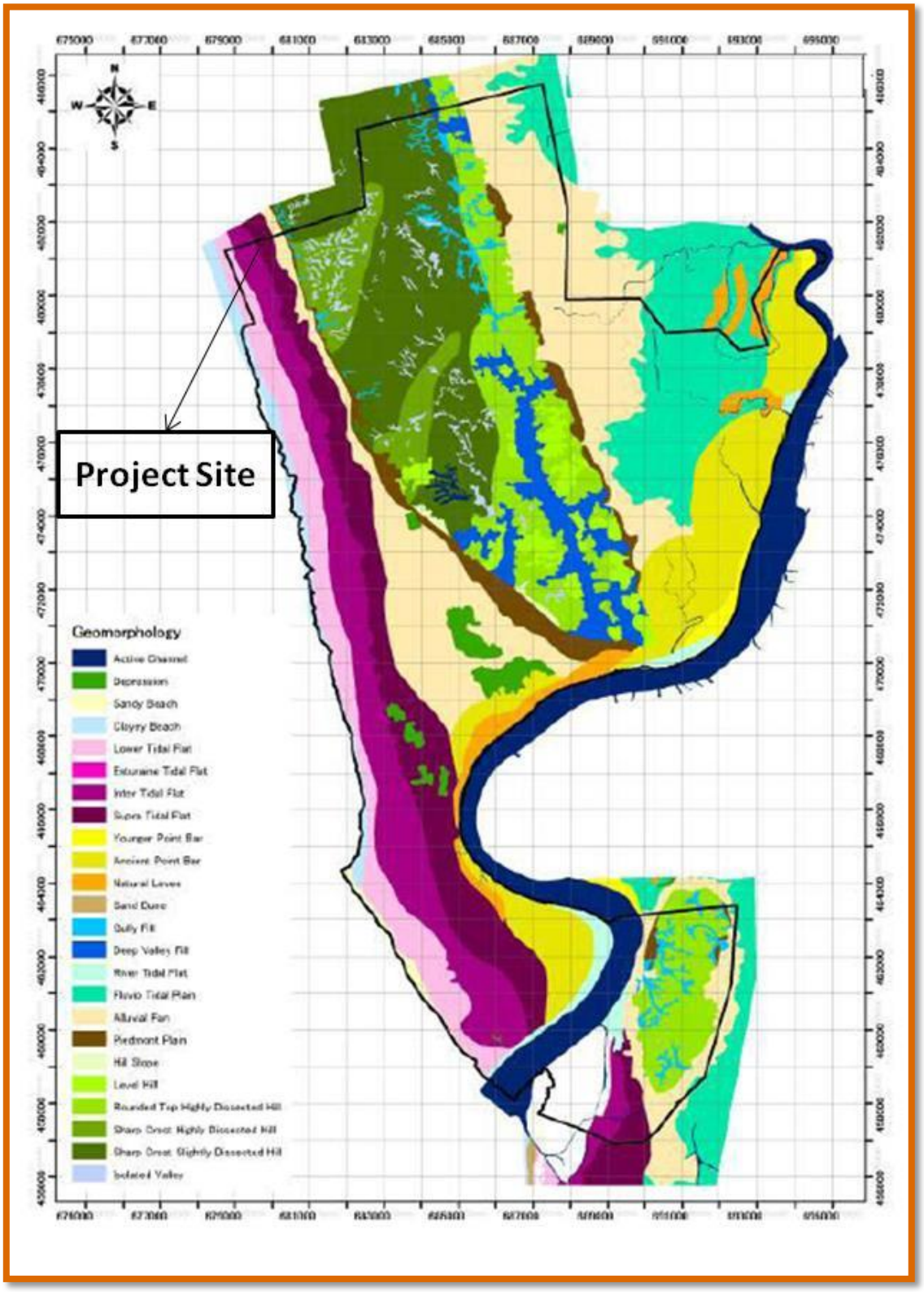
Geology

The geology of the project area can be generally classified as sedimentary with metamorphic rocks such as limestone including travertine. These occur as either of the following: quartzite, graphitic schist, chlorite, amphibole, mica and kyalite schist, hornblende, bitite and garnet, gneiss, acid gneiss, granulate or charkonite. The site is closed to the sea and Feni River and is covered with clay and sand deposits. As per the geological map of Bangladesh (figure 26), site is covered with stream and flood plain deposits and is classified as lower and inters tidal flats as per geomorphic map of Chittagong. Geomorphology map (figure 27) of Chittagong shows that project site is classified as inter tidal plains.



Source: Mahindra

Figure 26: Geological Map of Bangladesh



Source: Mahindra

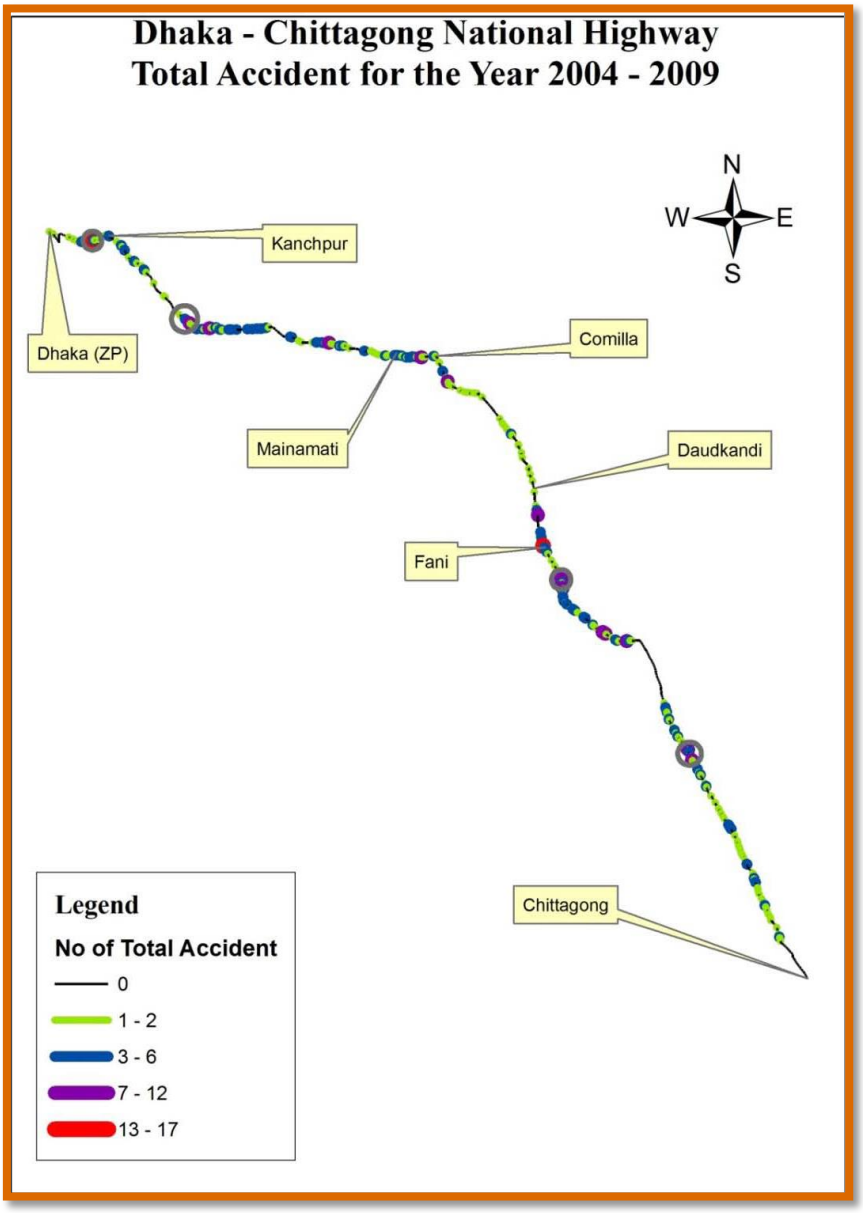
Figure 27: Geomorphic Map of Chittagong

4.9. Transportation Options for the EZ

The EZ has options of road, rail, air and water ways transportation. Availability of seafront makes project more viable for industrial development. Project site has good road and rail connectivity as well. The details of available options are given in the following section. Current traffic and estimated traffic generation from EZ is also given in this section.

Road Transportation System and Traffic Assessment

Project site is accessible by access road, i.e. Abu Torab Road which is 10 km from Dhaka Chittagong Highway. Abu Torab roab road connects to the highway in East direction and BWDB & CDSP Bund in West direction. Site lies adjacent to the CDSP bund. CDSP bund is covered with sand at some places and brick bed at some places and is non-motorable. Whereas Abu Torab road is motorable but is in a dilapidated condition and presently only 4 wheel drive vehicles can access the site. For movement of heavy traffic like trucks, Lorries, it is required to strengthen the existing Abu Torab road and construction of motorable excess road on existing CDSP bund from Abu Torab junction till project site. Also Dhaka Chittagong highway is one of the busiest highways in the country. Traffic is increasing every year on this highway. Bi-directional traffic volume on the highway n 2009 was recorded to be 5632798 whereas it was 3206277 in 2006. There is huge increment in traffic on this highway. Average traffic growth rate of 21.03% is estimated as per the study carried out by BUET. High rate of accidents are reported on this highway. Map (figure 28) showing the accident prone locations on the highway is given below. Total 840 accidents are reported on this highway between 2004-2009 and out of this 675 are fatal (Aalam & Ahsan, 2013)



Source: Alam, M.; Ahsan, H. M., 2013

Figure 28: Map Showing Most Accident Prone Location on the Dhaka Chittagong Highway

Estimated Traffic from EZ

Estimation of the traffic to be generated from EZ site at Mirershorai has been made. It is estimated approx. 96279.6 PCU will be generated from the EZ site after development. PCU calculations for the project are given in table 21 below.

Rail & Air Transportation System for Project Site

Nearest airport is Shah Amanat airport located in Chittagong at distance of 79 km in South direction from site. An unfinished Rampal airport is at 22 km from site in NNE direction. Nearest Railway station is Bartakia & Mirershorai Railway station which is at distance of 9.5 km & 10 kms respectively in East direction from site.

Water Transportation System

Inland water transportation system is well developed. Feni River is located at distance of 800 m from the site in west direction from the project site. Site is located at 4.0 kms from Bay of Bengal in South direction. A jetty should be developed for the transportation of men and material through sea for the EZ project. Chittagong port is deepest sea port of the country and is located at distance of 67 kms from the site (85 kms by sea route).

Table 16: Estimated Traffic Generation from EZ, Mirershorai Site

Description	Total Area		FAR Envisaged (Loacalised)	Maximum Built up Area in Sq.Ft	Area in Sq.ft for one person	Total population for demand calculation	Buses							Goods Vehicles				Slow Moving Vehicles			Total No. of Vehicles	Total PCUs / day	ratio of the 30th highest hourly traffic volume over one	ratio of heavy directional- peak hour (30th highest)	planning peak hour traffic volume (pcu/hour)	No. of lanes in one direction
	in Acres	in %					Standard bus	Other Bus	Mini Bus	Van	cars	Two wheeler	Auto rickshaw	Truck	MAV	LCV	Tractor	Cycles	Cart	Cycle Rickshaw						
CATEGORY A							3	3	2	1	1	1	1	3	5	2	5	1	8	2			0	1		
A. Industries							50	35	20	14	4	2	3	1	1	1	1	1	3	2						
							0	0	0	0	0	0	0	0	0	0	0	0		0						
Industry plot	309	0	1	135440688	400	338602	1354	484	2540	1209	29628	8465	9029	62	46	15	15	10158	0	6772	69778	72532			4352	2
							0	0	0	0	0	0	0	0	0	0	0	0		0						
							0	0	0	0	0	0		1	0	0	0	0		0						
Warehouse	11	0	1	1918624	800	2398	13	3	30	9	120	120	0	4	1	1	1	72	0	48	420	431			26	0
							0	0	0	0	0	0		0	1	0	0	0		0						
Commercial	39	0	2	3230004	100	32300	129	46	404	115	2423	1615	0	2	10	6	2	646	0	485	5883	5837			350	0
							0		0		0	0			1	0		0		0						
Residential	15	0	2	14619169	200	73096	322	0	548	0	6396	7310	0	0	6	1	0	2924	0	1462	18969	16254			975	1
							0	0	0	0	0	0			1			0		0						
Total Categ	374	0		173057658		551792																				
Category B																										
							0	0	0	0	0	0			1			0		0						
Control office	9	0	1	257355	100	2574	10	4	39	18	129	129	0	0	5	0	0	51	0	39	424	437			26	0
							0	0	0	0	0	0			1			0		0						
							0		0		0	0			1	0		0		0						
Residential	16	0	2	682797	200	3414	15	0	26	0	299	341	0	0	6	2	0	137	0	68	894	789			47	0
Total category B	25	0		940152		5988																				
GRAND TOTAL	399	0		173997810		557780	1843	537	3587	1351	38995	17980	9029	67	74	25	18	13988	0	8874	96368	96280			5777	3

Source: Mahindra

4.10. Cost of the Project

The total estimated cost of the proposed off-site facilities is about 8562 lakh taka that includes the construction cost of bund, administration building, access road and land development. Details of cost of each component are given in table 22 below.

Table 17: Cost of the Development of Proposed Off-site Facilities

S. No.	Description of work	Amount in Lakh Taka
1	Site development	5792
2	Access Road	1595
3	Administration Building	560
4	Boundary Wall	615
Total		**8562**

Source: Mahindra

5. Description of Environment (Environment and Social Baseline)

5.1. Prelude

The environmental status around the proposed project site is analyzed for valued environmental components viz., air, water, land, noise, soil, and ecology and socio-economic in a 10 km radial radius around the site. The baseline provides the basis for assessment of impact (likely changes in the baseline conditions) due to the proposed interventions (EZ development project).

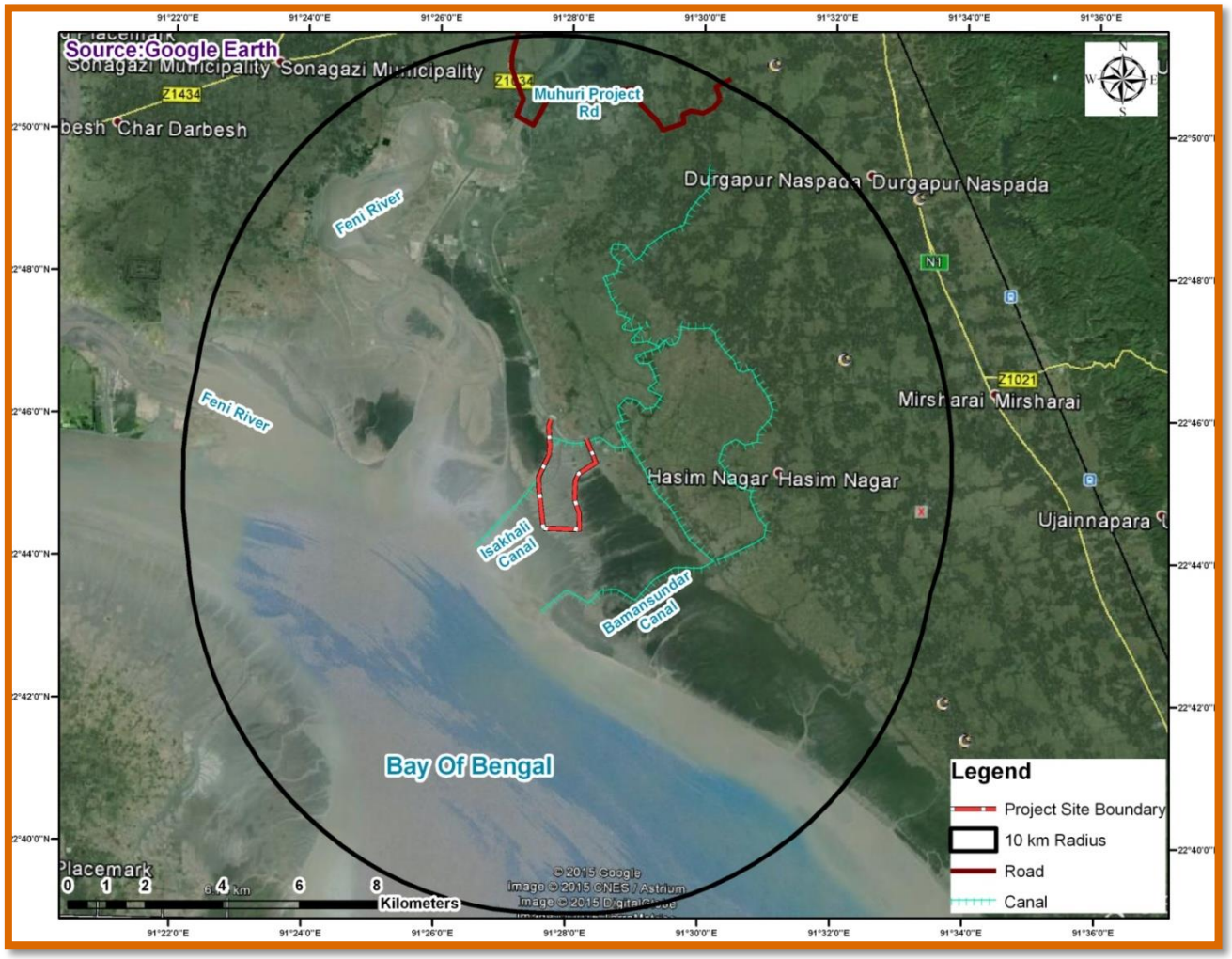
5.2. Site Description and Its Environs

The site and surrounding details have already been presented under chapter 4. The study area considered as 10 KM radius around the EZ site. The project activity areas are considered as core area and remaining study area as buffer zone. Environment setting of 10 km radius area around EZ site and surroundings of access road are given in figures 29 & 30 below.

Table 18: Environmental Setting

Particulars	Details
Location	Near Village Abu Torab, Mirershorai upzila, District Chittagong, Bangladesh Latitude: 22° 44.951'N Longitude: 91° 27.792'E
Nearby Villages	Charsharadh Village (3.0 km, SW) Nayapara Village (4.0 km, SW)
Site Elevation	Undulating, elevation variation of 3-8 m amsl
Nearest Airport	Shah Amanat International Airport (79 km, NNW)
Nearest Railway Station	Mirershorai Rail Station (10 km, West) Bartakia Rail Station (9.5 km, West)
Nearest Port	Chittagong Port (67 km, S)
Climatic conditions	Avg. Daily wind speed– 2-7 m/s Monthly Min. Temp. – 13.9°C (January) Monthly Max. Temp. – 32.3°C (May) Annual Avg. Rainfall – 2540 mm Monthly Average Humidity – 70-85%
Seismic Zone	Zone II
Forests / National Parks	None within 10 kms Mangrove Plantation Forest in East & West Direction of EZ site
Archaeologically important places/monuments	None within 300 m from the EZ site

Source: Google Earth & Site Visits



Source: Google Earth

Figure 29: Map Showing Environmental Settings within 10 km Radius of Project Site

Source: Google Earth

Figure 30: Map Showing Surroundings of Proposed Access Road

5.3. Baseline Data Collection and Monitoring Stations

The present EIA Report has been prepared based on the Primary field investigations / assessment, and secondary data from data collected from Department of Public Health and Engineering (DPHE), Bangladesh Water Development Board, Forest Department, Bangladesh Meteorological Department, Bangladesh Bureau of Statistics, existing studies, DoEB, published journals, and books, public consultation and site observations. Secondary data available on air quality, water quality and soil quality is used for the defining the baseline environment of the area.

5.4. Meteorology

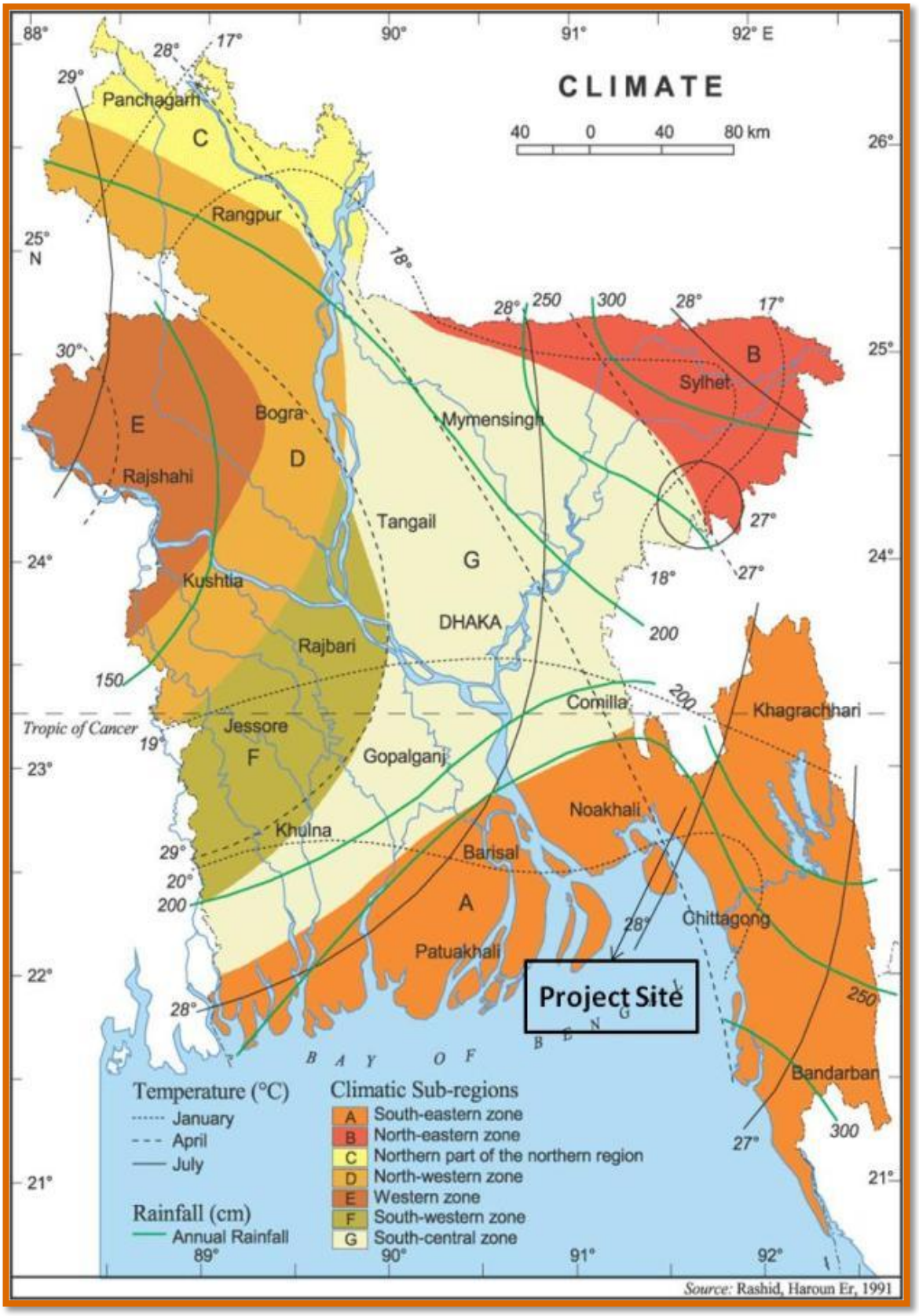
The project area lies in the South-Eastern climate zone of the country and shows three main seasons, i.e.

The Southwest Monsoon: May to October- 90% of the annual rainfall occurs during this period and relative humidity is high.

The Northeast Monsoon: It lasts from November to March.

The Hot Season: This hottest season extend from about late March to May. The highest daily temperatures generally occur at this time, and Flash floods often occur from the rivers entering the eastern part of the region from the Tripura Hills.

The climate is tropical in Chittagong. Chittagong has significant rainfall most months, with a short dry season. According to Köppen and Geiger, this climate is classified as Tropical Monsoon Climate (Am). Meteorological condition has been established using data on different metrological parameters accumulated from Bangladesh Meteorological Department for Chittagong Division. Summary of the analysis of metrological parameters are given in the following sections.



Source: BMD

Figure 31: Climate Region Map of Bangladesh

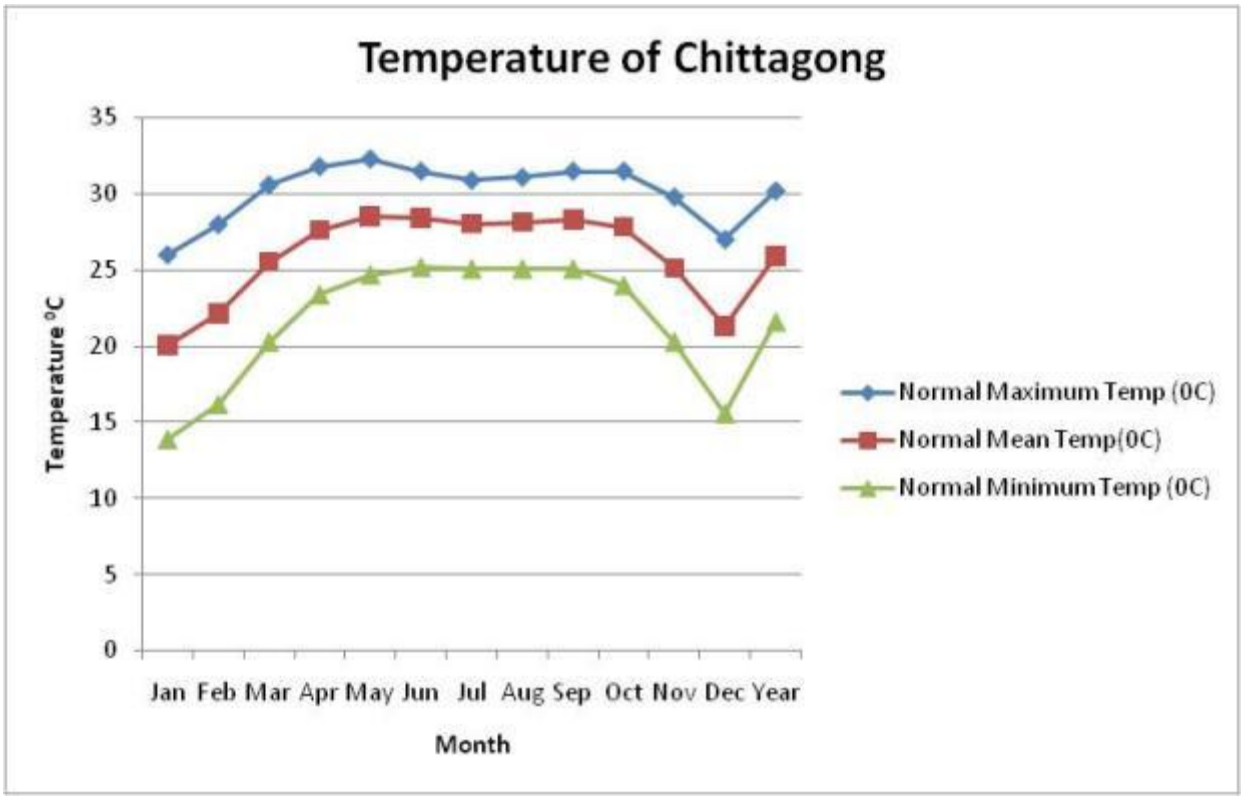
5.4.1. Temperature

The average temperature in Chittagong is 25.7 °C. In Mirershorai area temperatures vary from 6-9°C in winters and 37-41°C in summers. Temperature of Chittagong & Sitakunda area is given below in tables 24 & 25. Met stations in Chittagong city and Sitakund area are at distance of app. 50.0 and 25.0 kms respectively from the site.

Table 19: Temperature Data of Chittagong City

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Monthly Maximum (°C)	31.7	33.9	37.2	38.9	36.7	36.7	34.4	33.9	35	34.4	34.9	31.1	38.9
Normal Maximum (°C)	26.0	28.0	30.6	31.8	32.3	31.5	30.9	31.1	31.5	31.5	29.8	27.0	30.2
Normal Mean (°C)	20.0	22.1	25.5	27.6	28.5	28.4	28.0	28.1	28.3	27.8	25.1	21.3	25.9
Normal Minimum (°C)	13.9	16.2	20.3	23.4	24.7	25.2	25.1	25.1	25.1	24.0	20.3	15.6	21.6
Monthly Minimum (°C)	5.2	6.6	10.2	13.6	14.3	18.1	19.4	19.9	17.2	12.7	10.0	7.5	5.2

Source: BMD



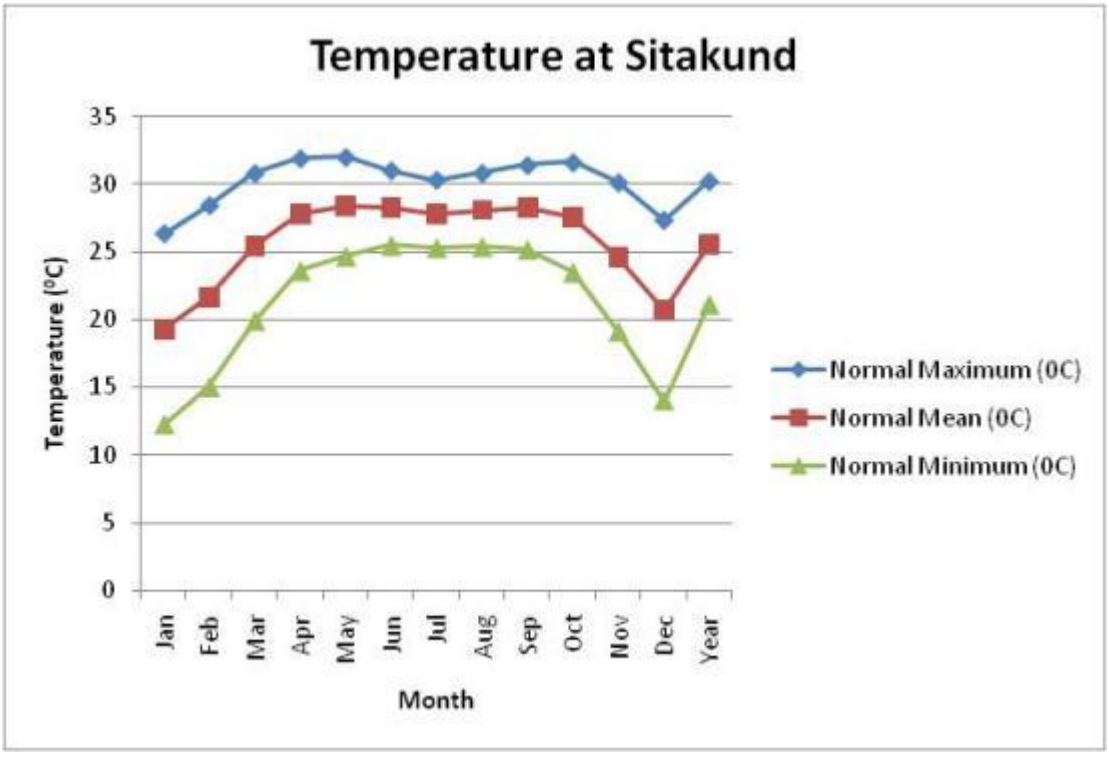
Source: BMD

Figure 32: Temperature of Chittagong City

Table 20: Temperature Data of Sitakund Area

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Monthly Maximum (°C)	26.6	28.0	32.5	32.4	32.4	31.2	30.4	31.3	31.5	32.7	29.1	27.4	30.5
Normal Maximum (°C)	26.3	28.4	30.8	31.9	32.0	31.0	30.3	30.8	31.4	31.6	30.1	27.3	30.2
Normal Mean (°C)	19.3	21.7	25.4	27.8	28.4	28.3	27.8	28.1	28.3	27.55	24.6	20.7	25.6
Normal Minimum (°C)	12.2	15.0	19.9	23.6	24.7	25.5	25.3	25.4	25.2	23.5	19.1	14.0	21.1
Monthly Minimum (°C)	11.2	14.6	18.3	24.0	26.9	25.9	25.6	25.5	25.5	24.5	21.0	13.5	21.3

Source: BMD



Source: BMD

Figure 33: Temperature of Sitakund Area

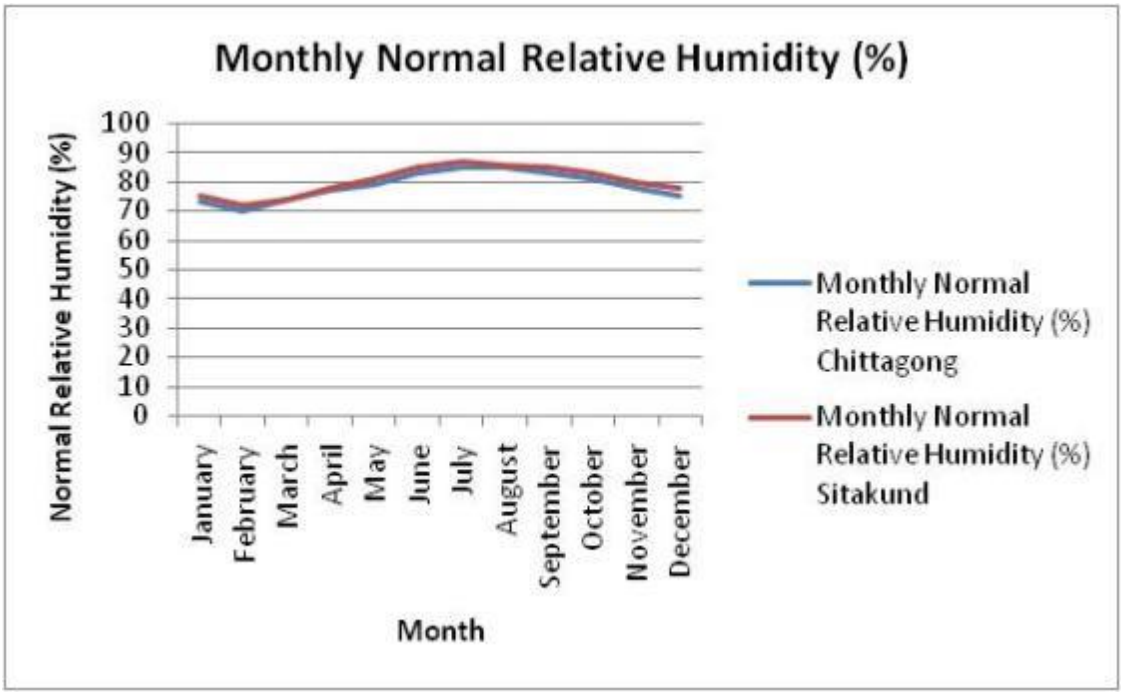
5.4.2. Humidity

Humidity in the Chittagong varies from 40% in day time of February month to 90% in month of July & August. Monthly normal humidity data of the Chittagong area is given in the table 26 below

Table 21: Monthly Normal Humidity in Chittagong District

S. No.	Month	Monthly Normal Relative Humidity (%)	
		Chittagong	Sitakund
1	January	73	75
2	February	70	72
3	March	74	74
4	April	77	78
5	May	79	81
6	June	83	85
7	July	85	87
8	August	85	86
9	September	83	85
10	October	81	83
11	November	78	80
12	December	75	78

Source: BMD



Source: BMD

Figure 34: Humidity of Chittagong

5.4.3. Rainfall

Rainy season is very prominent in this region like other coastal areas of the country. Nearest Meteorological station of BMD to the site is Sitakund which is app. 25.0 km to EZ site in SW direction. Average yearly rainfall of the area is 3215 mm. Average annual rainfall of the Mirershorai region is 2540 mm

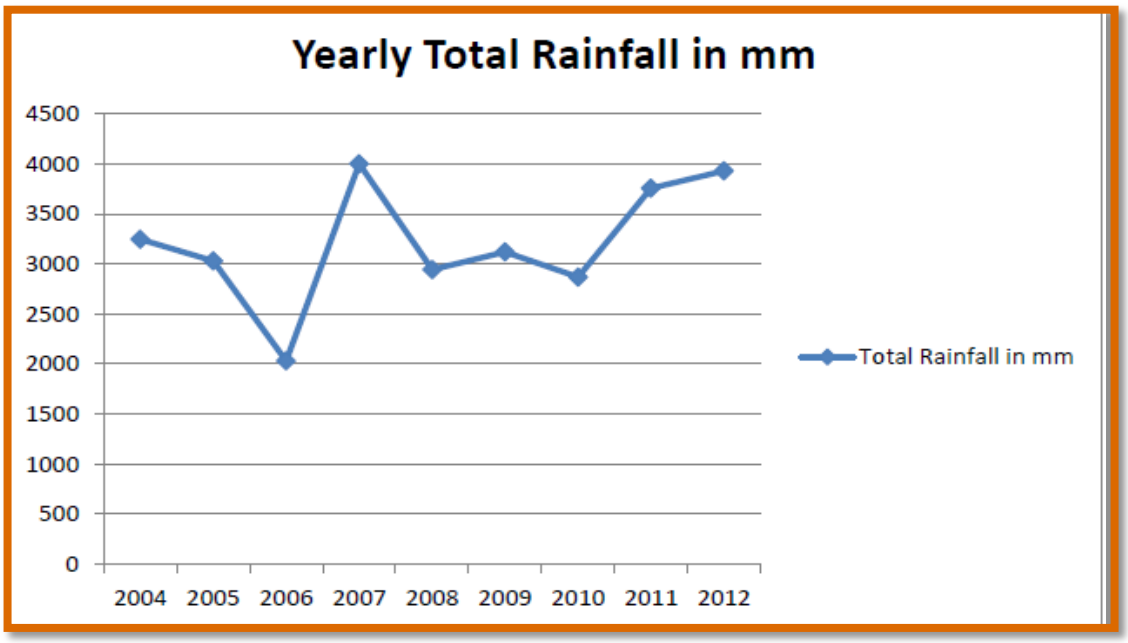
June July and August are month of highest rainfall in the area. Highest rainfall in 2012 occurred in July of 1274 mm. Hourly maximum Average daily maximum rainfall in the area is 195.1 mm and the highest

recorded figure is 269 mm in August, 2012. Average rainfall observed in three hours was about 103.1 mm and highest three hourly rainfall observed is 180.5 mm recorded in 2008.Average hourly intensity of the rainfall of the area is 34.4 mm/hour. Highest hourly rainfall of 60.17 mm/hr was recorded in year 2008. Normal monthly rainfall data of Sitakund area and nos. of rainy day is given in table 27 below.

Table 27 Average Normal Rainfall of Sitakund

S. No.	Month	Rainfall (mm)	Nos. of rainy days
1	January	5.6	1
2	February	19.6	2
3	March	91.9	4
4	April	184.5	8
5	May	351.0	13
6	June	548.4	16
7	July	726.8	19
8	August	545.6	18
9	September	316.4	14
10	October	240.3	8
11	November	54.2	2
12	December	7.9	1

Source: BMD



Source: BMD

Figure 35: Yearly Total Rainfall of Sitakund

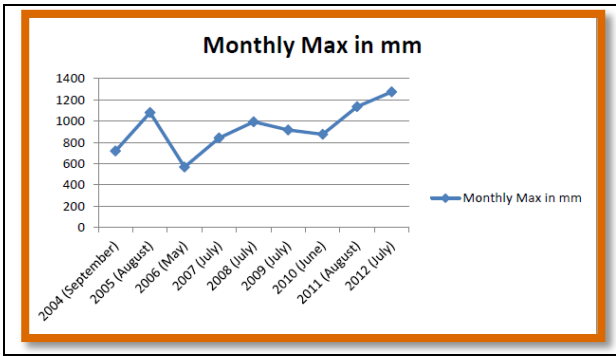


Figure 36: Monthly Maximum Rainfall of Sitakund

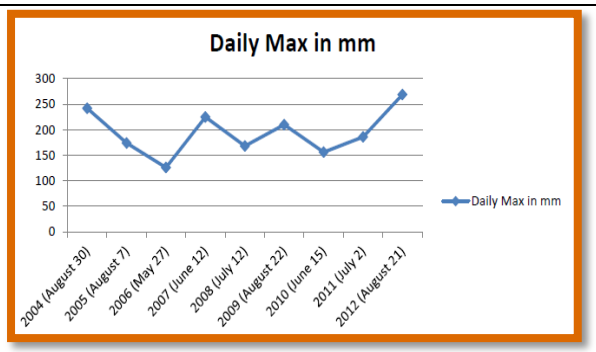


Figure 37: Daily Maximum Rainfall of Sitakund

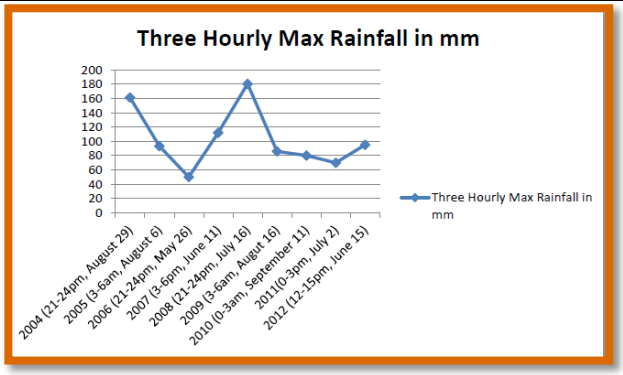


Figure 38: Three Hourly Maximum Rainfall of Sitakund

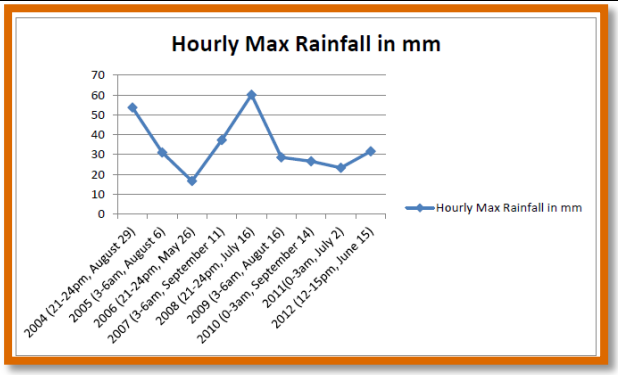


Figure 39: Hourly Maximum Rainfall of Sitakund

Source: BMD

5.4.4. Evaporation

Evapo-transpiration reaches its maximum level in April when temperature, sunshine and wind are all at, or close to, their maximum levels for the year. Potential evapo-transpiration data for 4 stations of the Chittagong Region are presented in table 28 below. Feni is nearest to the site at distance of app 15.0 km in NNW direction. In Feni evapo-transpiration varies from 68 to 145 mm/day and yearly evapo-transpiration in Feni is 1288 mm/day.

Table 22: Monthly Potential Evapo-Transpiration Data

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
Chandpur	68	82	129	146	139	107	109	112	103	101	77	62	1235
Comilla	71	89	138	152	144	120	118	122	111	103	81	64	1314
Feni	72	89	130	143	145	115	113	117	110	106	81	68	1288
Maijdee	67	83	125	145	141	106	106	115	104	101	78	66	1238

Source: BMD

5.4.5. Winds

Like the country's wind characteristics, the region is characterized by Southerly wind from the Bay of Bengal during monsoon and Northwesterly wind from Himalaya during winter. As per BMD, windiest month is May with average wind speed of 4 m/s and least windy month is October with average wind speed of 2m/s. Data on normal wind speed of the Chittagong and Sitakund area is given in table 29 below

Table 23: Normal Wind Speed Data of Chittagong and Sitakund Area

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
Chittagong	2.54	3.27	5.03	7.54	7.44	8.77	8.87	7.92	5.56	3.06	2.14	2.11	5.37
Sitakund	1.12	1.57	2.56	3.21	3.21	3.70	3.54	3.19	2.19	1.21	0.86	0.83	2.26

Units: m/s & Source: BMD

5.4.6. Sunshine Hours

The monthly average sun-shine hour in Chittagong varies from 4 to 9 hour/day in a year. Highest sunshine hurs are recorded in month of April, May and June. In general, maximum average sun-shine hour of 12 hour in a day is found in April, May & June.

5.5. Water Resources

5.5.1. Surface Water System & Drainage

Major water body within 10 km study area is river Feni, Feni reservoir, Isakhali canal and Bamon Sundar Canal. Project site lies in the flood plain of Feni River. Other water bodies in the 10 km radius area are Kachoppia khal, Daburkhali khal, Jailiachora khal, Kananchori khal, Maidrchora khal and Lambakhali khal.

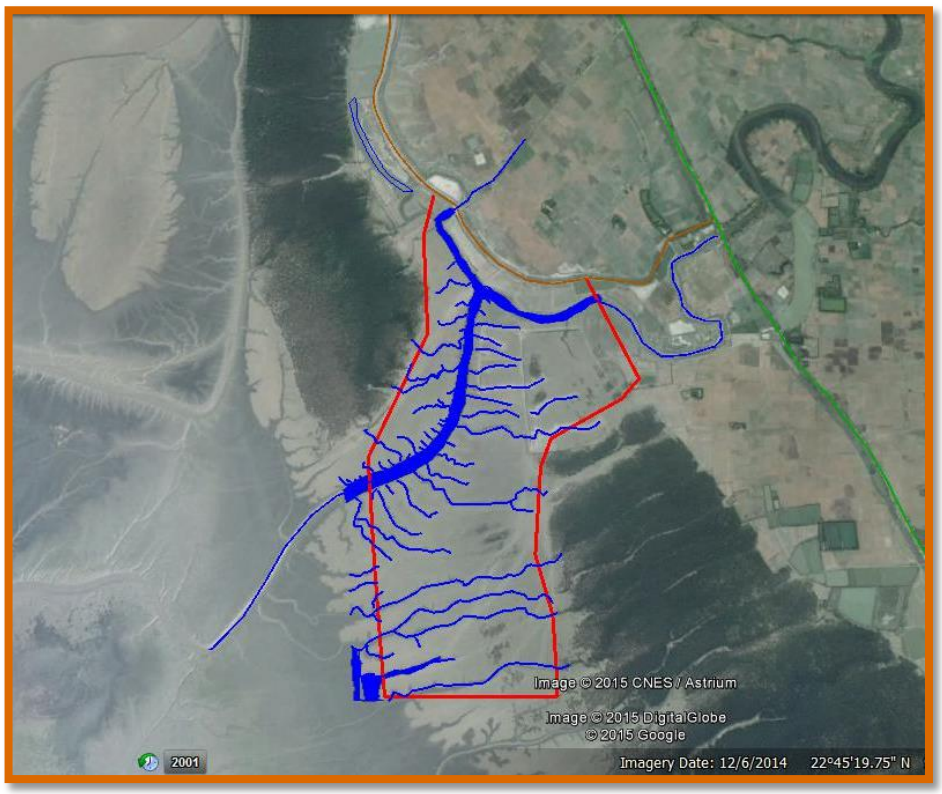
Feni River originates in the eastern hills of Tripura and enters Bangladesh at Belchhari of Matiranga Upzila of Khagrachhari District. If flows through Ramgarh (Khagrachhari), Fatikchhari (Chittagong) and then flows along the border of Chittagong (Mirershorai Upzila) and Feni (Chhagalnaiya, Feni, Sonagazi Upzila) districts, before discharging into the Bay of Bengal near Sonagazi. The length of the river is 108 Km. The principal tributary of the Feni River is the Muhuri River, which drains the Feni plain. Lemua canal is also a tributary to this river. Flow data of Feni River North of project site is given in figure 40 below.

Project site is wet land and it gets inundated fully during monsoon season. Forest area within the site gets flooded during monsoon and high tide. The area geo-morphologically is classified as coastal plains. Isakhali canal runs through the proposed EZ site and divides the project site into three parts. The canal is source of water for various villages in upstream. Water in Isakhali canal is controlled with help of sluice gate which is located in SW direction of the project site at entry point of the canal within the site. Whole site is criss cross with deep natural drains. Direction of flow is towards the Isakhali canal and the water from Isakhali canal is finally drained into the sea. Map showing drainage pattern within EZ and 10 km area is given below in figures 41 & 42.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1991	20.2	14.0	11.0	16.7	147.3	170.3	293.0	212.9	206.1	126.3	52.0	34.9
1992	21.8	19.3	119.9	13.3	15.4	113.6	49.9	132.5	96.6	57.8	22.5	9.5
1993	16.4	18.0	25.3	18.1	83.1	56.1	190.3	90.7	120.9	76.7	53.2	35.7
1994	30.2	23.5	4.5	27.7	47.8	100.6	277.6	146.5	111.8	80.8	47.5	42.8
1995	25.0	17.8	49.3	16.4	197.4	127.1	245.3	327.8	66.8	69.3	26.6	28.9
1996	16.1	14.4	12.0	12.2	74.9	154.0	60.0	128.0	41.0	99.0	166.7	19.7
1997	19.3	15.8	14.5	26.8	48.1	68.6	138.8	158.5	112.1	39.8	13.0	15.4
1998	32.2	31.7	24.3	43.4	86.1	256.6	112.7	176.2	197.3	69.2	49.0	26.4
1999	32.4	17.5	24.2	28.5	28.5	94.8	70.4	134.3	93.4	84.4	50.0	38.2
2000	25.2	34.1	43.8	48.9	122.5	143.2	184.1	245.8	125.4	90.8	92.6	77.3
2001	43.8	35.2	34.2	53.7	19.3	28.1	22.9	35.4	43.6	37.6	23.0	8.1
2002	4.1	1.7	1.1	1.0	2.2	32.2	222.9	72.7	23.4	23.0	9.3	4.1
2003	1.8	0.9	1.1	3.5	0.9	48.1	11.0	25.3	29.7	27.0	20.1	4.7
2004	1.3	0.8	0.7	10.5	0.7	72.7	107.8	363.6	236.3	250.1	174.9	144.5
2005	69.5	12.9	14.7	18.0	73.9	135.7	147.9	224.4	163.1	203.6	160.3	119.3
2006	85.8	82.0	81.7	95.4	90.1	169.1	214.3	313.1	137.2	117.4	90.2	83.7
2007	77.4	15.8	30.8	53.0	179.9	227.1	82.7	20.8	89.0	74.2	-	-
2008	21.4	14.7	15.1	14.1	19.4	31.5	52.2	114.0	104.9	103.3	102.2	100.7
2009	3.3	2.1	2.5	3.2	7.2	5.9	79.6	213.0	166.7	110.8	110.0	104.8
2010	40.7	11.6	7.4	7.3	27.2	89.5	76.4	86.5	76.4	91.9	55.1	34.1
2011	38.5	39.5	44.1	44.7	48.1	46.8	111.4	227.5	107.1	47.9	24.2	35.9
2012	33.0	27.9	33.5	34.0	106.6	119.1	99.5	-	-	-	-	-
Average	30.0	20.5	27.1	26.8	64.8	104.1	129.6	164.3	111.9	89.6	63.9	46.1
75% dependable	16.5	11.4	10.0	14.1	21.1	58.3	68.8	105.2	61.9	50.4	30.5	20.1

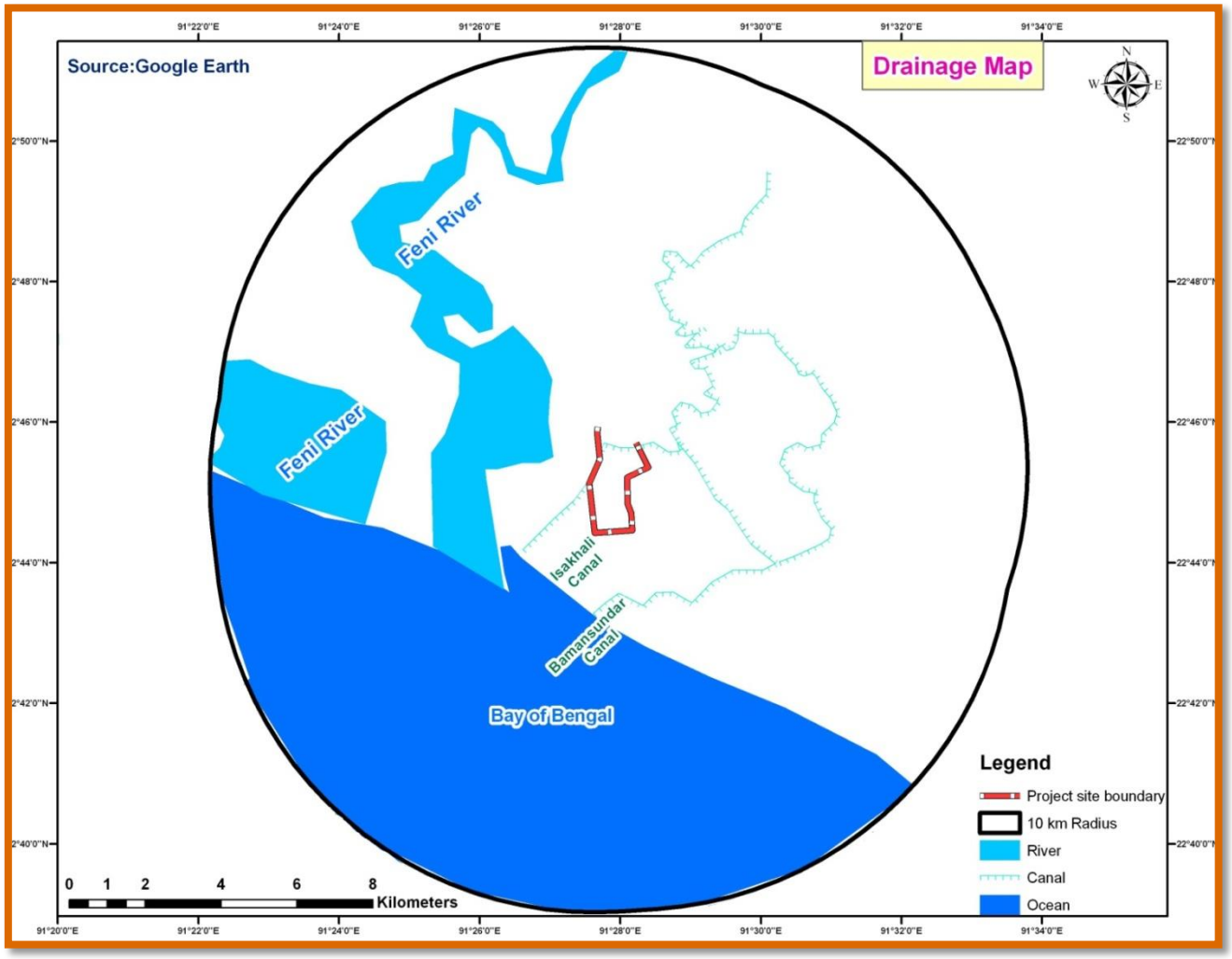
Source: IEE, BAN: Irrigation Management Improvement Project, Muhuri Irrigation Project, Chittagong

Figure 40: Flow Data of Feni River



Source: Google Earth

Figure 41: Drainage Pattern of EZ Site



Source: Mahindra

Figure 42: Drainage Pattern of 10 km Radius

5.5.2. Tropical Cyclones & Tidal flooding

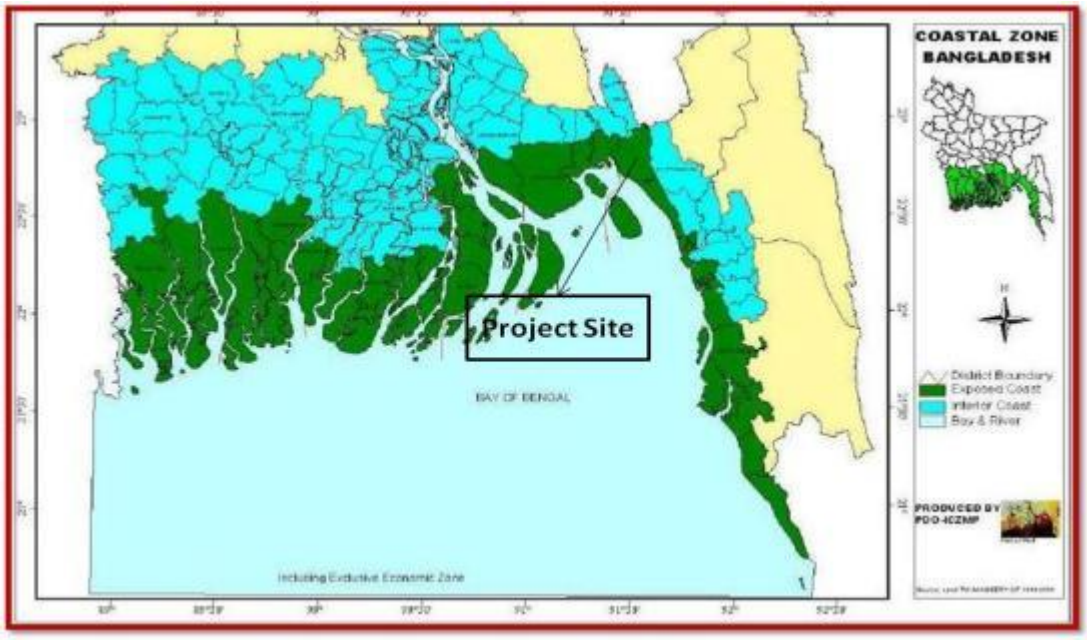
Bangladesh very often becomes the landing ground of cyclones formed in the Bay of Bengal. This is because of the funnel shaped coast of the Bay of Bengal, Most of the damage occurs in the coastal regions of Khulna, Patuakhali, Barisal, Noakhali and Chittagong and the offshore islands of Bhola, Hatiya, Sandwip, Manpura, Kutubdia, Maheshkhali, Nijhum Dwip, Urir Char and other newly formed islands. The coastal zone of Bangladesh is disaster prone. Project site is located in SE part of the coastal areas of Bangladesh. Map (figure 43) showing the coastal area of Bangladesh is given below. Mirershorai Upzila where the project site is located falls in the exposed coastal zone. Mean sea level has been measured by JICA in 1993 & 1994 and the data has been given below in table 30

Table 3024: Mean Sea Level Measured by JICA

Year	Total heights	Number of Values	Mean
1993	20,813.33	5,832	3.569
1994	26,944.64	7,866	3.425
Total	47,757.97	13,698	3.497 (average)

Source: JICA

Going through the collected data on tide levels of different years in the coastal areas of Bangladesh, it was found that the tidal height is about 3.5 meter in average. On normal occasions the tidal height varies from 3-4.5 metres. The highest surge height was found during the 1991 cyclone, about 6 meters.



Source: DMB

Figure 43: Coastal Map of Bangladesh

Numbers of cyclones have struck Chittagong in past and has cause severe damages at few times. As per the cyclone risk zone map (figure 44 & 46) of coastal area of Bangladesh, project site is located in the high risk area of Bangladesh. Cyclone risk zone and track map of Bangladesh is given in Figures below. Sixteen cyclones are recorded in last 25 years that had hit the coastal areas of Bangladesh. The maximum height experienced by the coastal belt in the Chittagong area was during the 1991 cyclone. It was among the deadliest tropical cyclones on record. Wind velocity was around 250 Km/h (155 mile/h) which caused the highest storm surge in the area with 6 meters (20 ft.) height. The death toll was 138,000 with approximately 40,000 in Anwara and Banshkhali area. The storm caused an estimated 1.5 billion US$ in damage. The high velocity wind and the storm surge devastated the coastline. The extensive damage

caused a huge increase in the price of building materials. The land level in Mirershorai region is quite high because it is located very close to the hilly areas of Sitakunda. That's why the damage here was not as much as the damage in the Anwara area. List of the major cyclones that had hit the Bangladesh coast is given in table 31 below.

Table 251: List of major cyclones of Bangladesh

Date & Year	Maximum Wind Speed (Km/hr)	Storm Surge height (meter)
30th October, 1960	211	4.6-6.1
30th May, 1961	160	6.1-8.8
28th May, 1963	203	4.2-5.2
11th May, 1965	160	6.1-7.6
15th December, 1965	211	4.6-6.1
1st November, 1966	146	4.6-9.1
23rd October, 1970	163	3.0-4.9
12th November, 1970	224	6.1-9.1
25th May, 1985	154	3.0-4.9
29th November, 1988	160	3.0-4.0
29th April, 1991	225	6.0-7.5
2nd May, 1994	210	2.0-3.0
25th November, 1995	140	2.0-3.0
19th May, 1997	220	3.1-4.2
2nd December, 2005 (Baaz)	--	--
14th May, 2007, (Akash)	--	--
15th November, 2007 (Sidr)	240	Up to 10
26th October, 2008 (Rashmi)	--	--
17th April, 2009 (Bijli)	--	--
25th May, 2009 (Aila)	120	3.0
16th May, 2013 (Viyaru)	--	--

Source: Banglaesh Disaster Knowledge Network & BMD

1960 (30-31 October) Chittagong, Noakhali, Bakerganj, Faridpur, Patuakhali and eastern Meghna estuary; severe cyclonic storm, maximum wind speed 210 km/h, surge height 4.5m -6.1m; about 10,000 persons killed, 27,793 cattle lost and 568,161 houses destroyed (especially 70% of houses in Hatiya blown off), two large ocean liners washed ashore, 5-7 vessels capsized in Karnafuli river.

1963 (28-29 May) Chittagong, Noakhali, Cox's Bazar and the offshore islands of Sandwip, Kutubdia, Hatiya and Maheshkhali were badly affected; severe cyclonic storm with stormwave rising 4.3-5.2m in Chittagong, maximum wind speed 203 km/hr and at Cox's Bazar 164 km/hr; more than 11,520 people killed, 32,617 cattle lost, 376,332 houses, 4,787 boats and standing crops destroyed.

1966 (1 October) Sandwip, Bakerganj, Khulna, Chittagong, Noakhali and Comilla; severe cyclonic storm with storm-waves of 4.7-9.1m, maximum wind speed 146 km/hr; affected 1.5 million people, loss of human life and livestock were 850 and 65,000 respectively in Noakhali and Bakerganj.

1970 (12-13 November) The most deadly and devastating cyclonic storm that caused the highest casualty in the history of Bangladesh. Chittagong was battered by hurricane winds. It also hit Barguna, Khepupara, Patuakhali, north of Char Burhanuddin, Char Tazumuddin and south of Maijdi, Haringhata and caused heavy loss of lives and damage to crops and property. Officially the death figure was put at 500,000 but it could be more. A total of 38,000 marine and 77,000 inland fishermen were affected by the cyclone. It was estimated that some 46,000 inland fishermen operating in the cyclone affected region lost their lives. More than 20,000 fishing boats were destroyed; the damage to property and crops was colossal. Over one million cattle head were reported lost. The maximum recorded wind speed of the 1970 cyclone was about 222 km/hr and the maximum storm surge height was about 10.6m and the cyclone occurred during high-tide.

1974 (24-28 November) Coastal belt from Cox's Bazar to Chittagong and offshore islands; severe cyclonic storm with a wind speed of 161 km/h and storm surge of 2.8-5.2 m; 200 people killed, 1000 cattle lost and 2,300 houses perished.

1977 (9-12 May) Khulna, Noakhali, Patuakhali, Barisal, Chittagong and offshore islands; cyclonic storm with a wind speed of 112.63 km/h.

1983 (14-15 October) Offshore islands and chars of Chittagong and Noakhali; severe cyclonic storm with a wind speed of 122 km/h; 43 persons killed, 6 fishing boats and atrawler lost, more than 150 fishermen and 100 fishing boats missing and 20% Aman crops destroyed.

1983 (5-9 November) Chittagong, Cox's Bazar coast near Kutubdia and the low lying areas of St Martin's Island, Teknaf, Ukhia, Moipong, Sonadia, Barisal, Patuakhali andNoakhali; severe cyclonic storm (hurricane) with a wind speed of 136 km/h and a storm surge of 1.52m height; 300 fishermen with 50 boats missing and 2,000 houses destroyed.

1985 (24-25 May) Chittagong, Cox's Bazar, Noakhali and their offshore islands (Sandwip, Hatiya, and Urirchar); severe cyclonic storm, wind speed Chittagong 154 km/h, Sandwip 140 km/h, Cox's Bazar 100 km/h and storm surge of 3.0-4.6m; about 11,069 persons killed, 94,379 houses damaged, livestock lost 135,033 and road damaged 74 km, embankments damaged.

1986 (8-9 November) Offshore island and chars of Chittagong, Barisal, Patuakhali and Noakhali; cyclonic storm hit 110 km/h at Chittagong and 90/h at Khulna; 14 persons killed, damaged 97,200 ha of paddy fields.

1991 (29 April) The Great Cyclone of 1991, crossed the Bangladesh coast during the night. It originated in the Pacific about 6,000 km away and took 20 days to reach the coast of Bangladesh. It had a dimension of more than the size of Bangladesh. The central overcast cloud had a diameter exceeding 600 km. The maximum wind speed observed at Sandwip was 225 km/hr. The wind speeds recorded at Chittagong is 160 km/hr. The maximum storm surge height during this cyclone was estimated to be about 5 to 8m. The loss of life and property was colossal. The loss of property was estimated at about Tk 60 billion. The death toll was estimated at 150,000; cattle head killed 70,000.

1991 (31 May to 2 June) Offshore islands and chars of Patuakhali, Barisal, Noakhali and Chittagong; cyclonic storm, maximum wind speed 110 km/h and surge height of 1.9m; people killed, cattle head perished, boats lost and standing crops destroyed.

1997 (16-19 May) Offshore islands and chars of Chittagong, Cox's Bazar, Noakhali and Bhola; severe cyclonic storm (hurricane) with a wind speed of 225 km/h, storm surge of 3.05m (similar strength to that of 1970 cyclone); only 126 people killed because of better disaster management measures taken by the government and the people.

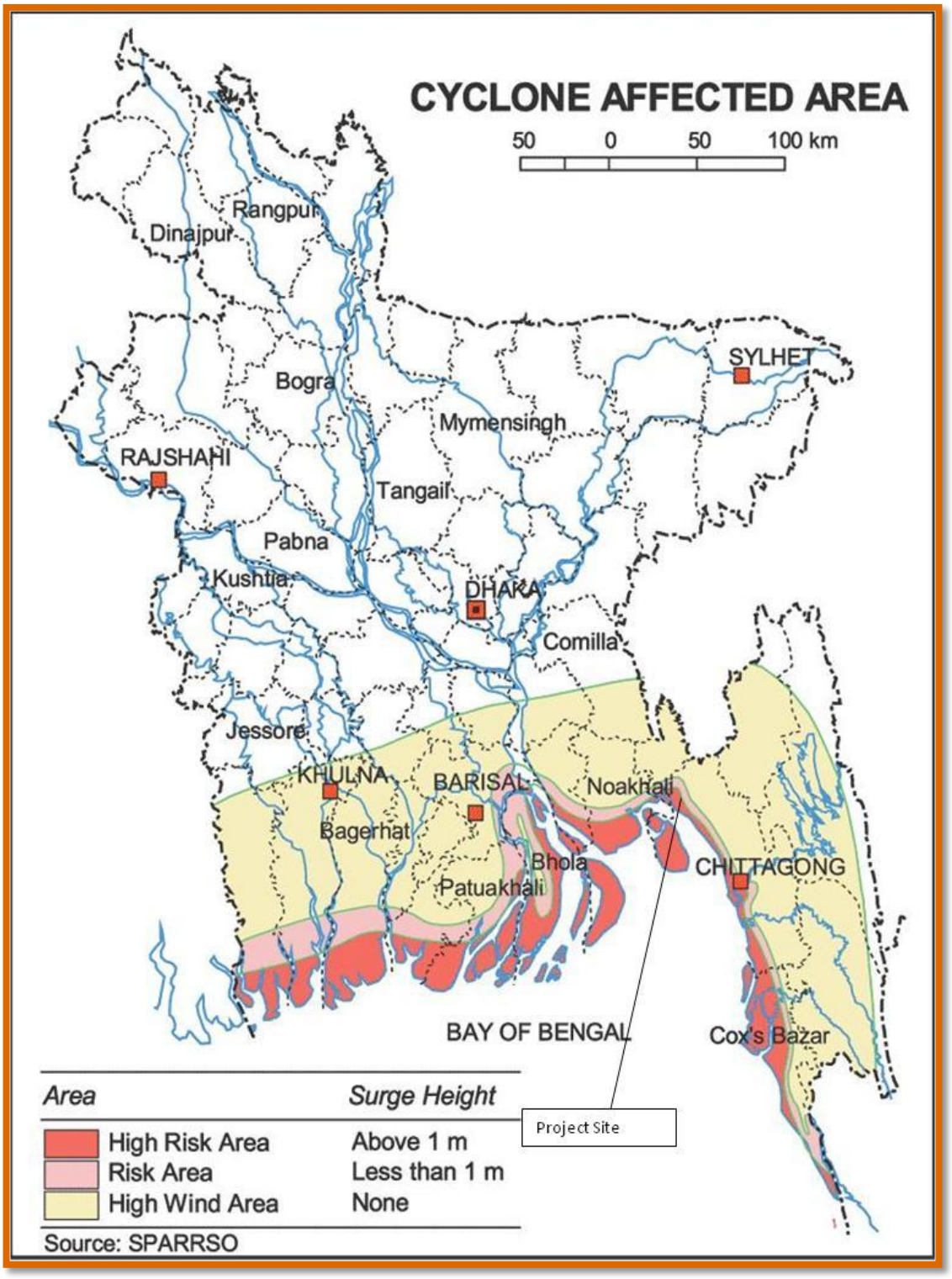
1997 (25-27 September) Offshore islands and chars of Chittagong, Cox's Bazar, Noakhali and Bhola; severe cyclonic storm (hurricane) with a wind speed of 150 km/h, storm surge of 1.83 to 3.05m.

1998 (16-20 May) Offshore islands and chars of Chittagong, Cox's Bazar and Noakhali; severe cyclonic storm (hurricane) with a wind speed of 150 km/h, storm surge of 1.83 to 2.44m.

2007 (12-15 May) Upon striking Bangladesh, Cyclonic Storm Akash produced a moderate storm tide, along with strong winds and heavy rains. The storm left dozens of boats missing, with three fisherman confirmed killed and another 50 missing. Near the coast, thousands of houses were damaged from the flooding caused by the storm. Cyclone Sidr formed in 2007 did not put much affect in this area.

2009 (14-17 April) Cyclonic Storm Bijli formed from an area of Low Pressure on April 14. As the storm neared landfall, ports in Chittagong raised their warning level to seven. Following the increased warning level, an estimated 10,000 evacuated from coastal regions. Weather officials estimated that the storm would produce a storm surge of 2.1 to 3 m (7 to 10 ft). On April 17, all flights in and out of Bangladesh were cancelled due to dangerous conditions. Shelters were also opened and were reportedly able to accommodate about one million people.

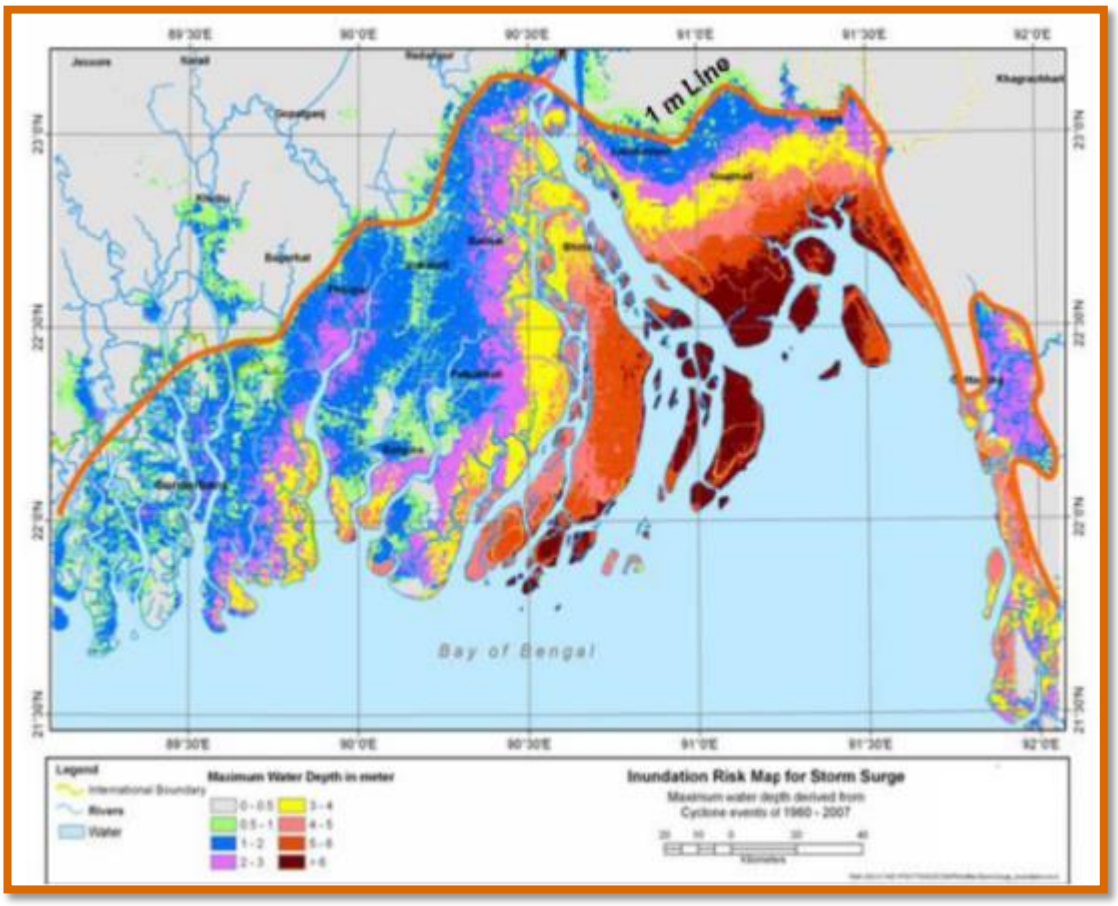
2009 (23-26 May) Cyclonic Storm Aila was about 475 km southwest of Chittagong port, 435 km southwest of Cox's Bazar port and 345 km south southwest of Mongla port. Maritime ports of Chittagong and Cox's Bazaar had been advised to keep hoisted danger signal number 6. Maximum sustained wind speed within 54 km of the storm centre was about 70 km/h rising to 90 kph in gusts or squalls.



Source: DMB

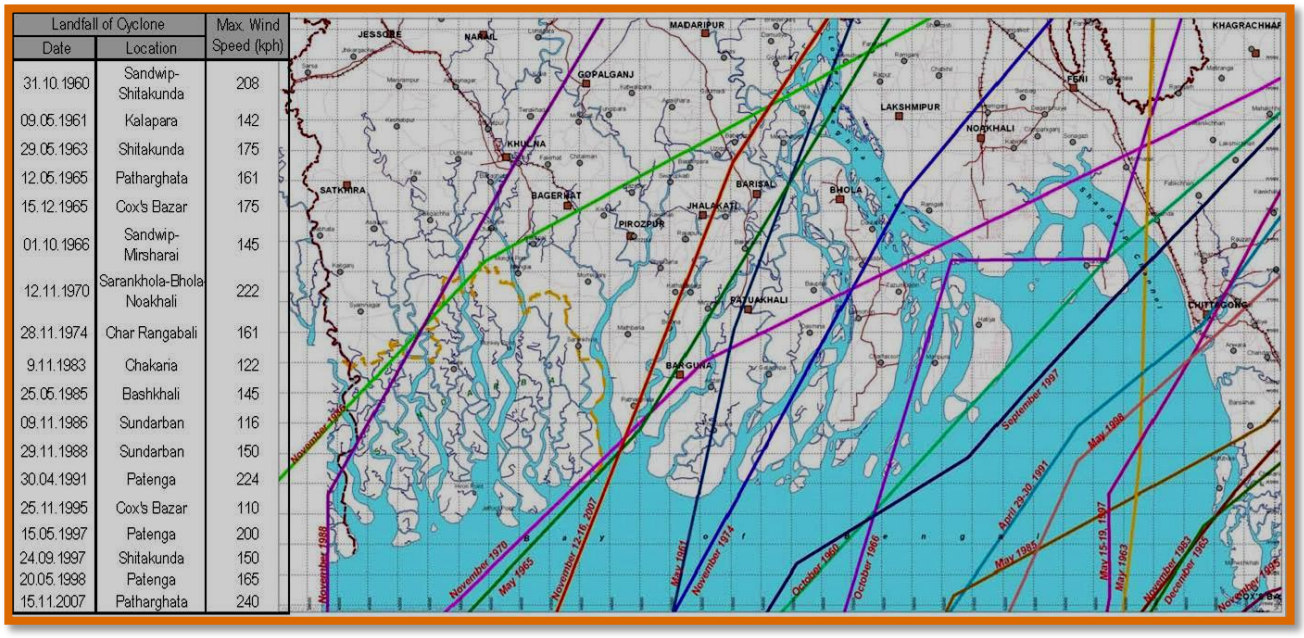
Figure 44: Cyclone Risk Zone Map

The inundation risk map (figure 45) for storm surge shows that the highest inundation depth having range between 5 m and 6 m lies in the Mirershorai area. Cyclone tracking map (figure 46) of the Bangladesh shows the Tropical cyclones from the Bay of Bengal accompanied by storm surges are one of the major disasters in Bangladesh. The country is one of the worst sufferers of all cyclonic casualties in the world. The high number of casualties is due to the fact that cyclones are always associated with storm surges.



Source: IWM

Figure 45: Inundation Risk Map for Storm Surge



Landfall of Cyclone		Max. Wind Speed (kph)
Date	Location	
31.10.1960	Sandwip-Shitakunda	208
09.05.1961	Kalapara	142
29.05.1963	Shitakunda	175
12.05.1965	Patharghata	161
15.12.1965	Cox's Bazar	175
01.10.1966	Sandwip-Mirsharai	145
12.11.1970	Sarankhola-Bhola-Noakhali	222
28.11.1974	Char Rangabali	161
9.11.1983	Chakaria	122
25.05.1985	Bashkhali	145
09.11.1986	Sundarban	116
29.11.1988	Sundarban	150
30.04.1991	Patenga	224
25.11.1995	Cox's Bazar	110
15.05.1997	Patenga	200
24.09.1997	Shitakunda	150
20.05.1998	Patenga	165
15.11.2007	Patharghata	240

Source: IWM

Figure 46: Cyclone Storm Track Map

Several cyclones protection measures have been taken by Govt. of Bangladesh for protection of inland area from cyclones. Mirershorai coastline is protected by two bunds constructed by Bangladesh water Development Board and under Char Development and Settlement Project. These two bunds protect inland area from tidal flooding. Also Mangrove plantation has been carried out along the coast line to further protect inland area. EZ site proposed is towards seaside of these bunds. Further to protect the EZ site from the flooding, a bund is proposed to be developed at the site. This bund will cover the project site in West, NW and SW area. North and South side is protected by the Mangrove forest planted by Forest Department (Coastal) of Mirershorai to protect inland area from tidal flooding. A peripheral drain and the Isakhali canal will be maintained within the site for drainage of storm water. Apart from this various cyclone shelters has been constructed near the EZ site by Ministry of Disaster Management and Relief. Photographs showing the protection measures taken by GoB for protection during Storms are given in figure 47 below.

	
CDSP Bund	Sluice Gate for Isakhali Channel

Cyclone Shelter Near EZ Site

Figure 47: Cyclone Safety Measures in Area

Tornado

It is the pre-monsoon period when most of the abnormal rainfall or drought conditions frequently occur in different parts of Bangladesh. Also there are severe local seasonal storms, popularly known as nor'westers (kalbaishakhi). Severe nor'westers is generally associated with tornadoes. Tornadoes are embedded within a mother thundercloud, and moves along the direction of the squall of the mother storm. The frequency of devastating nor'westers usually reaches the maximum in April, while a few occur in May, and the minimum in March. Nor'westers and tornadoes are more frequent in the afternoon. Nor'westers may occur in late February due to early withdrawal of winter from Bangladesh. The occasional occurrence of nor'westers in early June is due to the delay in the onset of the southwest monsoon over the region (Karmakar, 1989). List of the nor'westers and tornadoes is given in table 32 below.

Table 26: List of Tornadoes had hit the Bangladesh

Date	Location
14th April, 1969	Demra (Dhaka)
17th April, 1973	Manikganj (Dhaka)
10th April, 1974	Faridpur
11th April, 1974	Bogra
9th May, 1976	Narayanganj
1st April, 1977	Faridpur
26th April, 1989	Saturia (Manikganj)
14th May, 1993	Southern Bangladesh
13th May, 1996	Tangail
4th May, 2003	Brahmanbaria
21st March, 2005	Gaibandha

Source: Bangladesh Disaster Knowledge Network

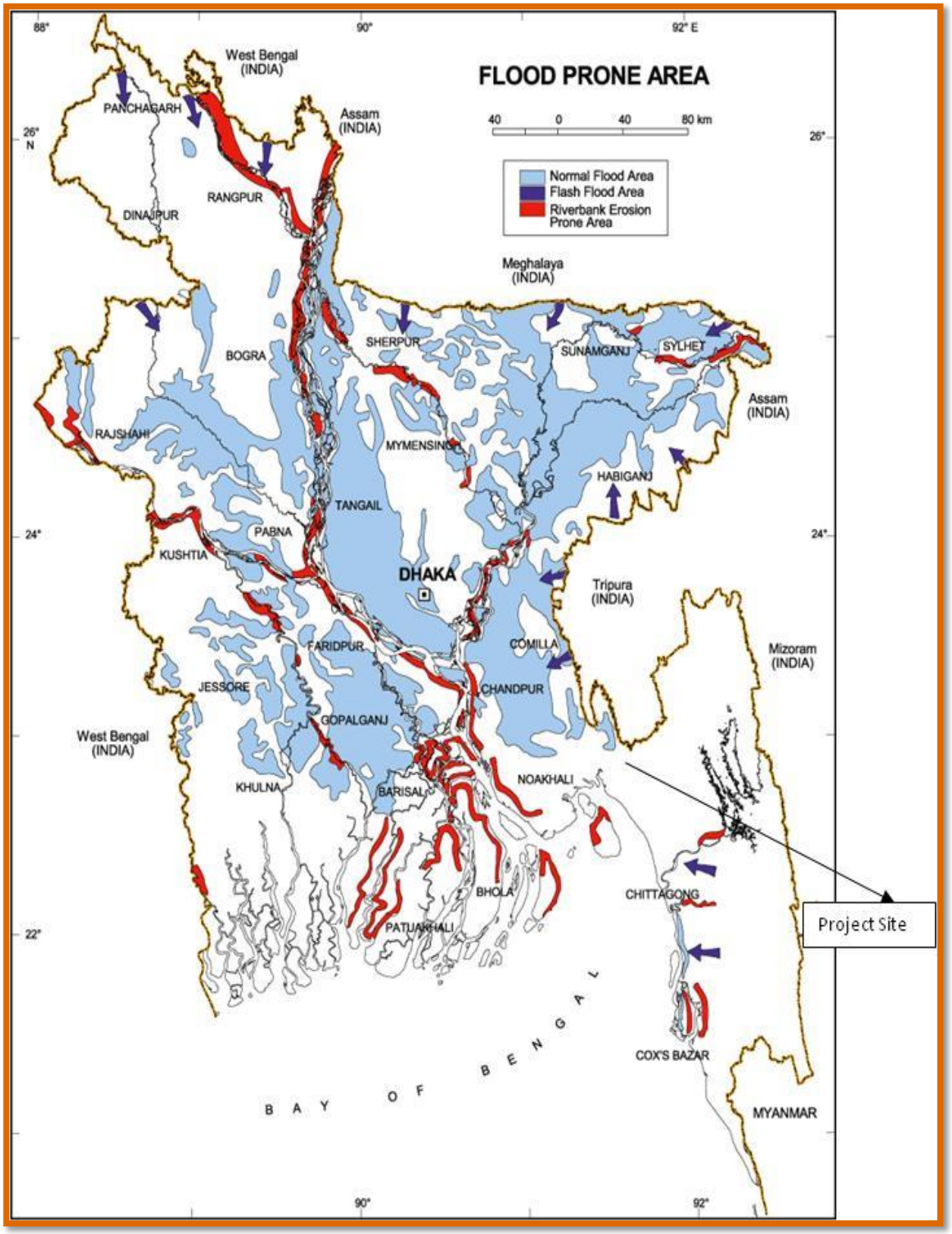
Floods

Floods are the most significant natural hazard in the country causing extensive damage to human life and property. The country lies on the downstream part of three major river basins: Brahmaputra, Ganges and Meghna and thus is frequently flooded. There have been many destructive floods in Bangladesh, including very severe floods of 1987, 1988 and 1998. The 1988 flood set

a new record for flooded area, while 1998 flood was unprecedented with its long duration. The flood damage potential in Bangladesh is increasing due to the possible causes of climate change, urban concentration in the three river basins, encroaching of settlements into flood prone areas, and overreliance on the safety provided by flood control works such as levees, reservoirs. There are two types of floods which occur in Bangladesh: annual floods (barsha) that inundate up to 20% of the land area; and low frequency floods of high magnitude that inundate more than 35% of the area (bonna). The major floods that occurred in 1954, 1955, 1974, 1984, 1987, 1988, 1993, 1998, 1999, 2000 and 2007 have been very destructive and caused serious threat to lives and economy. In the context of human exposure in flood hazard zones, nearly 19,279,960 people are present in these zones and Bangladesh ranks 1st among 162 nations. Similarly, the modeled amount of GDP in seismically hazardous zones puts Bangladesh 3rd among 162 countries. Flood hazard map of the Bangladesh is shown in figure 48 below.

Major River in the study area is Feni River. Feni River receives flow from Muhuri river, Lemua canal and various other khals.

During the monsoon for the period 2000-2004, the mean and maximum ranges of the tide in the Feni estuary have been found to be 3.50m and 5.50m respectively. The tides have also been studied on the basis of annual maximum High Water Level data collected over the periods 1985 to 2004 at the gauge downstream of the Feni regulator in the Feni River. The maximum high water level and mean of annual maximum high water level of Feni River, near Feni regulator, is about 6.0m and 5.276m (SOB-Survey of Bangladesh) respectively over the 20 years period. The seasonal mean high water level of the Feni River near the Feni regulator for the period 2000-2004 is also shown in table 33 below. From this table it has been found that the average mean high water level during pre-monsoon, monsoon, post-monsoon and the dry period are 3.47m, 4.14m, 3.61m and 2.69m respectively. Analysis of the daily mean high water level of Feni River downstream of the Feni regulator from 2000-2004 shows that the monsoon high water level exceeds 4.50m (PWD-Public Works Department) elevation few times a year (PWD= SOB + 0.46).



Source: DMB

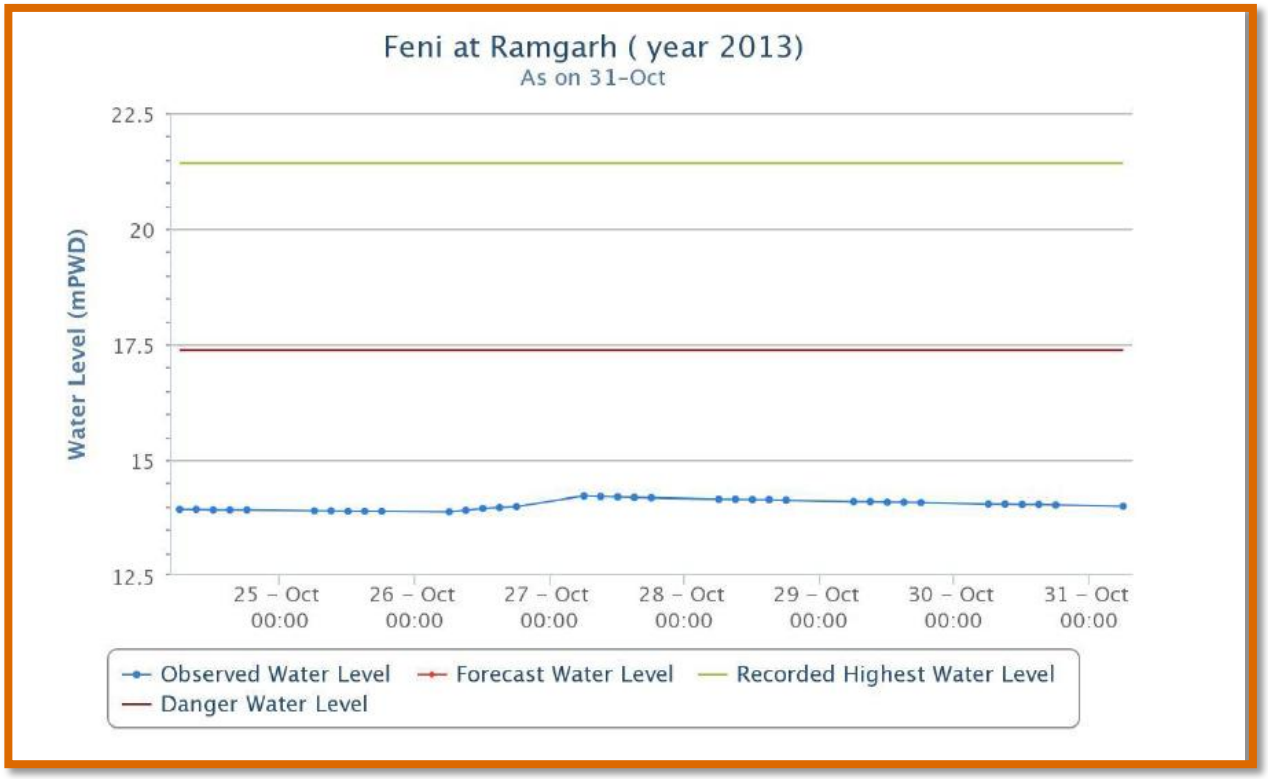
Figure 48: Flood Prone Area Map

Table 27: Mean High Water Level of Feni River Downstream of Feni River Regulator for the Period 2000-2004

Year	Mean Water Level in Meters			
	Pre Monsoon (March- May)	**Monsoon (June-Sept.)**	**Post Monsoon (Oct.-Nov.)**	**Dry Period (Dec-Feb)**
2000	3.46	4.3	3.62	2.79
2001	3.36	4.05	3.49	2.67
2002	3.38	4.04	3.55	2.56
2003	3.42	4.11	3.76	2.73
2004	3.73	4.23	--	--
Mean	3.47	4.146	3.605	2.6875

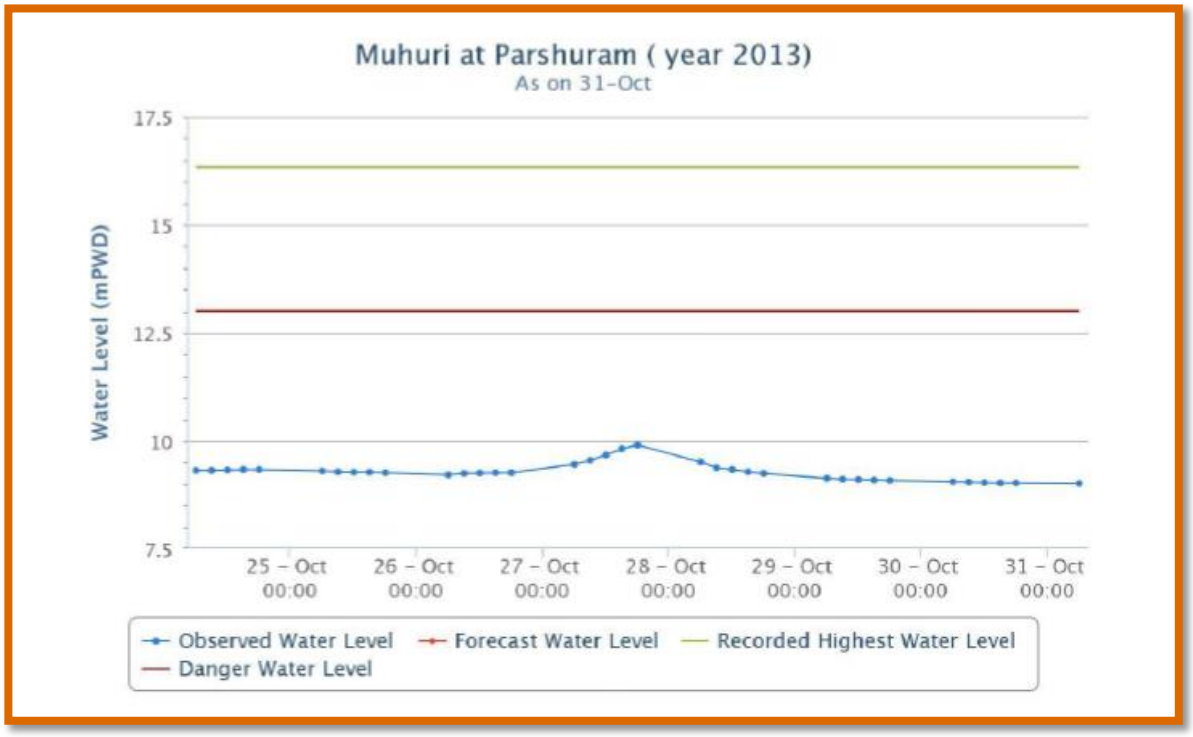
Source: IEE, BAN: Irrigation Management Improvement Project, Muhuri Irrigation Project, Chittagong

According to the web data from the Flood Forecasting & Warning Centre, the Bangladesh Water Development Board (BWDB), the past maximum water surface level is +17.49 m in Ramgarh. This point is 50 Km upstream of the EZ site. In Parshuram (80 Km upstream of EZ) the Muhuri River had a past highest water level of +13.0 m. These figures are critical for designing the flood protection system.



Source: BWDB

Figure 49: Past Maximum River Surface level at Ramgarh

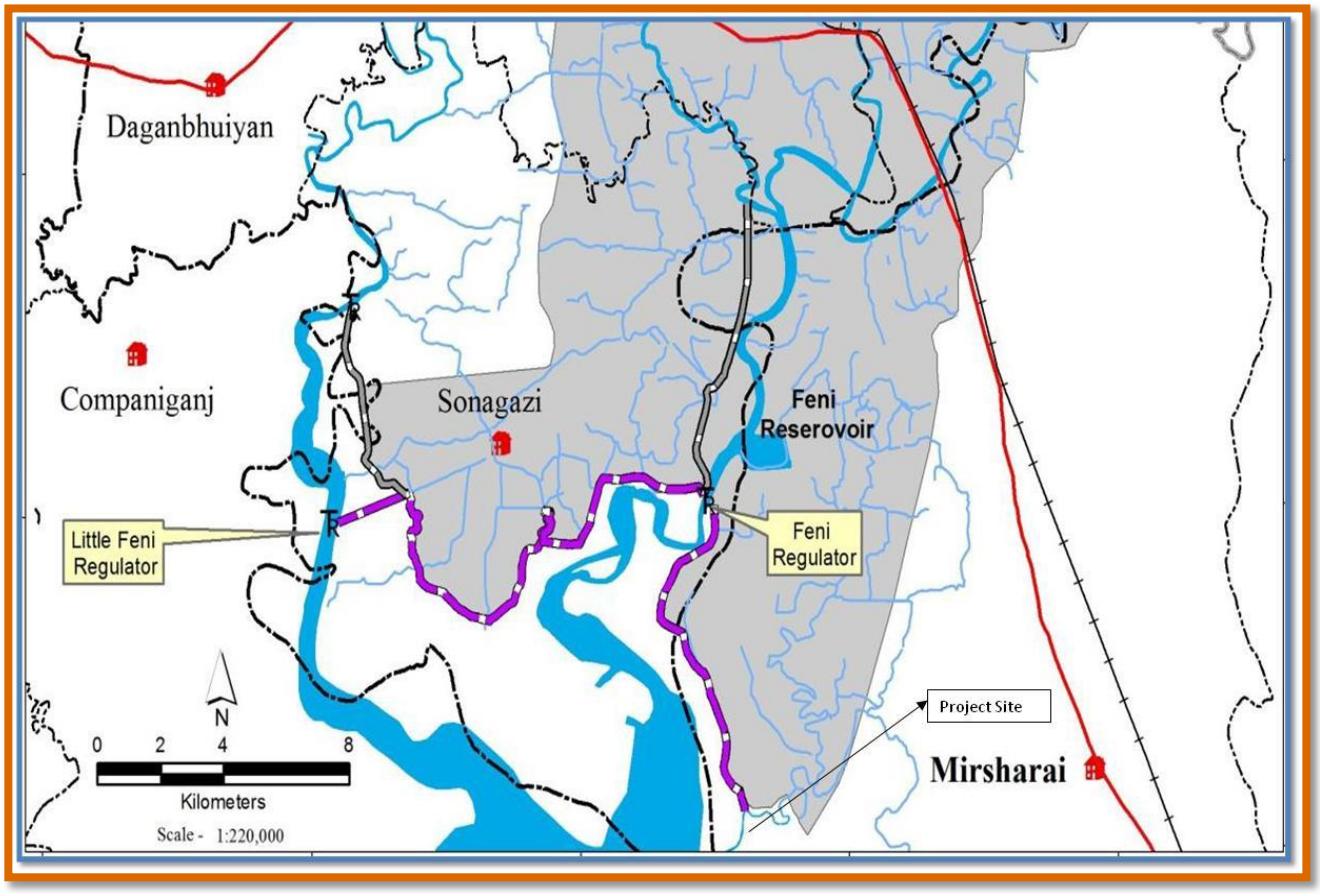


Source: BWDB

Figure 50: Past Maximum River Surface level at Parshuram

5.5.3. Salinity

River Feni is Major River in the study area. Feni River carries fresh water in upstreams, i.e above coastal embankment (Muhuri Project Road). In down streams water of Feni River is saline due to tidal influence. Salinity is more during lean season. Influx of saline water within the river is controlled with the help of regulators/gates. Map (figure 51) showing location of regulators in Feni River is shown below. Maximum salinity in Feni River is 21.2 ppt (The World bank, Department Research Group, Environment and Energy Team, March, 2014)



Source: IEE, BAN: Irrigation Management Improvement Project, Muhuri Irrigation Project, Chittagong & Site Visit

Figure 51: Map showing location of Regulators in Feni River

In many parts along the coast of this region brackish/saline water of marine origin renders the groundwater unsuitable for irrigation and potable water supply. In addition, extensive areas are found in the central and western parts of the region where the groundwater salinity exceeds 1000 µs/cm, and 2000–8000 µs/cm locally (WARPO).

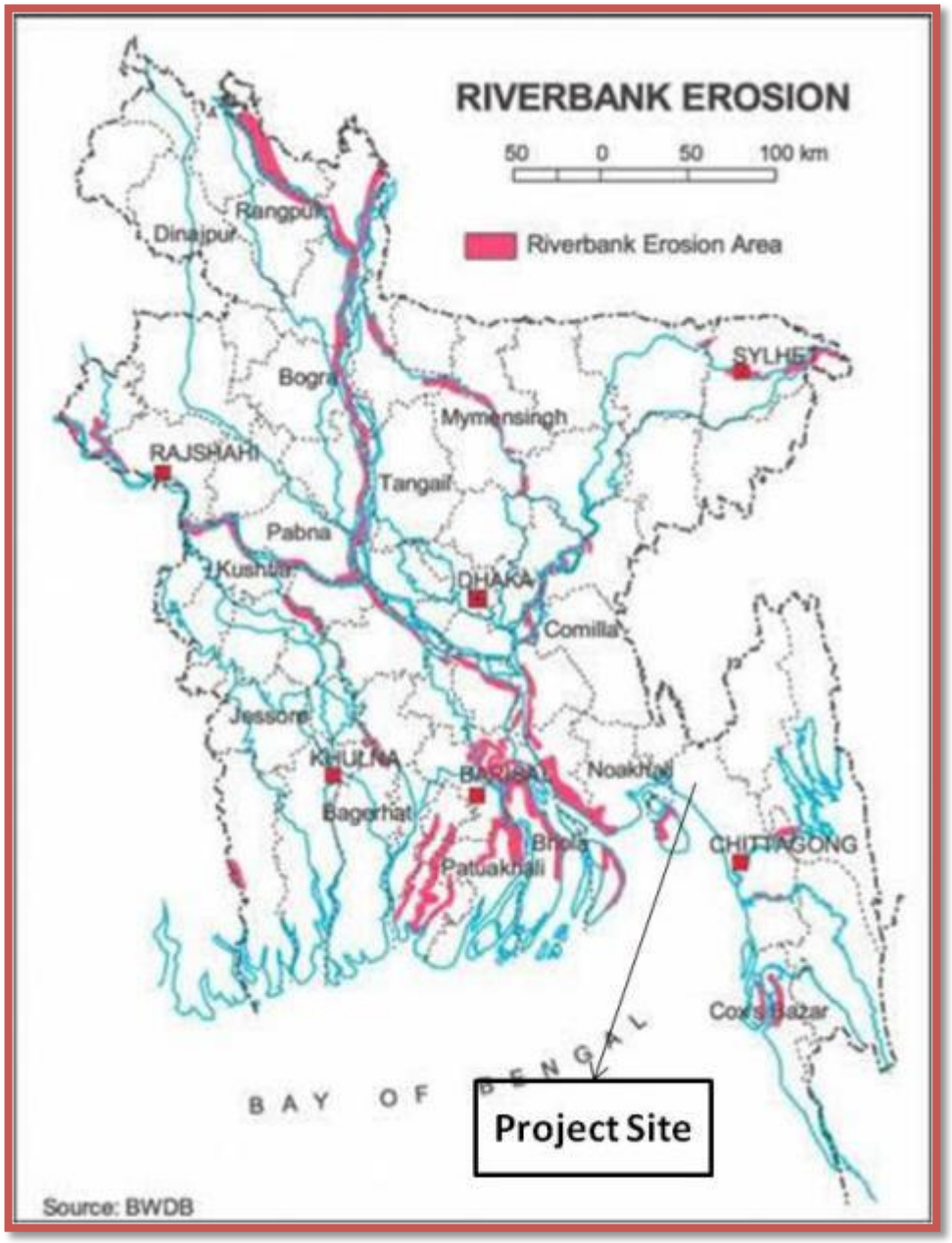
5.5.4. Drainage Congestion and Water Logging

The project area is covered with the clay and sand deposits brought by the fenny river. Project site is wetland and gets inundated during monsoon. Water logging is observed at site during monsoon season. Water enters the site (in forest area) during high tide. According to the information collected through focus group discussions (FGD), the area is affected in normal floods. But during heavy rainfall and sometimes during high tide cause water stagnation in the area for some time. Drainage is good; as water drains out quickly through canal lines with insignificant water logging problem

Storm water on site drains through the Isakhali canal flowing on the site. Storm water in upstreams does not enter the site due to presence of BWDB & CDSP embankment. Storm water in upstreams drains through Isakhali and Bamon Sundar canal. Site is criss-crossed with deep drains which joins the Isakhali canal. Isakhali canal drains into sea. A sluice gate is located in SW direction from EZ site which control the water level in Isakhali canal.

5.5.5. Erosion and Sedimentation

No erosion site at EZ site and at river bank is observed. Map showing areas prone to river bank erosion is given below in figure 52.



Source: http://www.livingwiththejamuna.com/essayintroduction.html

Figure 52: Map showing river bank erosion of Bangladesh

5.5.6. River Morphology

River Feni is morphologically stable. The change in river course since 1955 is presented in the following figures 53-56**.**

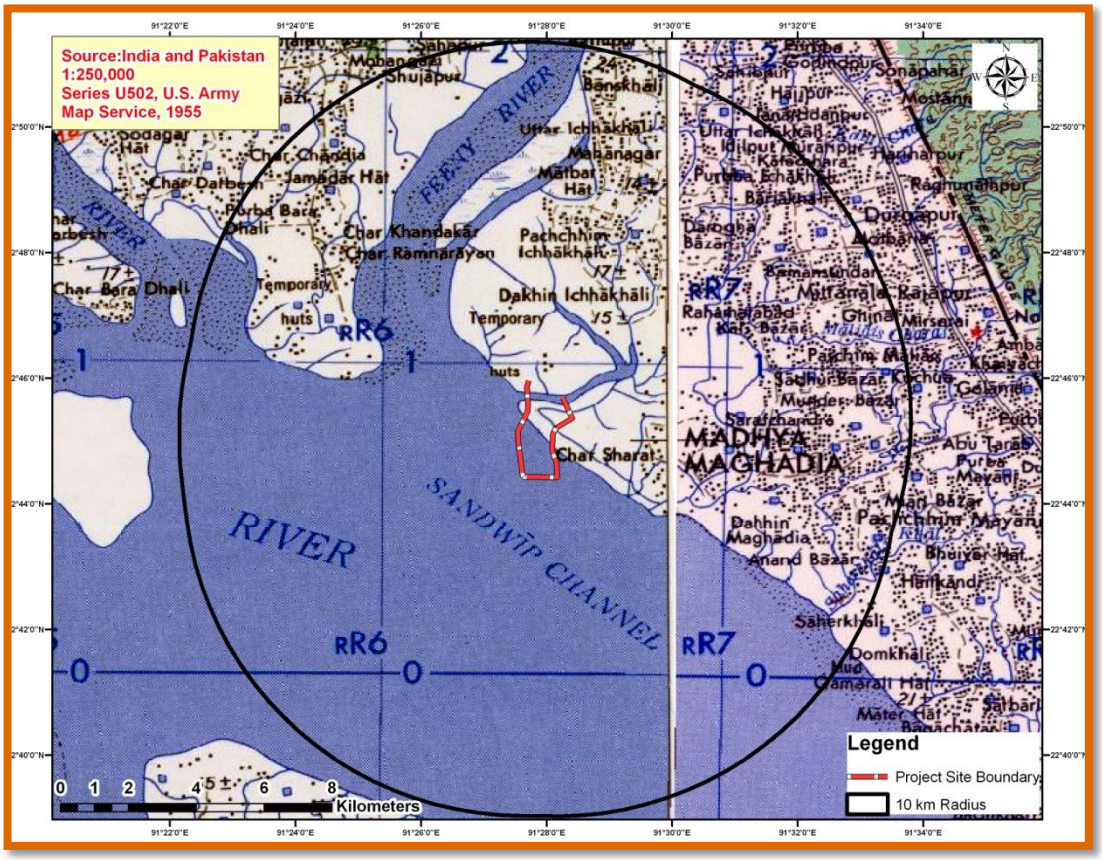


Figure 53: Toposheet Map (1955) showing course of Feni River

Source: Google Earth

Figure 54: Google Image (2006) showing course of Feni River

Source: Google Earth

Figure 55: Google Image (2011) showing course of Feni River

Source: Google Earth

Figure 56: Google Image (2014) showing course of Feni River

5.5.7. Navigation

Navigability of rivers in Bangladesh has been deteriorating steadily over the years. The withdrawal of water beyond the border and within Bangladesh for irrigation and other purposes has resulted in decreased navigability of rivers during dry season resulting in gradual channel decline.

The river network connects almost all the country's major cities, towns and commercial centers. Moreover, being cheap, safe and environmentally friendly, inland water transportation is often the only mode that serves the poor, proving especially useful during periods of widespread flooding.

Currently, container feeder service is available from Chittagong Port to Port Klang (daily); Port of Singapore (daily); and Colombo Port (every 2-3 days) for connecting the mother vessels serving international destinations. More than 5 feeder vessel operators with vessels capacity of 1,000 -1,500 boxes (containers) have deputed their feeder vessels in this circuit. The transit time is about 3-4 days from /to Chittagong Port to the hub ports. All international Shipping Lines have their presence in Bangladesh and some even operate their own feeder vessels.

Due to the steady growth in traffic volume, Chittagong Port performs well on the financial front. It is financing its 3rd Port development project at Paira Bandar with its own resources. Statistics of cargo handled at the Chittagong Port is given in the annex.

The third port, Paira Seaport, was inaugurated by the Prime Minister on 19th November 2013. It is on Rabnabad channel - which is 31 Km from the sea boundary, 316 Km from Chittagong, 130 Km from Mongla port and 340 Km from the capital. This port shall have draft of 8 -10 m when in operation.

In addition to the Pangaon ICT, the Government of Bangladesh granted approval to establish a container port on the bank of the Meghna River in Narayanganj District to the Ananda Group in November 2013. It will be the fifth inland container terminal (ICT) in the private sector. Approvals for establishing ICTs have already been granted to the Rupayan Group, Kumudini Welfare Trust, AK Khan and Company and Cemcor. Meanwhile, the Ministry of Shipping, GoB, is finalizing a draft of guidelines for establishing ICTs under private sector investment. A deep sea port is also proposed to be constructed at Sonadia, Cox Bazar. To develop inland waterway transportation, a jetty is also required to be proposed for the project.

5.5.8. Surface Water Quality

Feni River is the main river in the study area. Water in upstreams of Muhuri Project Road in Feni river is fresh whereas in downstream it is saline due to tidal influence. Surface water quality data for Feni & Muhuri River for year 2008-2009 is given in table 34 below

Table 28: Surface Water Quality Data Upstream and Downstream of Project Site

Parameters	Units	Feni River	Muhuri River
pH	-	7.47	7.16
Temperature	^{o}C	30.60	31.60
EC	μScm^{-1}	13710.00	65.90
TDS	mg/l	6854.95	32.70
DO	mg/l	7.45	4.88
Transperency	cm	30.0	25.0
Acidity	mg/l	13.26	8.84
Total alkality	mg/l	99.86	66.82
Total hardness	mg/l	52.0	40.0
Chloride	mg/l	2720	11.48
BOD	mg/l	1.97	2.61
COD	mg/l	2.94	2.87
NO_2-	mg/l	0.111	0.017
NO_3-	mg/l	1.0	0.03
PO_4^{3}-	mg/l	1.77	0.86

SO_4^{2-}	mg/l	4.32	4.01
Ni	mg/l	BDL	BDL
Zn	mg/l	0.054	0.048
Cu	mg/l	BDL	BDL
Co	mg/l	0.042	0.044
Cr	mg/l	0.012	0.019
Cd	mg/l	BDL	BDL
Pb	mg/l	0.070	0.012
Fe	mg/l	0.730	0.835
Mn	mg/l	0.250	0.17
% NaCl	%	0.100	0.100

Source: Rahman, Haque & Ahmed, 2011, University of Chittagong

Average value of pH of the River Feni (7.47) & Muhuri (7.16) was found in the alkaline region. EC and TDS found for the Feni (13710.00 µScm-1 and 6854.95 mgL-1) & Muhuri (65.90 µScm-1 and 32.70 mgL-1) respectively. Higher values were found for the Feni River. This is due to the tidal effect of sea water into these rivers. DO found for the River Feni is 7.45 mgL-1 and for Muhuri River is 4.88 mgL-1. For many fish and shellfish, extended periods of DO below 5 mg L-1 can cause adverse effects to larval life stages (EPA 1986). Acidity values found for the Feni river is 13.26 mgL-1 & Muhuri River is 8.84 mgL-1. Total alkalinity of the Feni (99.86 mgL-1) & Muhuri (66.82 mgL-1) is within the acceptable limit of EPA freshwater aquatic life criteria. Total alkalinity of these rivers is mainly for carbonates and bicarbonates as phenolphthalein alkalinity was not detected in any of the samples.

Total hardness found for the Feni River is 2720.00 mgL-1 and Muhuri River is 40.00 mgL-1. According to EPA classification water of Muhuri river water is soft but the Feni River water is hard. Chloride content of the Feni (131.16 mgL-1) & Muhuri (11.48 mgL-1) is within the acceptable limit of criterion continuous concentration (CCC) (230 mgL-1) and criterion maximum concentration (CMC) (860 mgL-1) limit for freshwater.

BOD values found for the Feni (1.97 mgL-1) & Muhuri (2.61 mgL-1) are quiet low and these rivers may be considered clean. (Banerji, 1997). Biney (1982) has classified the pollution level into three categories on the basis of BOD levels as follows:

- unpolluted(BOD < 4 mg/l)
- moderately polluted (BOD = 4 to 12 mg/l)
- grossly polluted (BOD > 12 mg/l)

COD found for the Feni River is 2.94 mgL-1 and Muhuri River is 2.87 mgL-1. Nitrite-N value found for the Feni River is 0.111 mgL-1 and Muhuri River is 0.017 mgL-1. Average values found for o-phosphate-P of the Feni is 1.77 mgL-1 & Muhuri River is 0.86 mgL-1. Total phosphate-P concentrations in excess of 1.00 mgL-1 P may interfere with coagulation in water treatment plants according to EPA, 1986. Excessive o-phosphate-P values were found due to the agricultural runoff and use of detergents in laundry purposes. Average values of sulphate-S found for the Feni is 4.32 mgL-1 & Muhuri River is 4.01 mgL-1.

Cadmium, Copper and nickel were not detected in any of the river water samples. Average values found for zinc for the Feni is 0.054 mgL-1 & Muhuri River is 0.039 mgL-1 was within the CMC and CCC limit (0.12 mgL-1) (EPA, 2002). Cobalt found for the Feni River is 0.042 mgL-1 & Muhuri River is 0.024 mgL-1. Average values found for total chromium for the Feni River is 0.042 mgL-1 & Muhuri River is 0.024 mgL-1 was within the CMC and CCC limit for Cr (III) (0.570 mgL-1 and 0.074 mgL-1) and for Cr(VI) (0.016 mgL-1 and 0.009 mgL-1), respectively. Lead found for the Muhuri (0.012 mgL-1) was within the acceptable limit but for the Feni (0.07 mgL-1) exceeded the acceptable CMC limit (0.065 mgL-1) for freshwater.

Average values of iron of the Feni (0.730 mgL-1) & Muhuri River (0.835 mgL-1) was found within the limit (1.0 mgL-1) for freshwater aquatic life. Manganese content of the Feni (0.25 mgL-1) and Muhuri

(0.17 mgL-1) exceeded the domestic water supplies limit (0.1 mgL-1). NaCl content found for the Feni River is 0.1 % & Muhuri River is 0.1%.

River Feni

Figure 57: Photographs of Feni River

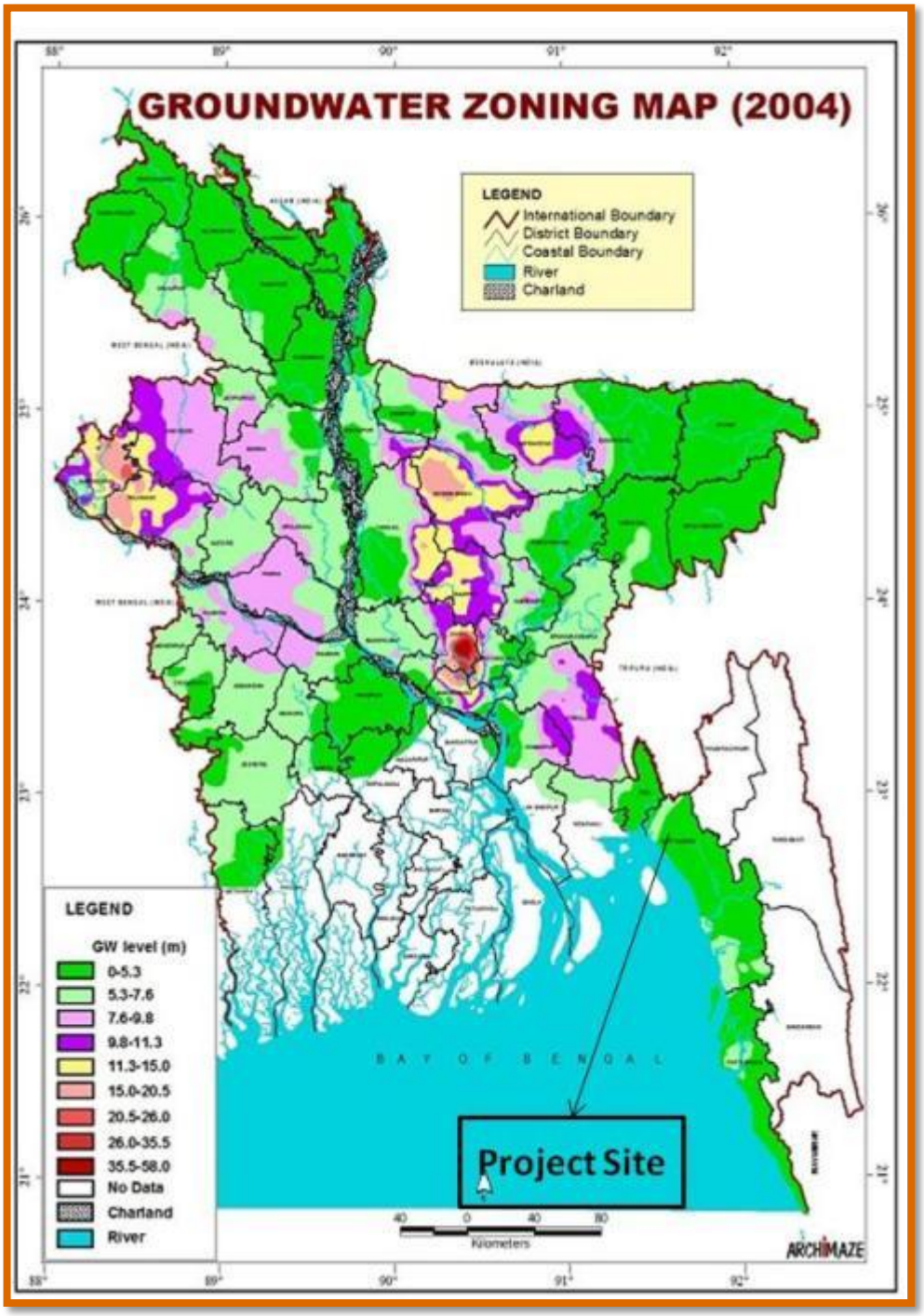
5.5.9. Ground Water system

Chittagong District is covered with Piedmonth and estuarine deposits. These deposits have tranmisivity of 400 sqm/day. These deposits are not favorable aquifers for extensive withdrawal. Aquifer material is covered with 25-30 m thick zone of silt and clay. Clay thickness gradually increases towards the Bar. Sandy materials are predominantly medium to coarse.

A shallow aquifer of about 20-50m thickness exists near the surface. Main aquifer is deep seated whose nature and extent are not known. Shallow aquifer exists at a depth of about 50m the depth to the main aquifer is not precisely known. Aquifers are semi-confined to confine in nature. Transmissivity of the Chittagong district varies from 114-600 sq m/day. Storativity/storage coefficient varies from 0.0007 to 0.03. Permeability of the aquifer varies from 3-10 sq m/day.

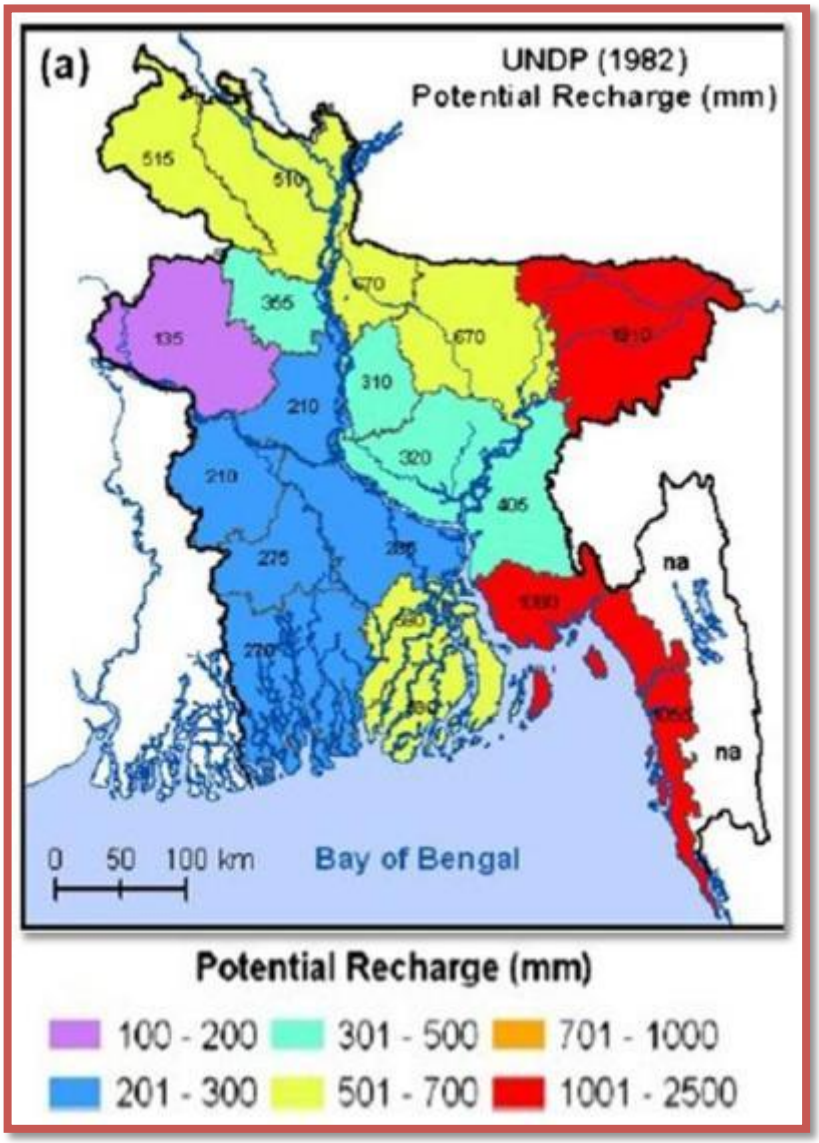
There is currently heavy use of groundwater for irrigation which is used to support the shortfall of surface water. Shallow groundwater is available within 2 to 4m below the ground surface in the project area but its quality it is not good and availability is variable. The groundwater is exploited by shallow tubewells for irrigation and deep tubewells with hand pumps for drinking water. There are a few deep tubewells where good quality water can be abstracted at a depth of greater than 150m for irrigation these can potentially provide yields of about 20 l/s. Ground water zone map of Bangladesh is given below in the figure 58.

Recharge of groundwater in the project area occurs by slow vertical percolation of rain irrigation water, seepage loss of the run–off the rivers and stored water in canals, khals, streams and rivers in groundwater. There is net groundwater inflow from the uplands to the north which may be a main source of recharge. The rate of percolation of water derived from rainfall to the aquifer is retarded due to thickness and impermeability of the upper clay layer. Recharge begins from the month of May peaks during August; the upper water bearing horizons quickly become saturated and due to the heavy surface soils much of the potential recharge is rejected.



Source: Ahmed, J; Haque R; Rahman M, Department of Chemistry, 2011, University of Chittagong

Figure 58: Ground water Zoning Map of Bangladesh



Source: Ahmed, J; Haque R; Rahman M, 2011, Department of Chemistry, University of Chittagong

Figure 59: Potential Recharge Area in Bangladesh

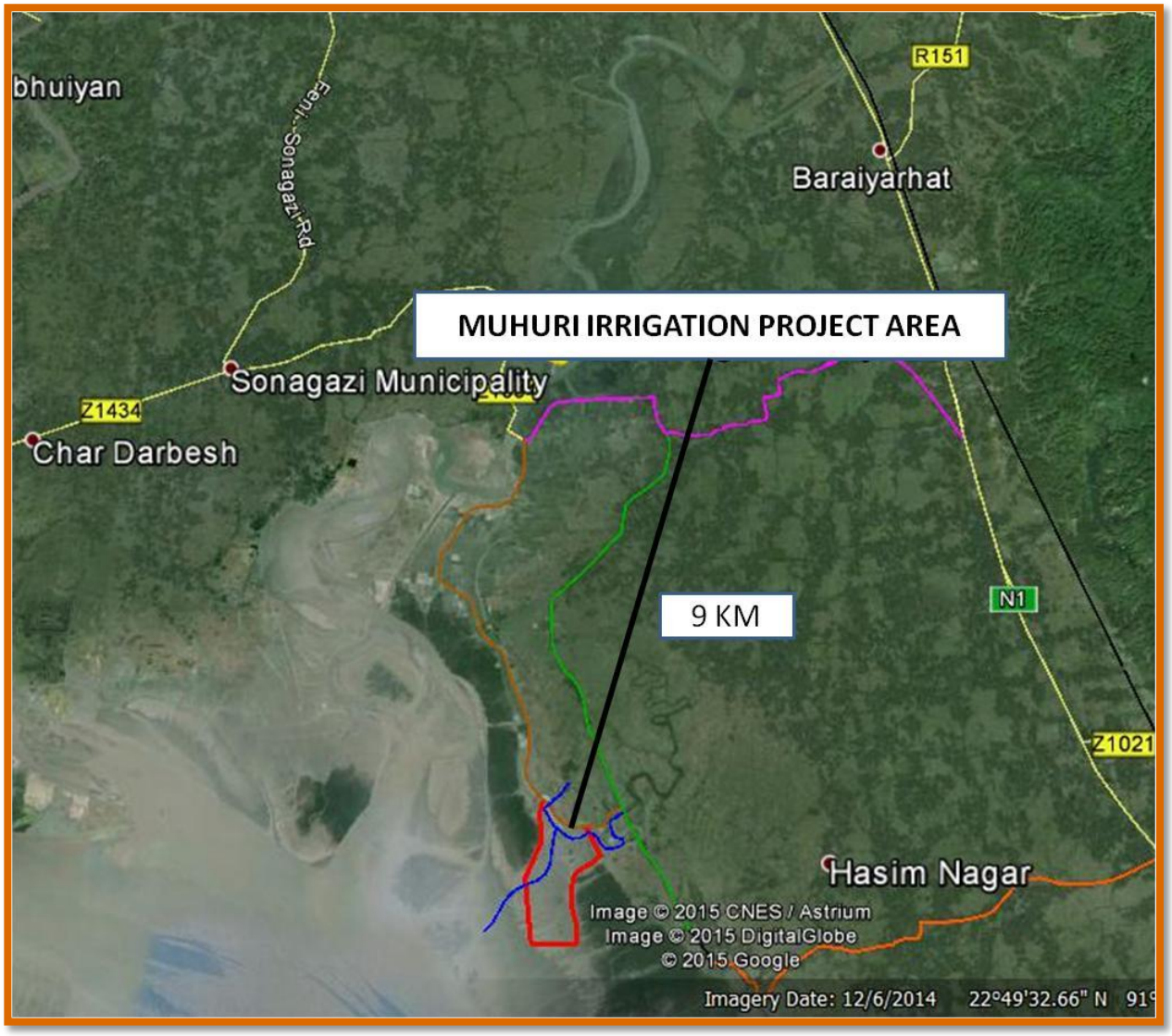
Ground water quality data for Muhuri Irrigation project area is available from secondary sources, i.e. study carried out for Muhuri Irrigation project. Muhuri irrigation project area is app. 9 km from the EZ site in north direction. Map showing Muhuri irrigation project area is given below in figure 60. Ground water quality data of the Muhuri Irrigation project is given in table 35 below.

Table 29: Ground Water Quality Data in Mirershorai Upzila

Parameters	Sample 1	Sample 2	Sample 3
Total Hardness (as $CaCO_3$)	36	45	44
Chloride (Cl^-)	26	69	32
Nitrate (NO_3)	0.33	0.71	0.61
Sulphate (SO_4)	1	<1	1
Arsenic (As)	0.007	0.018	0.007
Calcium (Ca)	9	10	9
Iron (Fe)	3.8	4.1	4.2
Magnesium	6	8	7

(Mg)			
Potassium (K)	3.3	4.1	4
Sodium (Na)	50.6	87.3	53.7
pH	6.45	6.86	6.98
Zinc (Zn)	<0.08	<0.08	<0.08
Boron (B)	0.2	0.2	0.22
EC (µs/cm)	247	426	308

Source:IEE Report, BAN:Irrigation Management Improvement Project



Source: Google Earth

Figure 60: Map Showing Muhuri Irrigation project Area

Arsenic contamination of groundwater is the prime concern in the Chittagong division. The problem was first discovered at the end of 1993; it is very much an issue in the Southeast region. The shallow aquifer has high arsenic concentrations including the, Feni districts. Studies by the Department of Public Health Engineering reveal that excess use of ground water for both irrigation and household use have lowered the ground water table. But recharging of ground water table is not occurring simultaneously due to delaying of rainfall, which could be attributed to climate change. The increased draw down in the ground water table has resulted in an increase in arsenic contamination due to increase in oxidation-reduction potential in the ground water table at shallow level. Summary of data for arsenic testing of water wells in the region is presented in table 36 below. Most affected of these aquifers lie beneath Meghna floodplains

Table 30: Contamination of Wells by Arsenic

Division	District	Number of Tests Carried Out				% o Wells Contaminated by			
		Field Tests	Pre-existing	Regional	All Tests	Field Tests	Pre-existing	Regional	All Tests
Chittagong	Brahmanb	536	51	51	638	42.9	43.1	37.3	42.5
	Chandpur	696	179	58	933	83.6	73.2	89.7	82.0
	Comilla	583	65	110	758	31.7	69.2	65.5	39.8
	Feni	80	38	50	168	42.5	28.9	34.0	36.9
	Lakshimpur	336	300	34	670	66.1	83.0	55.9	73.1
	Noakhali	679	430	48	1157	52.7	80.7	70.8	63.9

Source: IEE Report, BAN: Irrigation Management Improvement Project

Ground water quality data of the Feni district is also available from the study carried out by Rahman, Haque & Ahmed, 2011, University of Chittagong. Feni district is app. 25 kms from project site in NW direction. Ground water quality data for Feni district is given in table37 below

Table 37: Ground Water Quality Data of Feni District

Parameters	Units	Feni River
pH	-	6.08-8.86
Temperature	^{o}C	28.20-35.0
EC	μScm^{-1}	172.2-2528.0
TDS	mg/l	85.301-262.0
DO	mg/l	1.25-3.34
% NaCl	%	0.30-4.80
Acidity	mg/l	6.60-1023.77
Total alkality	mg/l	76.481-258.0
Total hardness	mg/l	26.0-554.0
Chloride	mg/l	8.17-481.76
NO_2-	mg/l	BDL-0.08
NO_3-	mg/l	BDL-6.30
PO_4^{3}-	mg/l	BDL-6.65
SO_4^{2}-	mg/l	BDL-72.07
Ni	mg/l	BDL-0.020
Zn	mg/l	BDL-0.015
Cu	mg/l	BDL-0.010
Co	mg/l	BDL-0.008
Cr	mg/l	BDL-0.005
Cd	mg/l	BDL-0.011
Pb	mg/l	0.02-0.07
As	mg/l	0.10-0.50
Fe	mg/l	0.10-8.46
Mn	mg/l	BDL-3.74

Source: Rahman, Haque & Ahmed, 2011, University of Chittagong

5.6. Land Resources

5.6.1. Archaeological Resources

There is no archaeological resource present within 300 m radius of the project site. Archaeological resources present in the Chittagong District are Bronze statues (8th and 9th centuries, in Anwara Upzila), Fakira Mosque (Hathazari), Musa Khan Mosque (1658), Kura Katni Mosque (1806), Kala Mosque (16th century), Chhuti Khan Mosque (Mirershorai), Kadam Mobarak Mosque (1719), Andar Killah Mosque, Wali Khan Mosque (1790), Badar Awlia Dargah, Bakshi Hamid Mosque of Banshkhali (1568), Chittagong Court Building (1893), Collegiate School, Ethnological Museum (1974).

Out of these, archaeological resources within Mirershorai are Duari Mosque, Jagannath Dham (Abu Torab), Kali Mandir (Karerhat), Shantiniketan Vihara, Abhay Charan Vihara.

5.6.2. Historical Events

Chittagong had been a sea port since the ancient time. The Arab traders had business transactions with this port since 9th century AD. Chittagong region was under the kingdom of Arakan during sixth and seventh centuries. Before the Muslim rule Chittagong had been either under the control of the Arakans or under the kings of Burma. Sultan Fakruddin Mubarak Shah of Sonargaon conquered Chittagong in 1340. After the defeat of Sultan Giasuddin Mahmud Shah in the hands of Sher Shah in 1538, the Arakanise again captured Chittagong. From this time onward until its conquest by the Mughals this region was under the control of the Portuguese and the Magh pirates. The Mughal Commandar Bujurg Umed Khan expelled the Portuguese from the area in 1666 and established Mughal rule there. The Mughals renamed Chittagong as Islamabad

On 18th April 1930, the revolutionaries looted the Chittagong armoury under the leadership of Mastarda Surya Sen. During this time the leaders of the women revolutionaries were Pritilata Waddedar, Bina Das, Lila Ray, Kalpana Dutta etc. The Declaration of Independence of Bangladesh was announced from Swadhin Bangla Betar Kendra located at Kalurghat.

Marks of the War of Liberation Mass graves and mass killing sites: Foy's Lake, Lalkhan Bazar, hilly area adjacent to Firoz Shah Colony, Kattoli Beach, CRB area, hills on the east of Sher Shah Colony, Patenga Air Port, hills around Nasirabad Residential Area and many other places.

5.6.3. Land Types

Land types are classified depending upon the depth of inundation during monsoon season due to normal flooding in an average year. SRDI has made the land type classification into five types, i.e. High land (Above flood level), Medium highland (Flooding depth 0-90 cm), Medium lowland (Flooding depth 90-180 cm), Lowland (Flooding depth 90-270 cm) and very lowland (Flooding depth >270 cm). Land type classification based on flooding during Monson Season by SRDI is given below in table 38:

Table 31: Land Type Classification

Land Type	Description	Flooding Depth	Flooding Characteristics
F0	Highland	0-30 cm	Non flooded to intermittent
F1	Medium Highland	30-90 cm	Seasonal
F2	Medium Lowland	90-180 cm	Seasonal
F3	Lowland	180-270 cm	Seasonal, but remains wet in early dry season
F4	Very Lowland	> 270 cm	Seasonal but remains wet in most of the dry season

Source: SRDI

As per the classification, project site will be covered under very lowland and study area will fall under both lowland and very lowland.

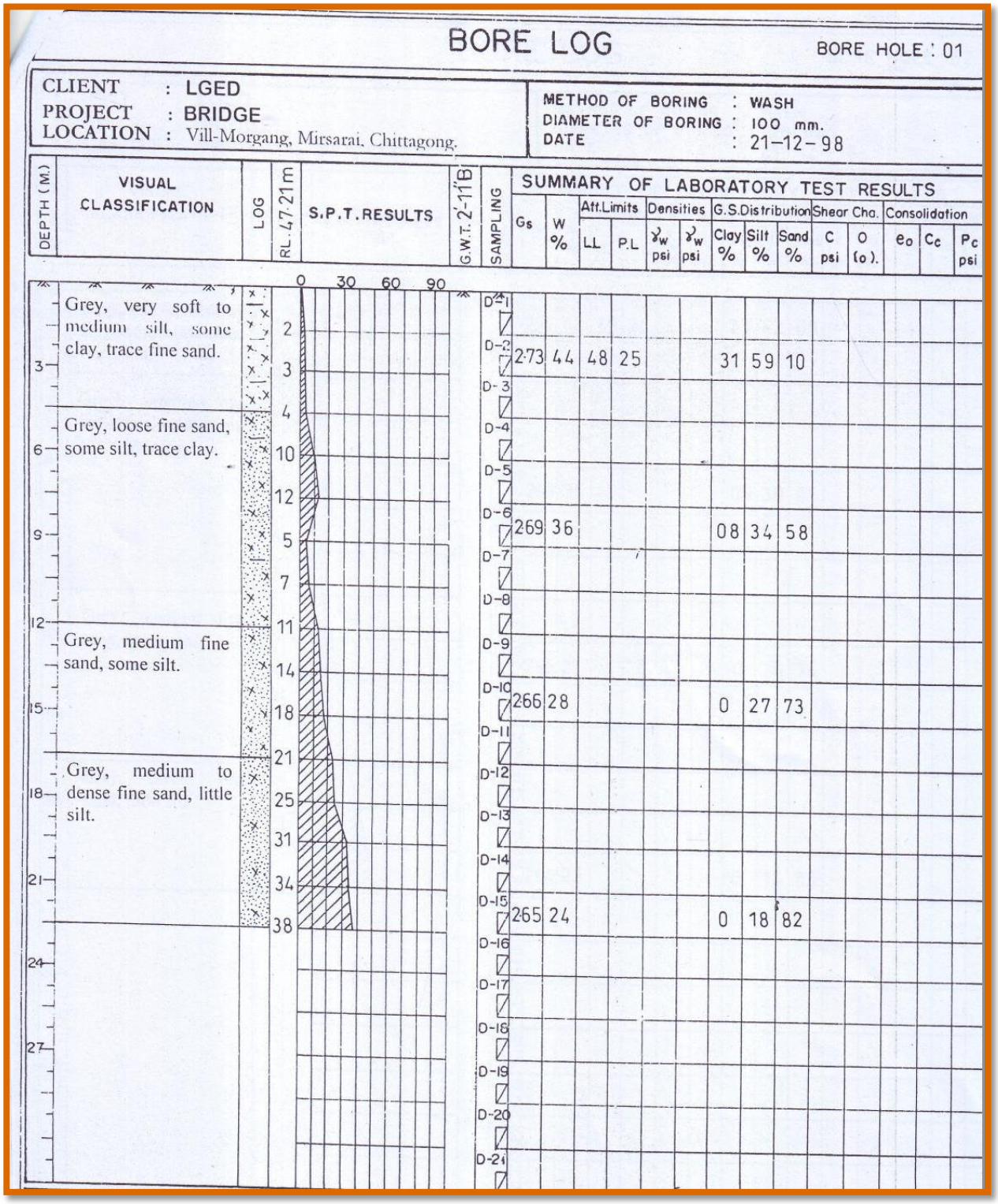
5.6.4. Soil Texture

The soils of Mirershorai EZ are sandy loam to clay loamy soils in some areas. Most of the farmlands in nearby areas are on sandy loams with some black cotton soils in the low lands. Black cotton soils characteristically host Acacia wood plant. Soils change to more sandy and gravel texture all the way to the foot of the escarpment. Likewise, the soil patches of sandy soil can be seen between Mirershorai EZ and Muhuri flood plain.

The top soil near the EZ is mainly very soft to medium silt with clay or clay-laden silt and with a trace of find sand. According to the sub-soil investigation record of this area (north-west of Chittagong District) the soil profile at shallow beyond shallow depth is mainly dominated by non-cohesive soil with a comparatively low SPT (Standard Penetration Test) value at the upper level. However, for better understanding, a field bore log data of a bridge site (bore hole location on the land) near Mirershorai EZ project (Morgang Khal on Morgang Road near Azampur Bazar) is presented next. Soil profile of the area is shown in figure 61 & 62 below

Soil Profile of the EZ Site

Figure 61: Photographs Showing Soil Profile of Area



Source: Pre Feasibility Study, Mirershorai

Figure 62: Bore log data- Near Azampur Bazar

As per the soil profile study, it is observed that upto depth of 4 m soil is grey, very soft to medium silt, some clay and trace fine sand. Beyond 4 m upto 11 m, soil is grey, loose fine sand with some silt and trace clay. Beyond 11 m, soil is grey medium fine sand with some silt. Beyond 21 m soil is grey, medium to dense fine sand

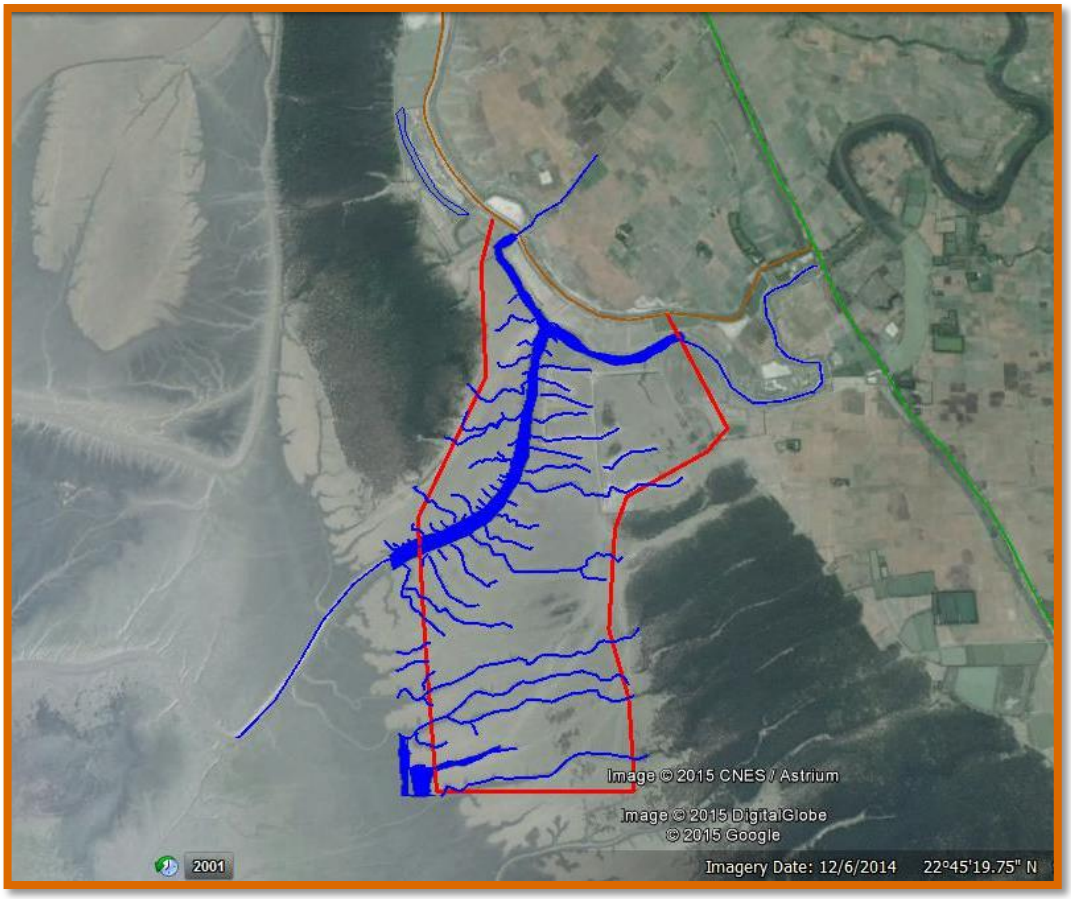
5.6.5. Land Use

EZ site is covered with sand and clay deposits. Total EZ site measures 610 acres. Land use breakup of the EZ site is given below in table 39. Land use map of EZ Site is given in figure 63 below.

Table 32: Land use Details for EZ Site

Land Cover Class	Area (Acres)	Area Percentage (%)
Development area	550	90.16
Isakhali channel	60	9.84
Total	610 Acres	100%

Source: Mahindra



Source: Google Earth

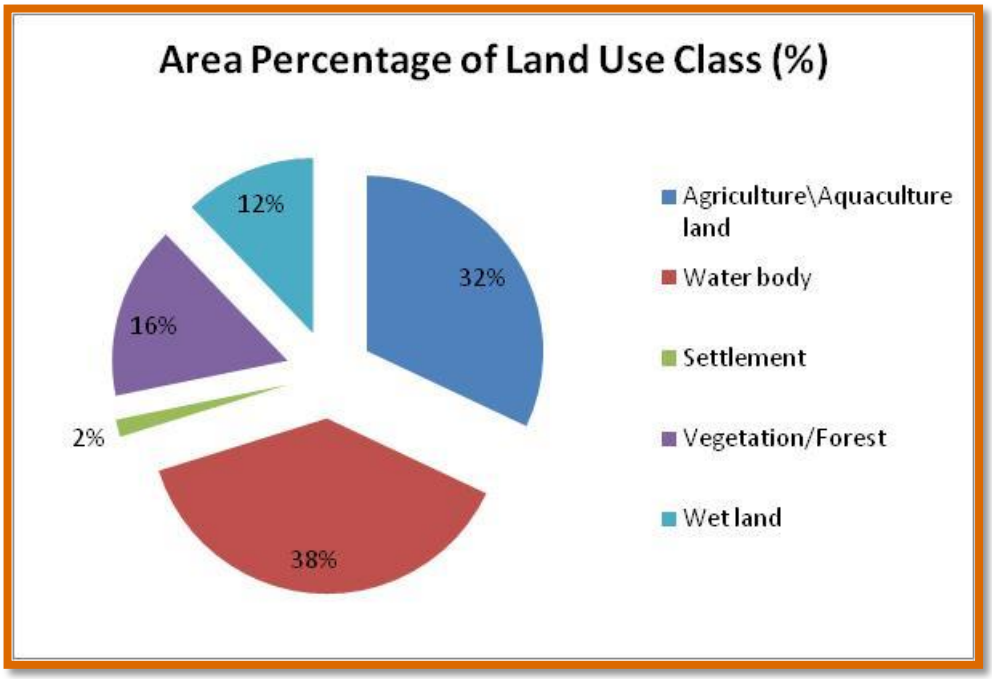
Figure 63: Land Use of EZ Site

Land use land cover study has been carried out for 10 km radius area of the EZ Site. Maximum area is covered by water bodies (38.2%) including Sea, rivers, canal, small stream & channels followed by agriculture & aquaculture land (32%). Area under vegetation/forest area is 52.25 sq km (16%) and area under wetland is 40 sq km (12.2%). Area under settlements is least and is equal to 5.10 sq km (1.6%). Land use area break up of 10 km study area is given in table 40 below. Land use map of the 10 km radius area is given in figure 64 & 65 below.

Table 40: Land use Details for EZ Site

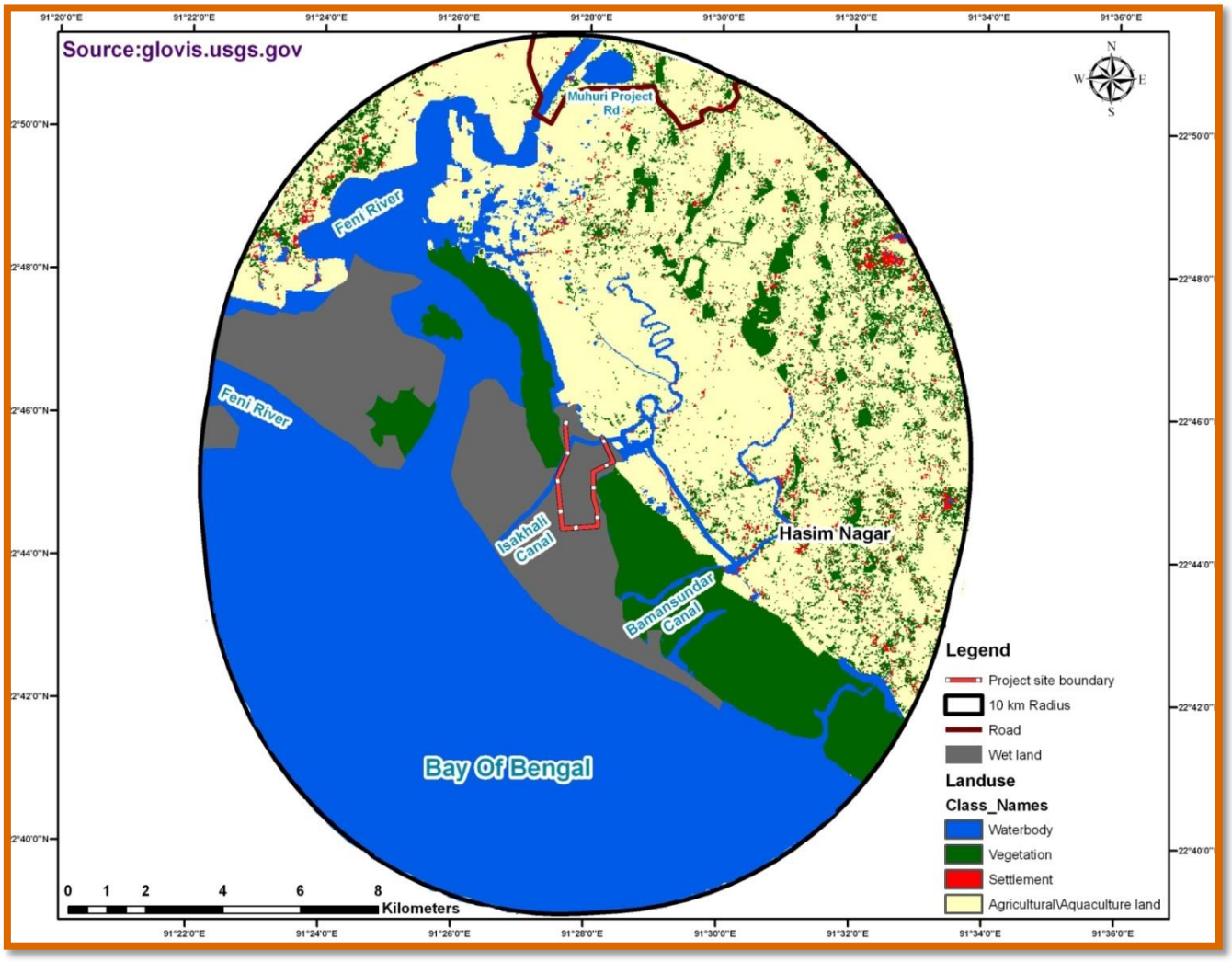
Land Use Land Cover Class	Area (Sq. km)	Area Percentage (%)
Agriculture\Aquaculture land	104.44	32
Water body	124.47	38.2
Settlement	5.1	1.6
Vegetation/Forest	52.25	16
Wet land	40	12.2
Total	326.26	100

Source: Mahindra



Source: Mahindra

Figure 64: Area Percentage of land Use Class in Study Area



Source: Mahindra

Figure 65: Land Use Map of the Study Area (10 km Radial Zone)

5.6.6. Topography

Bangladesh is the largest deltaic region in the world with most of its parts, at low elevations. It is a riverine country criss-crossed by innumerable rivers, rivulets and their tributaries. It is divided into five physical regions- the Ganges Delta proper to the southwest, the Paradelta to the northeast, and the southeast undulating Chittagong region.

Ganges total flood plains is the tidal landscape has a low ridge and a basin relief crossed by many tidal rivers and creeks. Local differences in height are generally less than 1 m compared with 2-3 m on the Ganges floodplain. Physiographic map of Bangladesh is given in figure 66 below.

EZ site is generally flat, low lying and poorly drained. The land use of the project site is 'wetland'. Isakhali channels and tributaries of Isakhali channels are present at the site which gets flooded during the monsoon & High tides. Site is required to be leveled and raised to a level of 0.75 m. At present elevation of the site varies from 5-7 m amsl.

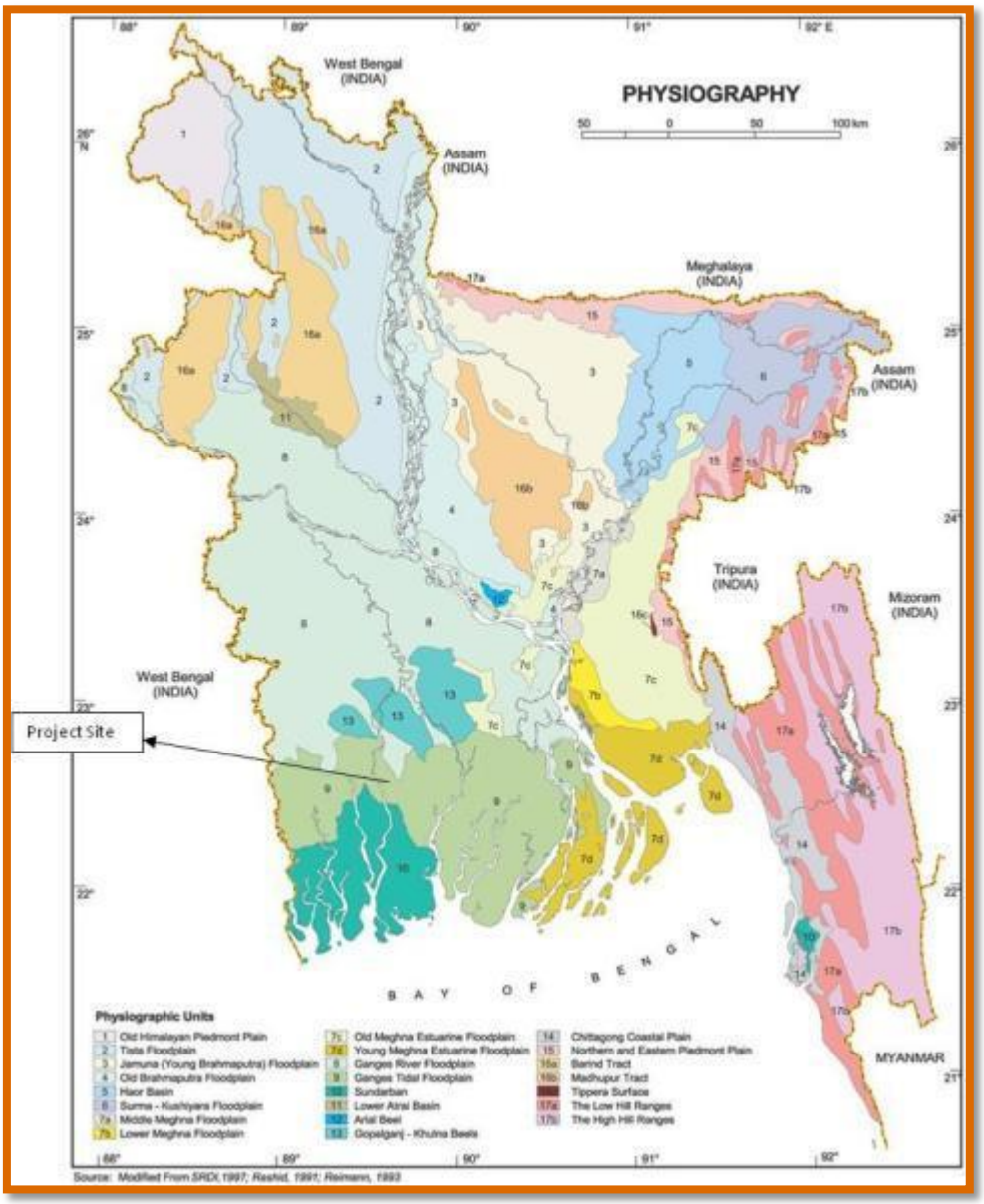


Figure 66: Physiographic Map of Bangladesh

5.6.7. Seismicity

Bangladesh is possibly one of the most vulnerable to potential earthquake threat and damage. Earthquake vulnerability of any place largely depends on its geology and topography, population density, building density and quality, and finally the coping strategy of its people and it shows clear spatial variations. In the earthquake zoning map (figure 67) of 1993, 26 percent of Bangladesh falls in high risk, 38 percent moderate and 36 percent in low risk zone in terms of earthquake vulnerability. The distribution of recorded earthquakes indicate a major clustering of seismicity around the Dauki Fault and scattering of other events along other major fault systems of Bangladesh. The magnitude of the earthquakes are moderate (4-6) and majority of them are shallow depth.

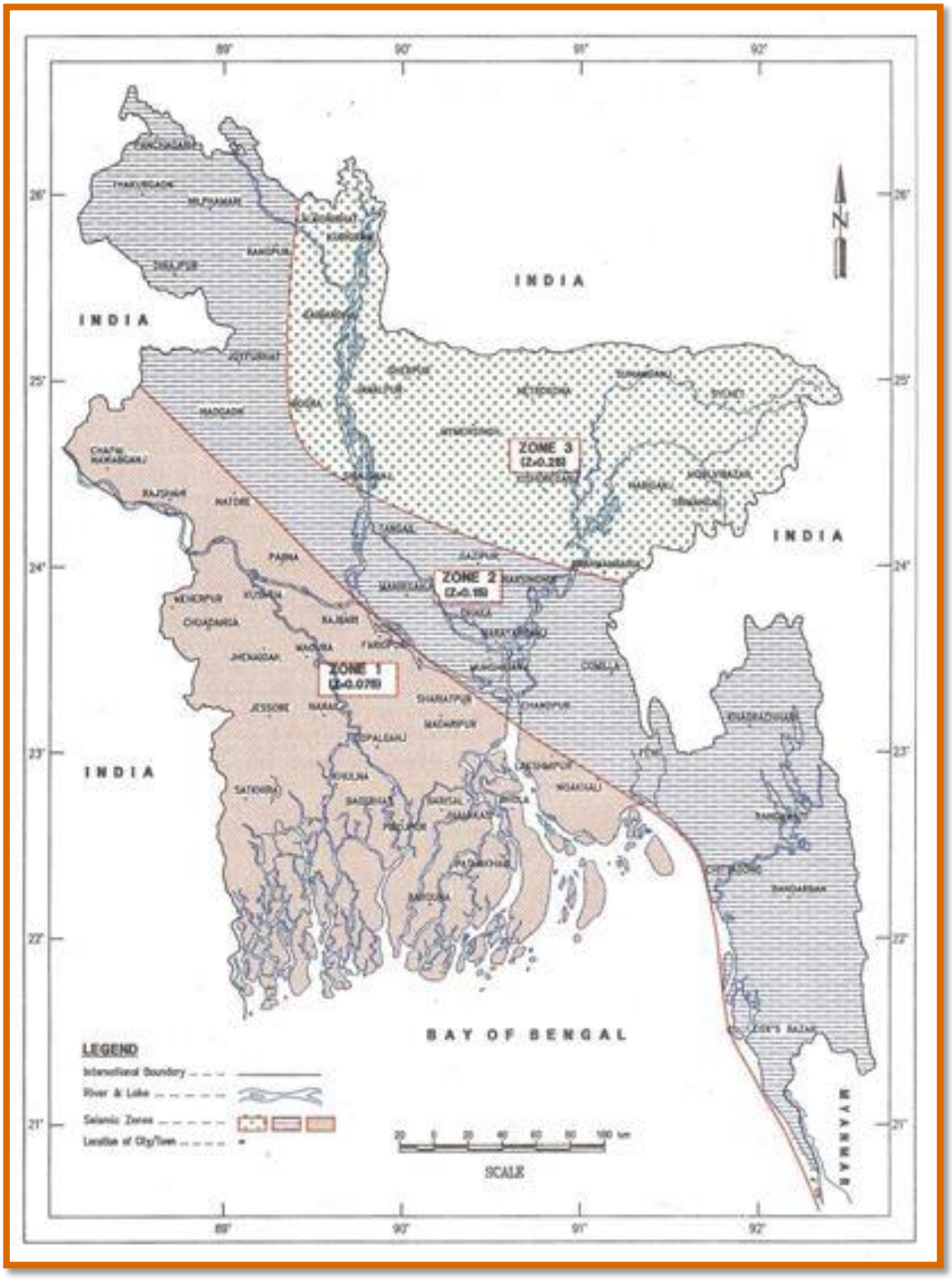
Most of the parts of Chittagong, the port city of Bangladesh consisting of fine sand and silt deposits are susceptible to liquefaction. Chittagong City is mostly a hilly region, but it also consists of alluvial flood plain and sandy sea-shore area. Although the hilly region is less susceptible to liquefaction, it is formed by sandy and clayey soil and the area bottom of the hill also liquefy if the intensity of shaking is high, which may cause landslide in the highly region. On the other hand, flood plains and sea shore areas consisting of fine sand and silt deposit with shallow water table in most of the places, which may liquefy during a strong earthquake.

According to the Global Seismic Hazard Assessment Program (GSHAP), the most hazardous division in Bangladesh is the port city, Chittagong. Chittagong metropolis together with its surroundings is situated in the seismic zone 2, which has a basic seismic coefficient, Z=0.15 (BNBC, 1993). Distance of EZ site from Chittagong is app 55 km from EZ site. Seismic zoning map of Bangladesh is given in figure below. List of the major earthquake that hit Bangladesh are listed in table 41 below.

Table 41: List of Major Earthquake Affected Bangladesh

Date	Name	Magnitude (Richter)
10 January, 1869	Cachar Earthquake	7.5
14 July, 1885	Bengal Earthquake	7.0
12 June, 1897	Great Indian Earthquake	8.7
8 July, 1918	Srimongal Earthquake	7.6
2 July, 1930	Dhubri Earthquake	7.1
15 January, 1934	Bihar-Nepal Earthquake	8.3
15 August, 1950	Assam Earthquake	8.5
22 November, 1997	Chittagong Earthquake	6.0
22 July, 1999	Maheshkhali Earthquake	5.2
27 July, 2003	Rangamati Earthquake	5.1

Source: Bangladesh Disaster Knowledge Network

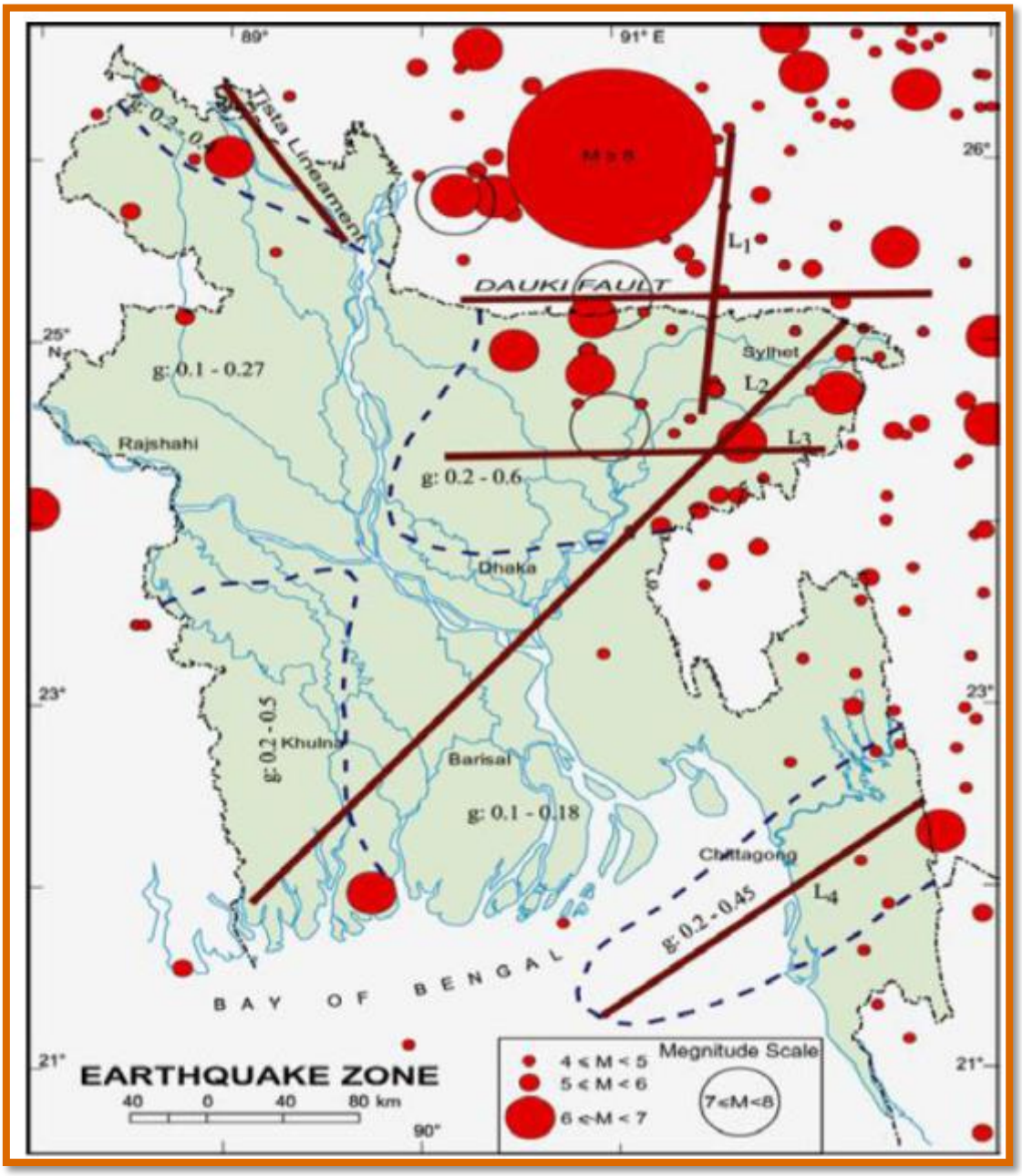


Source: Bangladesh Disaster Knowledge Network

Figure 67: Seismic zone map of Bangladesh (BNBC, 1993)

The most hazardous division in Bangladesh is Chittagong division. Northern and southern sections could expect to have maximum peak ground acceleration (PGA) ranging between 0.24g to 0.40g. The Chittagong Hill Tracts region can expect the highest PGA of up to 0.4g to 0.48g. In the basic seismic zoning map of Bangladesh, Chittagong and its surrounding region has been shown under Zone II with

basic seismic coefficient of 0.15 (BNBC-1993), but recent repeated shocking around this region indicating the possibilities of potential threat of even much higher intensity like 0.35g than projected. If the Indian seismic zones were extended across the border into Bangladesh, the country would lie in zones IV and V. The seismicity of Bangladesh is shown in figure 68 below.



Source: Bangladesh Disaster Knowledge Network

Figure 68: Seismic Activity of Bangladesh

5.7. Agriculture Resources

The physiographic unit of the project is: Chittagong Coastal Plain (AEZ# 23), sub-regions are Piedmont Plains and River Flood plain (23a) and Young Tidal Floodplain (23b) with general soil type Non-Calcareous Grey Flood plain Soils (non-saline) in both of the sub-region soils. The soil texture in both of the sub-region soils is loamy. The landscape of the area- comprised of mainly medium high land to high

land. The soil type pre-dominates with Non-Calcareous Grey floodplain soils (no-saline). Map showing Agro-economic zones of Bangladesh is given in figure 69 below

Source: FAO, Bangladesh

Figure 69: Agro-economic Zone of Bangladesh

As per the land use land cover study of 10 km radius of the project site, approx. 34.48% of the area is covered under agriculture & aquaculture land. No agriculture or aquaculture activity was found at the site during visit. As per focused group discussion, villagers from CharShardh village carry out some agriculture and aquaculture practice within EZ site in winter season.

5.7.1. Farming Practice

Agriculture

Farmers practice agriculture in this region for 3 seasons, i.e. Rabi, Kharif I and Kharif II. Source of irrigation in this region are storm water are rain water harvesting ponds, ground water, khals/canal etc. Major crops of the region are paddy, betel leaf, betel nut, potato, corn, turmeric, tea, peanut, mustard, patol (heap), brinjal, ginger, cucumber and other vegetables.

Aquaculture:

During the 1960s, coastal aquaculture in the Chittagong region was normally a function of salt production. During the monsoon season, some salt producers would utilize their salt pans mainly for subsistence fishing but also occasionally to supplement their income through the sale of the shrimp and finfish surplus. With the increase of demand and price, this practice gained increased acceptance in the region. Harvesting of tiger shrimp is most practiced due to its demand.

Aquaculture is practiced extensively around the EZ site. Govt. has initiated various aquaculture programs to harvest fishes especially Ruhi, Catla and Korps near the EZ site for providing the livelihood to the people in Mirershorai. Shrimps culture (Bagda and Golda) is also practiced in large scale. The culture period was typically four months for Bagda and six to seven months for Golda. Varieties of feeds such as cooked rice, fishmeal, oil cake and snail muscle are used for shrimp culture. Mainly virus disease was responsible for the great loss of shrimp in this area. Mud crabs are collected by people from the mudflats area, i.e. forest and along the canals.

<table>
<tr><td colspan="2">  </td></tr>
<tr><td colspan="2">Agriculture Field</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Collected Mud Crabs</td><td>Fish Culture Pond</td></tr>
</table>

Aquaculture Pond

Pea Plant in a field

Figure 70: Photographs Showing Agriculture Fields and Aquaculture Ponds

5.7.2. Cropping Pattern and Intensity

Major portion of the land within study area is under agriculture. Agriculture land comprise of fallow and agriculture land areas, seasonal gher and aquaculture ponds. There are three cropping seasons, i.e. Kharif-I, Kharif-II and Rabi. Major agriculture pattern in study area is Fallow-T.Aman (Local), local vegetables & fruits and B. Aus. Major crops of each cropping season are given in table 42 below

Table 33: Cropping Seasons in Area

S. No.	Cropping Season	Major Crops	Months
1.	Kharif-I	B. Aus, Jute and vegetables	March to May
2.	Kharif-II	T. Aman (HYV & L) and fallow land	June to October
3.	Rabi Season	Boro (HYV), vegetables, fruits and pulses	November to February

Source: FAO, Bangladesh

Crop Calendar

During Kharif 1 season HYV rice is the principal crop, during Kharif 2 medium Aman and Aus crops are grown or jute is cultivated in medium lowland. During the Rabi season, wherever the land dried up in early October to mid-October, farmers grow legumes, oil seed and vegetables. Vegetables are mostly confined to highland, oil seeds to medium land and pulses to medium lowland. Paddy is major cash crop of the farmers in the study area and requires year-round production activity. Oilseeds, vegetables and other seasonal crops are the significant crops in this area. Cropping patterns and crop diversity for kharif and Rabi seasons are scheduled according to land types, flooding frequency and duration of floods. The patterns in the study area are dictated by the local hydrologic regime and are essentially based on rice. Non-rice crops are grown mostly in the non-irrigated land in rotation with Rabi Aus and Aman, depending on the land type. Winter crops are intercropped with sugarcane. Irrigated HYV Boro is grown is winter in sequence with T. Aman on medium high land and T. Aman on medium lowland. Major vegetables in the area are tomoato, potato, lady finger, brinjal, pumpkin, cabbage, cauliflower, radish, sweet potato, jackfruit etc. Legumes grown are arhar, masor, keshari and moong dal.

5.7.3. Cropped Area

As per the land use land cover study of 10 km radius of the project site, approx. 34.48% of the area is covered under agriculture land. No agriculture land area will be used for development of EZ.

5.7.4. Crop Production, Damage and Constraints of Crop Production

Farmers of Chittagong district produce food crops, cash crops, fruits, vegetables, livestock and poultry, fish, timber and fuel wood. Majority of household also have poultry, livestock and produce poultry and livestock produce for daily consumption and selling.

Major constraints of agriculture in the study area is availability of arable land, crop damage, seasonal flooding of land, water logging, soil salinity and availability of high quality seeds and fertilizers. Crop damage is reported to occur during focused group discussions due to both excess and scanty rainfall. Pre-monsoon and post-monsoon drainage congestion limits crop production. In monsoon season, the duration of water logging thus limiting the crop choice

5.8. Livestock and Poultry

Livestock and poultry, being an essential sector of integrated farming system, play an important role in the economy of the study area. Livestock provide significant draft power for cultivation, threshing and crushing of oil seeds. Cow dung is used as a source of manure and fuel. Meat, milk and eggs are used for human consumption and a ready source of funds. Most of the households raise poultry and livestock, a practice that significantly reduce the poverty by generating employment and income.




Figure 71: Photographs Showing Livestock & Poultry in the area

5.8.1. Feed and Fodder Shortage

The owners of the livestock population are facing problems in respect of availability of fodder and feeds during the month from March to December due to shortage of grazing fields. In dry and Kharif-I seasons, the lands are generally submerged with saline water especially in the project area and major portion of the study areas. During Kharif-II season, the fields are covered with T. Aman (Local). Rice straw is the main fodder for cattle. Bran of wheat and rice, oil cakes, powder of cereal crops etc. are the other common fodders, but the availability of these feed in these areas is rare. Shortage of grazing area throughout the year aggravates the feed problem to the animal population. Poultry population at family level survives by scavenging and generally, no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry.

5.8.2. Livestock/Poultry Diseases

Most common livestock diseases found in the study area are foot and mouth disease (FMD), Anthrax, Diarrhoea, PPR etc. The got/cyst in head is common disease of goat. Major poultry diseases are Duck Plague, Paralysis, New Castle, Fowl pox, and Dysentery etc. The most vulnerable period is between July to October (rainy season) months for spreading diseases to livestock and poultry populations. The duck plague generally occurs in summer.

5.9. Fisheries

5.9.1. Introduction

Fisheries resources of the study area are rich and diversified. Study area consists of rivers, aquaculture ponds, canals and Khals. Details of the fisheries of the study are is given in sections below

5.9.2. Habitat Description

Fish habitats of the area are creeks, Khal, rivers, aquaculture ponds, natural ponds and beels. Water in these bodies varies from fresh to brackish. Both natural and cultured fisheries exist in the study area. The Feni river estuary has moderate species diversity. Species diversity is higher in the estuarine mouth compared to that of its upstream direction.

5.9.3. Fish Biodiversity & Migration in Feni River Estuary

Project site is app 800 m from the Feni River Estuarine system. From study of Halder, G.C; Haroon, A.K.Y; Khan, M.A.A.; Tsai, C.F., 1991, it was found that Feni River Estuary are used by 34 species of upstream fresh water fishes, 11 species of estuarine dependent fish water species and nine species of marine fishes for various purpose and at different stages of their life. From study of Md. Iftakharul Islam et.al., it was found that 29 species of fisheries from 20 families are reported in Feni River Estuary system. These species are from variable habitats like fresh water, brackish water and marine water. All these

fisheries migrate to Feni River Estuary system to complete on or more stage of their life. Out of these 20 families of fisheries found by Md. Iftakharul Islam et.al., it was found that 18 are fishes, 9 are shrimp and 2 are crab. The most abundant species was found to be *Odontamblyopus rubicundus* that constitute 42.64% of the total species found in the Feni River estuary, followed by *Pseudapocryptes elongates* (10.14%), *Stolephorus sp.* (9.22%), *Trypauchen vagina* (6.38%). Abundance of species in Feni River varies with season as per study of Md. Iftakharul Islam et.al. and is given in following table 43. Also the fisheries diversity present in the Feni River Estuary along with their habitat is listed in the table 44.

Table 34: Dominant Fisheries in Different Seasons

S. No.	Season	Dominant Species
1	Premonsoon season	*Trypauchen vagina* (26.05%), *Exopalaemon styliferus* (15.21%), *Mugil cephalus* (8.28%), *Parapenaeupsis styliferus* (5.57%), *Macrobrachium rosenbergii* (4.37%), *Matapenaeus monoceros* (4.07%).
2	Monsoon season	*Odontamblyopus rubicundus* (58.21%), *Pseudapocryptes elongates* (13.50%), *Tenulosa toil* (4.79%), *Stolephorus sp.* (4.23%).
3	Post monsoon season	*Odontamblyopus rubicundus* (40.12%), *Pseudapocryptes elongates* (16.68%), *Stolephorus sp.*(7.44%), *Macrobrachium mirabeli* (5.33%), *Parapenaeupsis sculptelies* (4.28%).
4	Winter Season	*Odontamblyopus rubicundus* (48.11%), *Stolephorus sp.* (25.26%), *Mugil cephalus* (7.86%)

Source: Islam, I, 2012, Temporal pattern of Fish Assemblage of Feni River, Feni, Bangladesh-Fish Bio-diversity of Feni River

Table 35: Fish and Shrimp Species Recorded in the Feni River Estuary

Family	Scientific Name	Local Name	Habitat	Climate
Ambassidae	*Chanda nama*	Chanda	Benthopelagic Freshwater brakish	Tropical
	Stolephorus sp.	Mola	Benthopelagic Freshwater brakish	Tropical
Anguillidae	*Anguila sp.*	Kuicha	Marine, brakish	Tropical
Alpheidae	*Alpheaus spp. (Rafinesque, l8l5)*	Alphaed shrimp	Marine, brakish	Tropical
Bagridae	*Mystus gulio (Hamilton, l822)*	Guilla	Demarsal, anadromous, freshwater, brakish	Tropical
Clupeidae	*Tenualosa toil (Valenciennes, l847)*	Illish	Marine, freshwater, Brakish, Pelagic-neritic, anadromous	Subtropical
Cynoglossidae	*Cynoglossus lingua*	Kukur jeeb	Demarsal, amphidromus, Freshwater, brakish, marine	Tropical
Cyprinidae	*Puntius ticto*	Tit punti	Benthopelagic, Freshwater,	Tropical

Engrualidae	*Coila ramkorati (Hamilton, 1822)*	Alua	Pelagic- neritic, amphidromus, brakish, Marine	Tropical
Gobiidae	*Apocryptus bato (Hamilton, 1822)*	Chiring	Demarsal, Amphidromus, freshwater, brakish, Marine	Tropical
	Pseudapocryptes lanceolatus (Bloch- Schneider,1801)	Goby	Amphidromus, freshwater, brakish, Marine	Subtropical
	Odontamblyopus rubicundus (Hamilton, 1822)	Raja Cheoa	Marine brackish, benthopelagic, amphidromous	Subtropical
	Oxyurichthys microlepis	Nuna baila	Marine brackish,	Tropical
Leucosiidae	*Matuta victor (fabricus,1781)*	Kakra	Marine brackish,	Tropical
Mugilidae	*Mugil cephalus (Linnaeus,1758)*	Bata	Benthopelagic Amphidromus, freshwater, brakish, marine	Subtropical
Mastacembelidae	*Mastacembelus armatus*	Baim	Marine, Brackish, Freshwater	Subtropical
Polynemidae	*Polynemus peradiseus (Linnaeus, 1758)*	Taposi	Marine, freshwater, brackish, demersal, amphidromous	Tropical
Sciaenidae	*Johnius belangerii (Cuvier, 1830)*	Poa	Demarsal amphidromus brakish, marine	Tropical
Taenioididae	*Trypauchen vagina*	Lal cheoa	Marine brackish, benthopelagic, amphidromous	Subtropical
	Pangassius pangassius	Pangass	Freshwater, brakish,	Subtropical
Palaemonidae	*Macrobrachium rosenbergii*	Golda chingry	Fresh water, Esturine water	Subtropical
	Macrobrachium villisimanus	Dimuaicha	Brackish,	Tropical
Peneaidae	*Penaeus monodon*	Bagda chingri	Marine brakish	Subtropical
	Parapenaeopsis sculptelies	Boro chama	Marine, brakish	Tropical
	Matapenaeus monoceros	Horina chingri	Marine, brakish	Tropical
	Parapenaeopsis stylifera		Marine, brakish	Subtropical
Palaemonidae	*Exopalaemon stylifera*		Marine, brakish	Subtropical
	Macrobrachium mirabile		Marine, brakish	Subtropical
Portunidie	*Scylla serrata*	Kakra		Subtropical

Source: Islam, I, 2012, Temporal pattern of Fish Assemblage of Feni River, Feni, Bangladesh-Fish Bio-diversity of Feni River

5.9.4. Fish Production & Effort

Total annual inland fish production of Chittagong district is 89988.86 MT. Out of this 12549 MT is produced from rivers, 21 MT from beels, 30367 MT from flood plains, 44132 MT from ponds, 459 MT from seasonally cultured water bodies and 2460.86 MT from aquaculture ponds. Out of total fish catch from rivers (12549 MT) it is estimated that 15MT of fishes are major carps, 5 MT are other carps, 12439 MT is Hilsa, 11 MT are big prawns, 37 MT are small prawns and 42 MT are other fishes.

There are in total 11 Govt Hatcheries which yields 672 Kgs of Post larvae (PLs) and 236 private hatcheries which yield 59997 kgs of PLs and 4091 lakhs Tilapia Juveniles.

People in study area extensively practice aquaculture and pisiculture both. People practice shrimps Bagda pona (*Penaeus monodon*) & Goda pona (*Macrobrachium resenberil*) and crab (especially mud crab/*Scylla serrata*) cultivation in the study area. Crabs are collected from inter-tidal creeks, khals, mangrove area and rivers. Fishes mainly Ruhi, hilsa and Karps are reared in fisheries project run by both Government and people. Government promote aquaculture and pisiculture activities extensively in coastal areas to provide livelihood to people and reduce their dependency on Mangrove forests planted along the coast line.

5.9.5. Fisheries Management, Problem and Issues

People practice fishing in Isakhali canal which runs through the EZ site. Development of EZ site will restrict the fishing activities in Isakhali canal section within EZ site. Also development of sluice gate in the downstream may restrict fish movement between sea and canal when the gates are closed during high tides. Due to presence of Bamon sundar canal and free fishing in upstream Isakhali channel, impact on fishing activities will be minimal. Also 5 m wide zone of no development and retaining wall will be developed along the Isakhali channel within EZ site which will check direct exposure of Isakhali channel to upcoming industries and will protect the quality of water in Channel and thus aquatic life. BEZA in future will monitor the industries to ensure that no waste is being thrown in Isakhali channel to restore its quality and aquatic life.

5.10. Ecological Resources

5.10.1. Bio-ecological zone

The baseline ecological surveys were carried out, based on various secondary sources (Forest Department Data, Scientific Studies and previous similar studies) which are further validated from through field observations and interaction with local people. Present biological assessment was carried out for core zone (at the economic zone site and offsite facilities areas) and buffer zone (10 km surrounding the core zone area).

5.10.2. Core Zone –Ecological assessment

Flora & Fauna of Economic zone site & Administration Building:

Upcoming economic zone is located at in Mirershorai Upzila under Chittagong district and is devoid of any plantation. Site is flat low land area covered with grey silty clay soil. Site is wetland and remains inundated in water during monsoon. Water from Sea also enters the site and nearby Mangroves forest during high tides. Mud crabs were also found at site during the visit. Large variety of fishes and shrimps exists in the Isakhali channel passing through EZ site. Site does not support major vegetation, whereas trees are planted on the CDSP bund which covers the site from East direction. Some of the trees planted on the bund are Akashmoni, Jhao Ghas, Karoi etc. Site is adjacent to Mangroves Forest in NW and SE direction. Majorly 3 species of Mangroves are planted in these forest and they are Kewda, Bain & Gewa.

Apart from these species other weeds like Pan ghas, Lata shak, Noona Jhao, katar were also observed in these forests. Also a quantitative analysis was carried out to assess the density, abundance and frequency of the species in adjacent Mangroves forests through quadrate method. 10 nos. of 10 m X 10 m quadrates were laid in the Mangroves forests and the nos. and name of species occurring in the quadrate were noted down. In case of Gewa growing in bunch, each shoot is considered as single tree. Measure of the girth and height were also done for all the three species. Girth was measured at breast height (app. 1.5 m from ground). Girth & height of Gewa was found to be varying from 2-8 cm and 0.5-3 m. Girth & height of Kewda tree was found to be varying from 40-65 cm and 3.5-4.6 m. Girth and height of Bain trees was found to be varying from 50-80 cm and 3.5-6 m. Quantitative analysis of the same is given in the following table 45. Photographs of the site showing vegetation and adjacent Mangroves Forest (Bamon Sundar Forest) are given in figure 72 below.

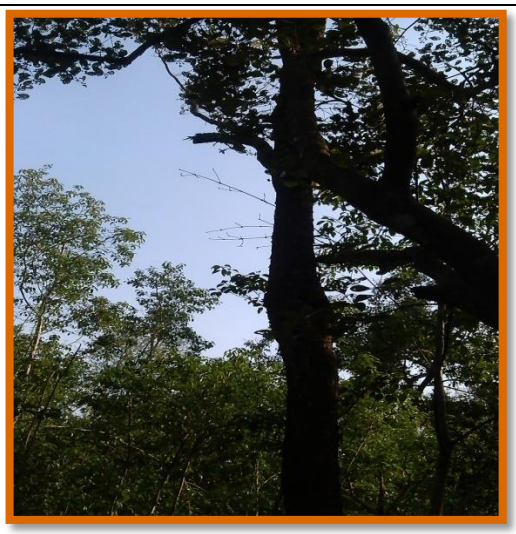
Vegetation at EZ Site

Tree Plantation on CDSP Bund (in section abutting EZ site)

View of Mangroves Forest from EZ Site

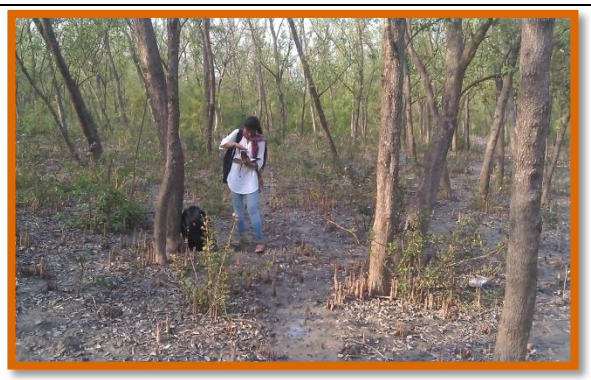




Vegetation of Adjacent Mangroves Forest

Mud Crabs within EZ Site



Quadrate Sampling in Mangroves Forest

Figure 72: Photographs Showing Vegetation & Fauna at EZ Site

Table 36: Quantitative Analysis of the Floral Species of Planted Mangroves Forest Adjacent to EZ Site

Species	No. of Species in 100 sq m of area										Total	Density	Frequency	Abundance
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10				
Baina	7	0	0	6	7	0	3	1	2	5	31	3.1	0.7	4.4
Kewda	1	17	12	2	0	16	2	12	8	0	70	7	0.8	8.75
Gewa	139	17	2	89	90	8	68	14	44	101	572	57.2	1	57.2
Total	147	34	14	97	97	24	73	27	54	106	673	--	--	--

Source: Site Visit

Flora & Fauna of Access Road

It is proposed to develop an access road of 6 km length and 5 m width on existing CDSP bund. This bund is currently non motorable. Access road will be constructed till Abu Torab junction from Abu Torab junction, Abu Torab road is paved and is in good condition. There is rich both naturally and planted vegetation along the access road. List of the trees along the access road is given in table 46 below. Photographs of the vegetation are also given below in figure 73.

Vegetation along proposed access road/existing CDSP bund

Figure 73: Photographs Showing Vegetation along the Proposed Access Road

Table 37: List of Trees along the Access Road

Species Name	Local Name	Family
Acacia moniliformes	Akashmoni	Leguminosae
Areca catechu	Supari	Palmae
Avecenia alba/ Avicennia Marinavierh	Baen	Aviceniaceae
Azadirachta indica	Neem	Meliaceae
Carica papaya	Pepey	Caricaceae
Cocos nucifera	Narikel	Palmae
Excoecaria agallocha	Gewa	Euphorbiaceae
Herritiera fomes	Sundari	Sterculiaceae
Mangifera indica	Aam	Anacardiaceae
Manilkara zapota	Safeda	Zapotaceae
Phoenix sylvestris	Khejur	Palmae
Psidium guajava	Peyara	Myrtaceae
Sonneratia apetala	Kewda/Keora	Lyrthaceae
Spondius pinnata	Amra	Anacardiaceae
Swietenia mehagoni	Mehogani	Meliaceae
Syzygium cumini	Jaam	Myrtaceae
Syzygium samarengense	Jamrul	Myrtaceae
Tamarindus indica	Tentul	Leguminosae
Terminalia catapa	Kathbadam	Combrataceae
Tectonia grandis	Teak	Lamiaceae
Gmelina arborea	Gamari	Verbenaceae
Brassica juncea	Raisharisha	Brassicaceae
Olea europaea	Olives	Oleaceae
Terminalia bellirica	Bohera	Combretaceae
Terminalia chebula	Horitoki	Combretaceae
Phyllanthus emblica	Amla	Phyllanthaceae
Protium serratum	Gutgutiya	Burseraceae
Propospis cineraria	Jand	Fabaceae
Casuarina equisetifolia	Jhao Ghas	Casuarinaceae
Albizia lebbeck	Koroi	Fabaceae
Delonix regia	Krishnachura	Fabaceae
Leucaena leucocephala	Ipil Ipil	Fabaceae
Carissa carandas	Karamcha tree	Apocynaceae
Artocarpus heterophyllus	Jack fruit	Moraceae
Polyalthia longifolia	Pseudo Ashoka	Annonaceae
Musa parasisiaca	Banana	Musaceae
Garuga pinnat	Bhadi	Burseraceae
Abelmoschus esculentu	Bhendi	Malvaceae
Erythrina indica	Mandar	Fabaceae
Acacia mangium	Mangiam	Fabaceae
Dalbergia sissoo	Sheeshu	Fabaceae
Lawsonia inermis	Kat Mehndi	Lythraceae
Swietenia mahagony	Mahagony	Meliaceae
Arundinaria	Cane Ghas	Poaceae
Samanea saman	Rain Tree	Fabaceae
Zizyphus mauritiana	Boroi	Rhamnaceae
Calotropis	Calotropis	Apocynaceae
Ceriops decandra	Gora	Rhizophoraceae
Litchi chinensis	Litchi	Sapindaceae
Ficus benjamina	Dumur	Moraceae
Citrus maxima/Citrus grandis	Jambura	Rutaceae
Mimosa pudica	Lazzabati	Fabaceae
Pinus densiflora	Pine	Pinaceae
Excoecaria agallocha	Gewa	Euphorbiaceae

Nypa fruticans	Golpata	Arecaceae
Heritiera littoralis	Sundri	Lauraceae

Source: Site Visit

5.10.3. Buffer Zone: Ecological Assessment

Buffer area of 10 km is considered for studying the ecology around the project site. Study area has all terrestrial, aquatic and wetland ecosystem. The river & canal systems of the area are rich in aquatic flora and fauna. Substantial fishing activities are carried out in these rivers & canals. Major land use in the study area comprises of the wetland and agriculture/aquaculture. Aquaculture ponds can be seen everywhere in the study area and people practice aquaculture throughout the year along with the agriculture. Mangroves plantation carried out by forest department exits adjacent to EZ site. An assessment on the ecology has been made for the study area from the available secondary data.

Common Flora and Fauna in buffer zone

10 km area around EZ site majorly comprises of agricultural/aquaculture land followed by water bodies. Flora and fauna in the study area is given below. Ramgarh reserve forest & Mahamaya forest are other zones rich in bio-diversity but are not within 10 kms radius of EZ site.

Terrestrial Flora

There are no major forests apart from Dhoomkali forest, Bamon Sundar forest & Mogadia forest occurs within 10 km radius area of EZ site. Flora in the study area majorly comprises of the trees which were found along the access road and are given in the table above. Apart from the trees mentioned in the above table trees existing in study area are: Deodara (*Cedrus deodara*), yellow bell (*Tecoma stans*), Hibiscus (*Hibiscus rosa sinensis*), Chikrashi (*Chukrasia tabularis*), Telsur (*Butea monosperma*), Jarul (*Lagerstroemia speciosa*), Kadam (*Neolamarckia cadamba*), Dhakijam (*Syzygium grande*), Davana (*Artemisia pallens*), Lotkon (*Baccaurea ramiflora*), money plant (*Epipremnum aureum*), Toon (*Toona ciliate*), Bokain (*Melia azedarach*) and Banyan (*Ficus benghalensis*). Photographs of flora of buffer zone are given below in figure 74. Varied variety of vegetation occurs along the Isakhali and Bamon Sundar canal in study area. This vegetation is both naturally occurring and planted by forest department. Golpata is planted all along the Bamon Sundar canal by Forest Department, Mirershorai.

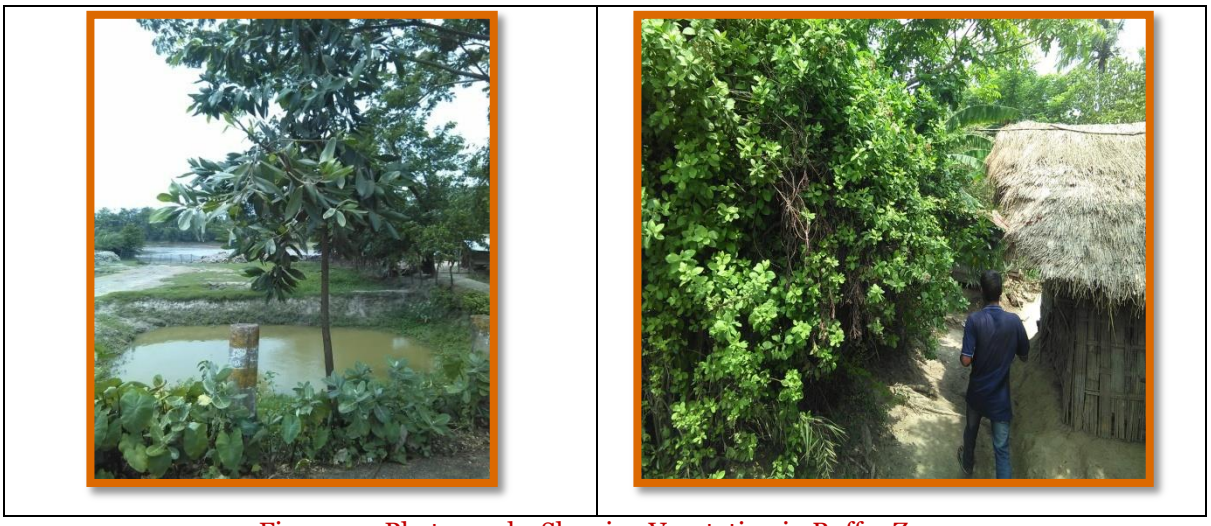


Figure 74: Photographs Showing Vegetation in Buffer Zone

Terrestrial Fauna

Mammals & Reptiles

Cows, goats, dogs, cats, mule, horse, monkey are found in the study area during the visit. No wild fauna was found in study area. As per discussion with local people it was learned that deer and fox are found in planted mangrove forests but none were spotted during visit. In Ramgarh reserve forest wild animals like Fox, Monkeys, Langoor, Ullunk, Wild Cats, Wild Boar, Bisons, Deer, Otter/Udbilaw (*Lontra Canadensis*), Kat Biral, Elephant, Bonrui, Rabbits, Deers, Wild goats & wild goats. But Ramgarh forest does not falls within 10 km radius area. Apart from the mammals, reptiles like chameleon, garden lizard & Gohar Saanp were also observed during the visit. Apart from this villagers informed that cobras and python also present in this region.

Avifauna

Avifauna like Gugu/Dove (*streptopelia chinensis*), Paira/Pigeon, Doyal (*Magpie Ribbon*), House sparrow/Choroi, Parrot/Tiya, Crow (*Corvus splendens*), Myna/Shalik, Babui/Baya Weaver (*Ploceus philippinus*), Dhooli Bawk, Sarosh/Eastern Great Egret (*Ardea modesta*), Kaali Bawk, Machranga/Kingfisher (*Halcyn smyrensis*), Eagle, Koyal/Kokil (*Eudynamys scolopaceus*), Baali, Dhanesh/ Indian grey hornbill(*Ocyceros birostris*), Baijja hash, blue throated barbet (*Megalaima asiatica*), Duck (*Anatidae anatinae*), Dhar Bawk/Egret, Konch Bawk/Pond Heron (*Ardeola grayii*) are found in the study area. Photographs of the birds observed in the study area are given in figure 75 below. Apart from these, as per discussion with local people, few migratory birds also visit EZ site. Some of them are Goshawk (*Accipiter gentillis*), Sparrow, hawk (*Accipiter nisus*) and Pied Harrier (*Circus melanoleucus*). Visit was also made to Mahamaya Lake to study the avifauna. Some aquatic birds like Northern Pintail etc were also seen during visit.

Figure 75: Photographs Showing Birds in the Study Area

Butterfly

Presence of butterfly was found in the settlement areas, fields, road side plantation and at bank of river. Some of the common butterfly of the Chittagong region are Gaudy Baron, Golden Browing, Leopard Lace, Clipper, Common Batwing, Common Gem, Orchid, Yellow hellen etc.

Aquatic Ecology

Fisheries

Consultation was carried with the fishermen in study area to gain knowledge about the fish species in canals, River Feni, Khals, Beels, ponds etc. Fish species in Feni River Estuary system is discussed and detailed in Fisheries section given above in this chapter. Fish species occurring in Canals & ponds are: Golda chingri, Bagda chingri, Chiring, Pangash fish, Coral fish, Promphet fish, *Catla Catla*, Ruhi, Hilsa, Bata fish, Gulla, Pua, Riksha, Lorka, Senuwa, Loitta, Nylotika, Mud crabs, Holona, mrigal, silver carp, gras carp, karpio, barbs (putis), Chitol, Folai, catfish (Tengra, Singi, Magur, Boal, Pungus), Snakehead (Shol, Taki), bele etc

Planktons

Planktons which occurs in waters of River Feni are of following genus: Spirogyra, Zygnema, Volvox, Pediastrum, Anabaena, Desmidium, Gonatozygon, Mougeotia and Microcystis and the zooplankton genera were, Asplanchna, Notholca, Daphnia, Filinia and Cyclops. Crustacean larvae (Nauplii) are also found in river water

5.10.4. Ecosystem Service and Function

Presence of rich flora and fauna of Mirershorai and river system and trees plantation provides good ecobalance situation currently for maintaining the climatic situation of the area. Since project development will be carried out taking all the measures for preventing or reducing environmental pollution, thus project development will not affect the ecosystem significantly.

5.11. Socio Economic

5.11.1. Socio Economic Condition

Mirershorai EZ covers area of 610 acres out of which 550 acres will be developed and remaining 60 acres is under Isakhali canal. Majorly as per preliminary assessment, three types of industries including light engineering, textile and food processing will come up in the EZ zone

Proposed Mirershorai EZ is located in Mirershorai Upzila under Chittagong district which further comes under Chittagong Division. Chittagong Division is geographically the largest of the seven administrative divisions of Bangladesh. Although Chittagong division as a whole is better off when compared to the other divisions in terms of the population below the poverty line, the picture is still grim. According to the World Bank report 26.2% of the population of Chittagong division lie below poverty line (SIA Report, Mirershorai EZ). The commissioning of the EZ will have a catalytic and transformative impact on the socio-economic and cultural life of people residing within this area and is expected to lead to substantial socio economic benefits for the people living in the EZ and the surrounding influence zone. Social Impact Assessment (SIA) study of the project area was done by PwC India.

The proposed EZ lies approximately at a distance 79 km from Chittagong airport (Shah Amanat International Airport), 182 km from Dhaka city and 67 km from Chittagong port.

Mirershorai came into existence as a Thana in 1901 and was upgraded to an Upzila in 1983. The Upzila consists of 2 paurashava, 18 wards, 41 mahallas, 16 unions, 109 populated mauzas and 208 villages. The average size of population of each ward and mahalla are 1546 and 679 respectively. On the other hand, the average size of population of each union, mauza and village are 23181,3403 and 1783 respectively according to the 2011 Census (District Statistics Chittagong, BBS 2011)

Demographic Profile of Mirershorai Upzila

Population

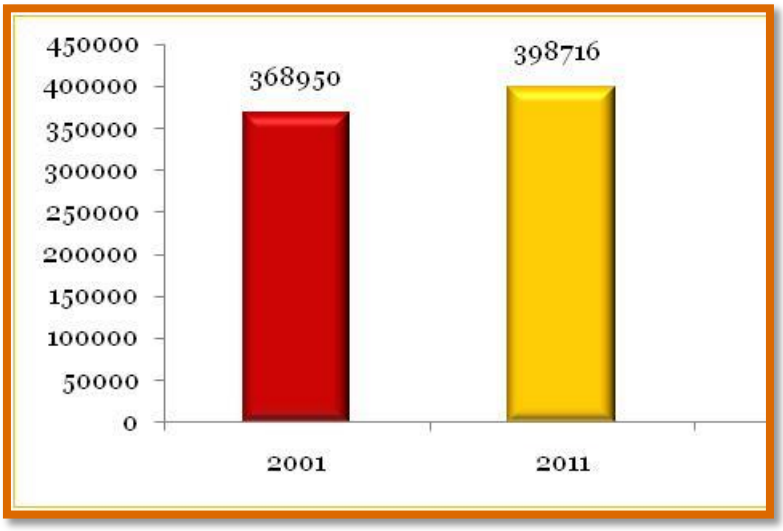
According to the Census 2011 report, the total population in Mirershorai Upzila is 398716 and the population density per sq. km of the area is 826 persons. The 2011 Census data reveals that the decadal population growth rate for the Upzila is 8.07% in comparison to the 2001 Census data.

Table 38: Demographic Details

Administrative Unit	Area (Sq.KM)	Total HH	Average HH size	Gender ratio*	Floating population (HHs)	Population Density
MirershoraiUpzila	482.88	79545	5	89	164	826

Gender ratio* = no. of Males/ 100 Females

Source: Population and Housing census 2011, Community report: Chittagong, BBS



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 76: Population of Mirershorai Upzila (number)

In Mirershorai Upzila, majority of the population fall within the age group of 15-49. The percentage of young population is quite high than the dependent population implying that the majority of the population belongs to the employable age group, which is vital for fuelling the economic growth of the local area.

Table 39: Population- age wise details

Age Group % Population	0-14	15-49	50-64	65+
Mirershorai Upzila	34.2	50.4	9.6	5.7

Source: Population and Housing census 2011, Community report: Chittagong, BBS

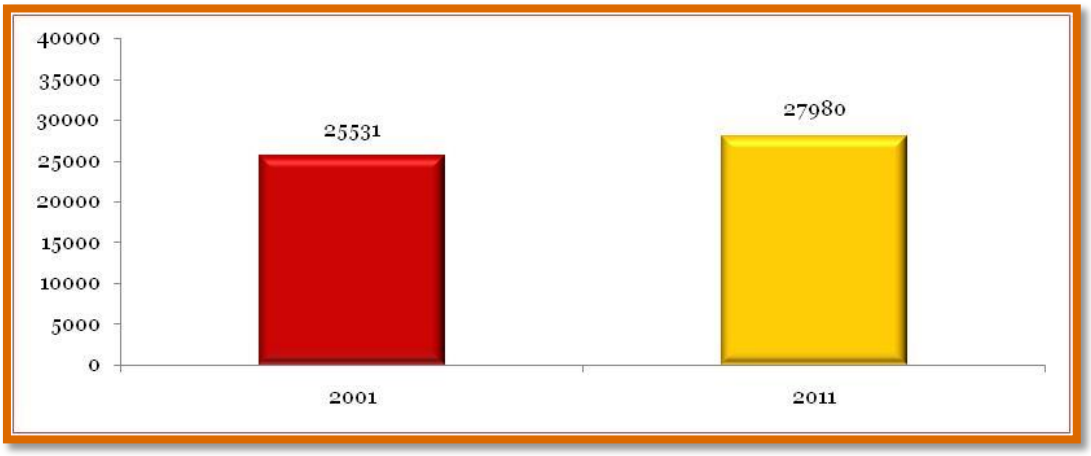
EZ zone falls within Isakhali Union of Mirershorai Upzila. According to the Census 2011 report, the total population in Isakhali Union is 27980. It is observed that the population density per sq. km of the area is 439 persons. The 2011 Census data reveals that the decadal population growth rate for the Union is 9.59% in comparison to the 2001 Census data.

Table 40: Demographic Details

Administrative Unit	Area (Sq.KM)	Total HH	Average HH size	Gender ratio*	Floating population (HHs)	Population Density
Ichhakhali Union	63.75	5205	5.37	84	16	439

Gender ratio* = no. of Males/ 100 Females

Source: Population and Housing census 2011, Community report: Chittagong, BBS



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 77: Population of Isakhali Union (number)

In Isakhali Union, majority of the population fall within the age group of 15-49. The percentage of young population is quite high than the dependent population. Therefore, this implies that the majority of the population belongs to the employable age group, which is vital for fuelling the economic growth of the local area.

Table 50: Population- age wise details

Age Group % Population	0-14	15-49	50-64	65+
Ichhakhali Union	37.1	47.9	9.3	5.8

Source: Population and Housing census 2011, Community report: Chittagong, BBS

Religion & Culture

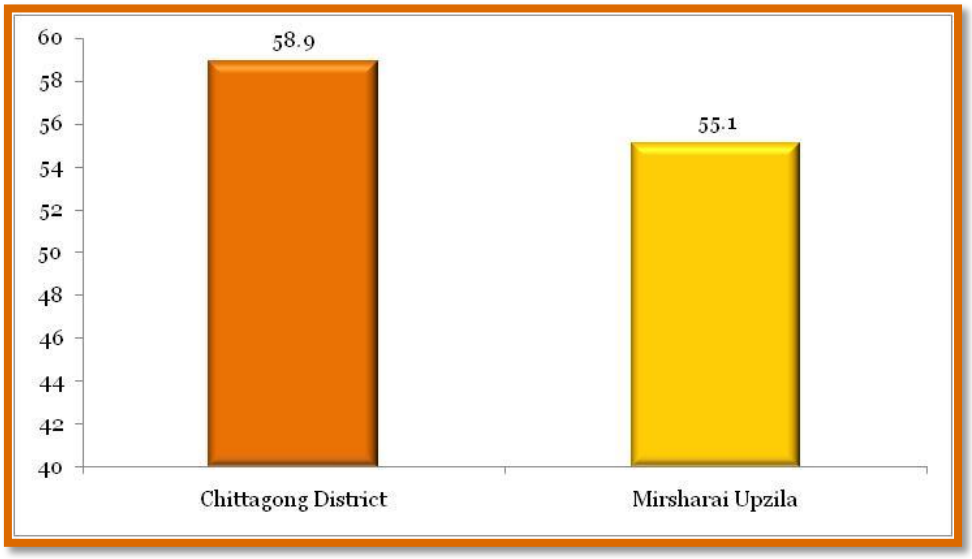
The majority of the population in Mirershorai Upzila is dominated by Muslims (86.12 %), followed by Hindus (12.36%), Buddhists (1.22 %) and Christians (0.018 %). The floating population of Upzila is 0.04% of the total population. Further, there are 1.14% indigenous people (tribal or ethnic minority) within these areas.

The majority of the population in Isakhali Union is dominated by Muslims (87.90 %), followed by Hindus (11.89%) and Buddhists (0.18 %). The floating population of the Union Parishad is 0.06 percent of the total population. Further, there are no indigenous people (tribal or ethnic minority) within these areas.

5.11.2. Quality of Life Indicators

Literacy rate and educational facilities

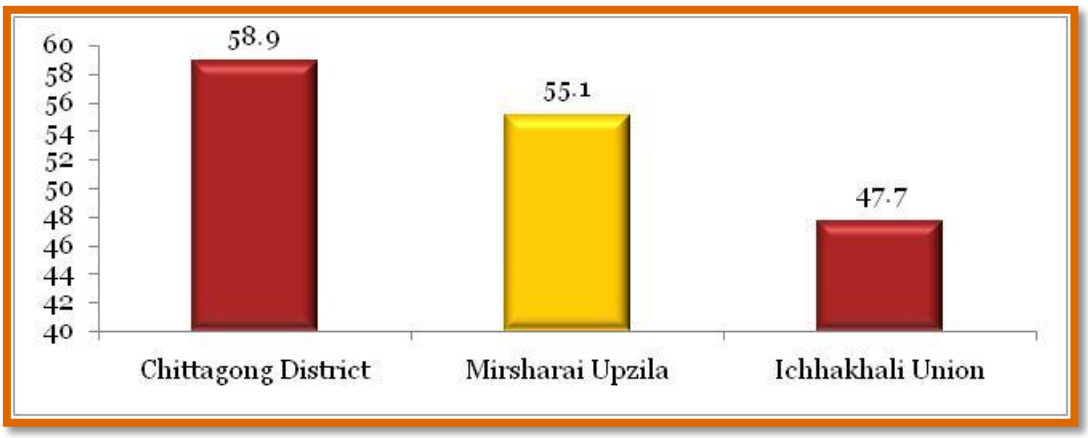
The literacy rate in Mirershorai Upzila (55.1%) is a little lower than the district level (58.9 %) but higher than the national level figure (51.8 %).The female literacy rate (53.3 %) is almost equal to the male literacy rate (57.1%).



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 78: Literacy rate in Mirershorai Upzila in comparison with the district level data (percentage)

The literacy rate in Isakhali Union (47.7%) is lowest among the Mirershorai Upzila (55.1%), Chittagong district (58.9 %) or the national level figure (51.8 %). The female literacy rate (47.2 %) is almost equal to the male literacy rate (48.3%).



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 79: Literacy rate in Isakhali Union in comparison with the Upzila and district level data (percentage)

5.11.3. Income & Poverty

Employment Status

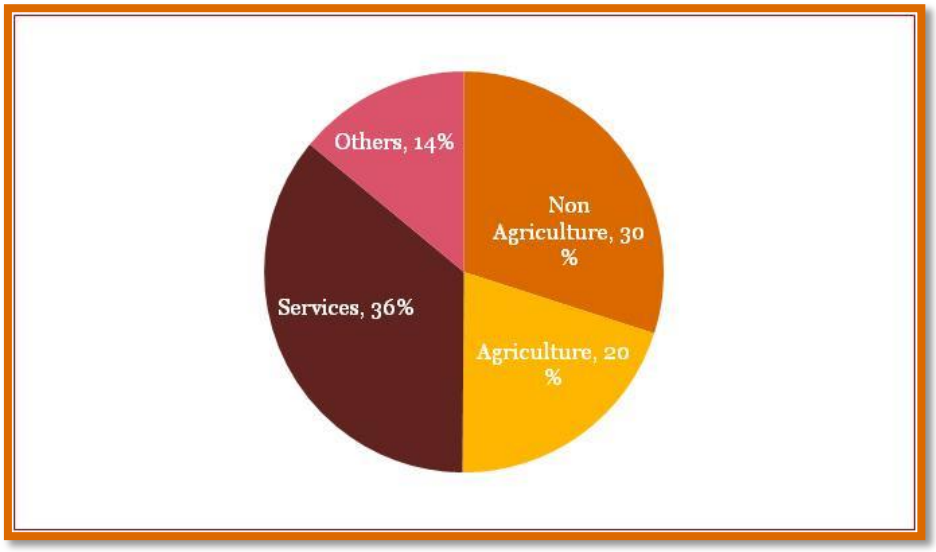
Households by Main Sources of Income

In Chittagong district as a whole, the services sector is the major source of employment providing employment to around 36% of the population. Non-Agricultural sector on the other hand accounts for 30% employment, while 20% comes from the agricultural sector. Table 51 analyses the scenario of major source of income of households at district level. Figure 81 illustrates Distribution of population by field of employment of Mirershorai Upzila as per Population and Housing Census 2011, Chittagong district.

Table 41: Households by Main Source of Income

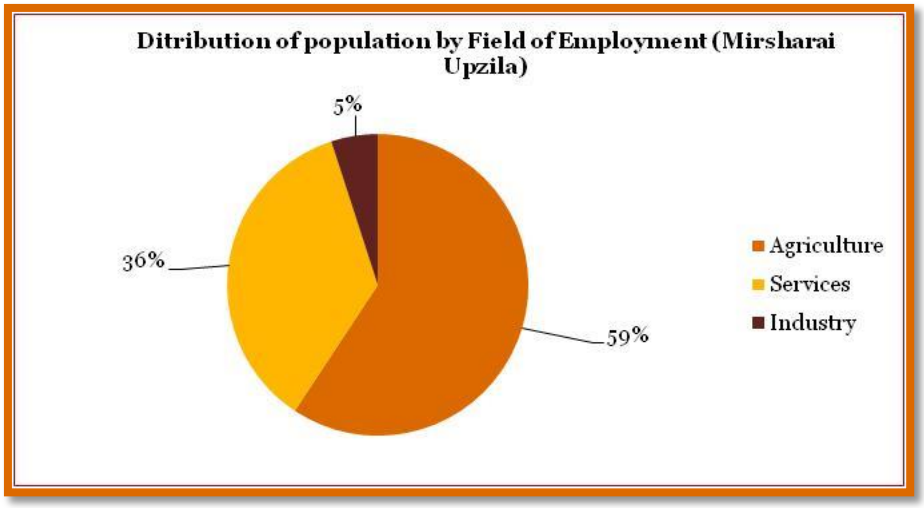
Administrative unit	Total Households	Main source of incomeof households (%)					
		Self employed (Agriculture %)	Self employed (Non-Agriculture %)	Service (%)	Day laborer (Agriculture %)	Day laborer (Non-Agriculture %)	Others (%)
Chittagong District	1567	13.47	17.10	35.93	6.7	12.89	13.98

Source: Labour Force Survey, Bangladesh 2011



Source: Population and Housing census 2011, Community report: Chittagong, BBS

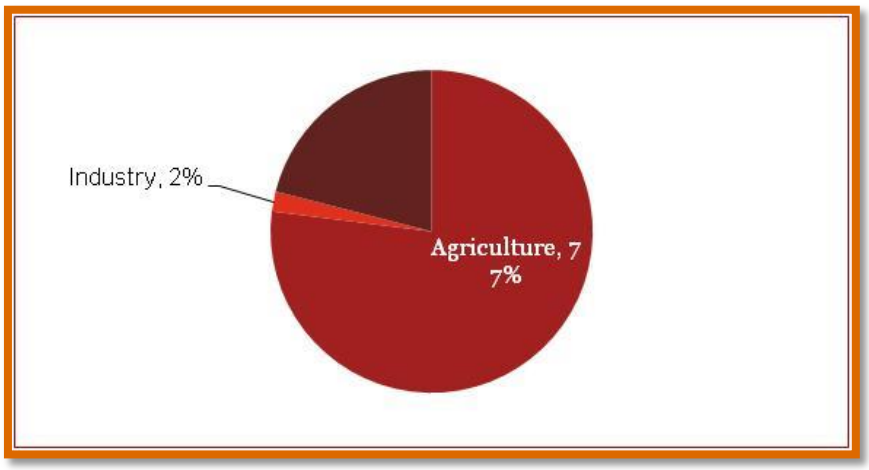
Figure 80: Source of employment (Chittagong District)



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 81: Field of Employment (Mirershorai Upzila)

On basis of above data, the negligence of industry sector in Mirershorai Upzila comes into the picture. The development of EZ could boost the employment in Industry sector and there can be gradual shift of population from Agriculture to Industry and Service sector.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 82: Distribution of population employed by field of employment in Isakhali Union

In Isakhali Union it is found that 7% of population is engaged in agriculture activities and 2% are engaged in industrial activities.

Field of activities in Isakhali Union: The total number of people not attending school and employed is 1,625, among whom 1,587 are males and only 38 are females. In Agricultural activities 1236 males and only 21 females are involved. Very few are employed in industry, only 25 males and 4 females. Men's involvement in the service sector is noticeable, 326 males are working in this sector compared to only 13 females.

The employment status clearly shows that the majority are dependent on agriculture related activities. The number of people in the service sector is just above one fourth of the number involved in agriculture. The very low number of people employed in industry is due to lack of opportunity. Thus, the development of EZ will generate quite a lot job opportunities, which will change the scenario of the region and will contribute to a reduction in migration to the large cities such the capital, Dhaka and the nearby mega-city of Chittagong. This locality is expected to become a new hub for business the service sector with all urban facilities.

Working Age Population, Economically Active Population and Participation Rate

The working age population in Chittagong district is 4.91 million (around 65% of the total population). Of these, males and females roughly have an equal share. However, if one considers the economically active population (i.e. the population that is actually working), the ratio is highly skewed towards the male population. Of the economically active population, more than 70% comprise of males. Further, at an overall level, the work force participation (w.r.t. the working age population) is also observed to be low, at 56%, as compared to the national level statistics of 59%. The work force participation of males is 80% vis-à-vis female participation (w.r.t. female population) at 32%.

Thus, the commissioning of the EZ could act as a facilitator to reduce the gap between the economically active population and Work Force Participation to a great extent.

Table 42: Working Age population, Economically Active Population and Participation Rate

Administrative structure	Working Age Population(In millions)			Economically Active Population(In millions)			Participation Rate(%)		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Chittagong District	4.91	2.45 (49.90%)	2.46 (50.10%)	2.759	1.967 (71.29%)	.793 (28.71%)	56.2	80.3	32.2

Source: Labour force survey, 2011

Wages

The scenario for wages, analysed at the Upzila level reveals that the daily average wage rate of male agriculture labourer at the Upzila level is BDT 500 and that for female labourers isBDT300, as against the BDT 658 daily average wage rate of labour in the manufacturing sector. The details of the Upzila level wage rates of various categories of labourers as per the District Statistics 2011 report are given in table 53 below.

Table 43: Daily average wage rate of laborers in Mirershorai Upzila (Wages are in BDT)

Upzila	Typeof labor	Mason	Helper	Carpenter	Color	Electric	Plumber
Mirershorai Upazila	Construction worker	500	300	500	600	400	500
	Non agriculture labor	Porter	Garden labor (male)	Garden labor(Female)	Other labor		
		500	350	300	350		

Source: Population and Housing census 2011, Community report: Chittagong, BBS

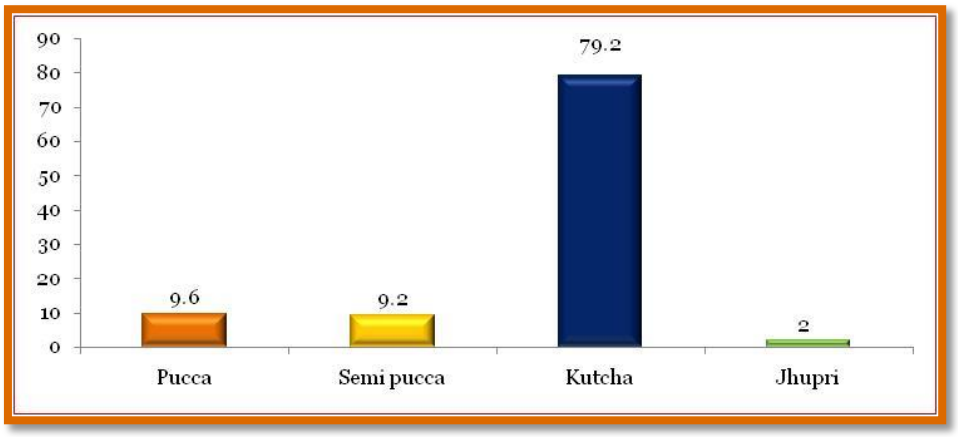
However, it has been observed through various studies on EZs and from primary consultations that the minimum wages at EPZs are generally set at a higher level than elsewhere in the economy and these are implemented effectively (Progress, Emerging Challenges, and Future Directions, Thomas Farole, Gokhan Akinci, the WB). BEPZA as per their circular dated 2013 has revised the minimum wages for the workers of the enterprises. Accordingly, a highly skilled worker is entitled to BDT: 11, 200/month and an unskilled worker is entitled to BDT: 5992/month. Accordingly, the setting of the Mirershorai EZ is expected to increase the average wage rate in the region.

Poverty information: No poverty related data is directly provided in the latest Census. But the data on occupations, education and household types are presented to give an idea of the locality. From these variables, the area seems impoverished and not many well-off families live in the proposed EZ area. Thus, the EZ will contribute to the improvement of all the unions within the Upzila, and also the adjacent ones. It can be expected to change the poverty scenario in a positive way.

5.11.4. *Infrastructure facilities*

Housing Condition

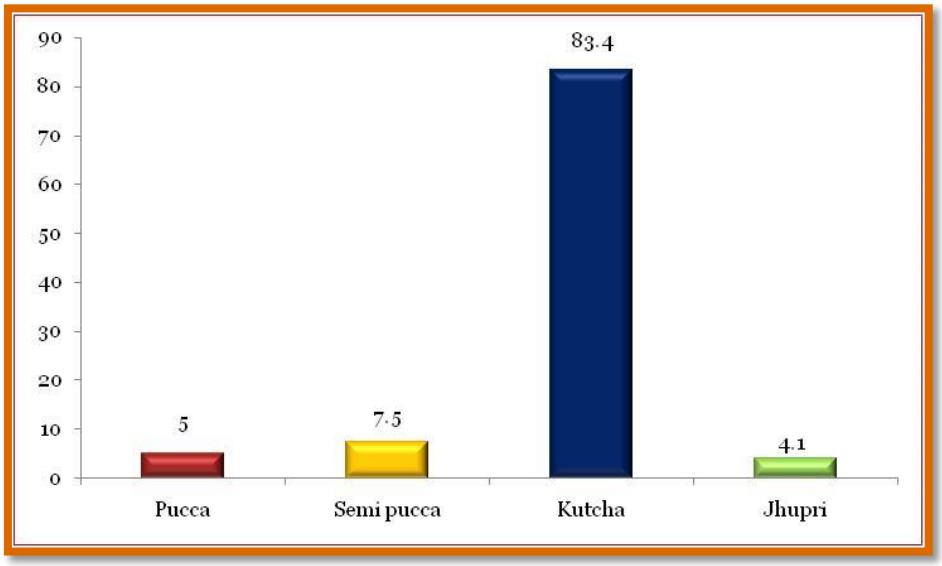
The quality of housing in the area shows that 79.2% people in Mirershorai Upzila have "kutcha" houses, indicating their low social and economic status. The kuccha houses are vulnerable and increase the risk to life in the event of natural disasters such as floods or cyclones. The need to provide good housing will be a challenge for the administration and will have to be dealt with effectively.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

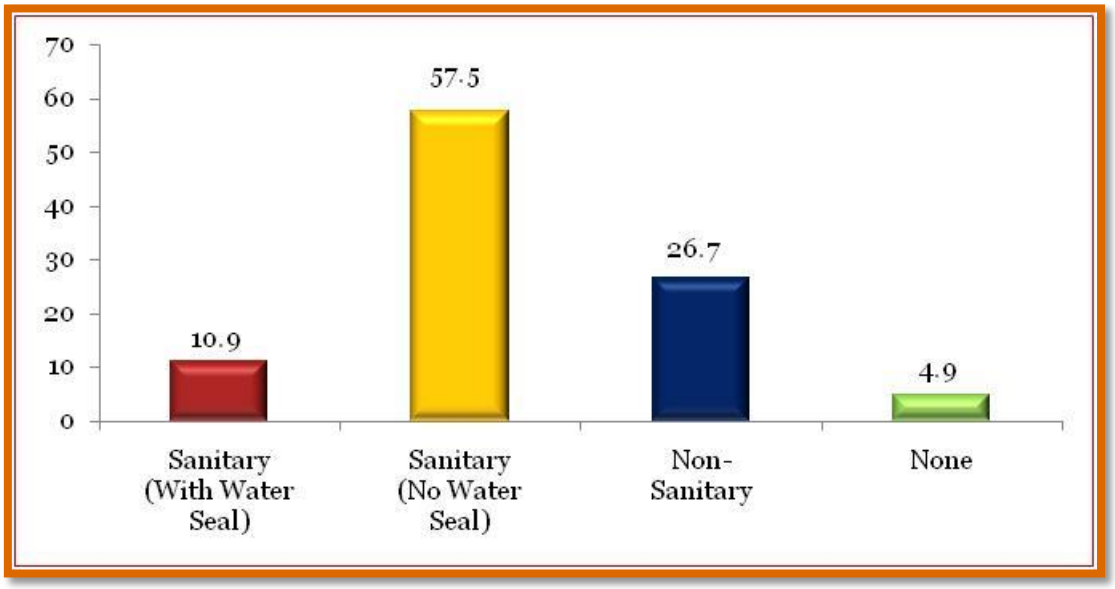
Figure 83: Housing pattern in Mirershorai upzila (percentage)

The quality of housing in the area shows that 83.4 percent people in Isakhali Union have "kutcha" houses, indicating their low social and economic status. The kuccha houses are vulnerable and increase the risk to life in the event of natural disasters such as floods or cyclones. The need to provide good housing will be a challenge for the administration and will have to be dealt with effectively. The household pattern, sanitation facilities and behaviour shows a grim picture of poverty in the proposed EZ area. Most of the households have kutcha houses and a very low percentage of households have pucca houses. The number of people using proper sanitary toilets is small - most people having non-water sealed sanitary ones. 30%-35% of households either have non-sanitary toilets or no toilets at all.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 84: Housing pattern in Isakhali Union (percentage)

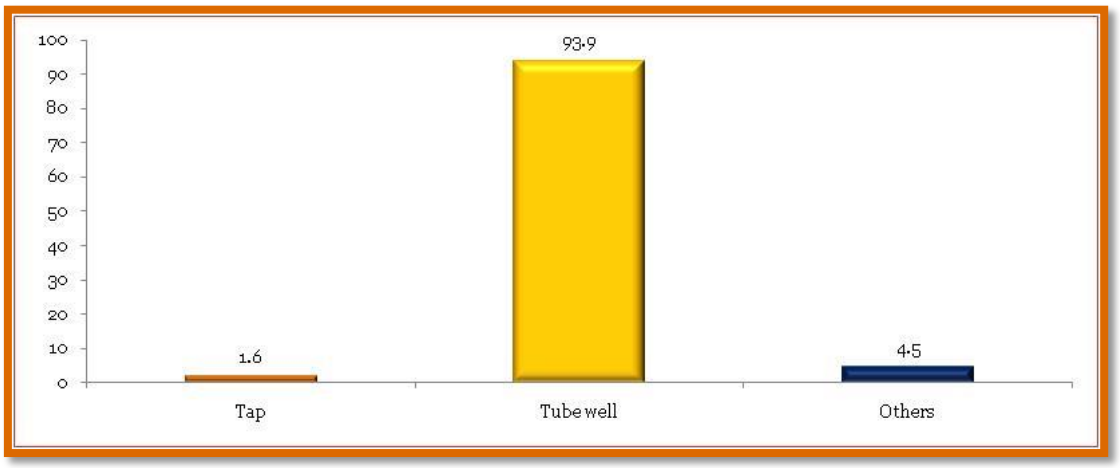


Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 85: Sanitation facilities in Isakhali Union (percentage)

Services

A review of the project area highlights the fact that scarcity of safe drinking water is an acute problem faced in the region. Tap water is available to only 1.6 percent of population. The majority 93.9 % of the population use Tube well and 4.5% relies on other sources for drinking water such as ponds. The scarcity of water intensifies during the summer season when the salinity of water increases and during cyclones when the water sources get damaged and, contaminated with saline water. In this situation people are forced to drink unsafe water or spend their limited financial resources on collecting or purchasing water from other sources. Women and the vulnerable population are the most affected during this situation.

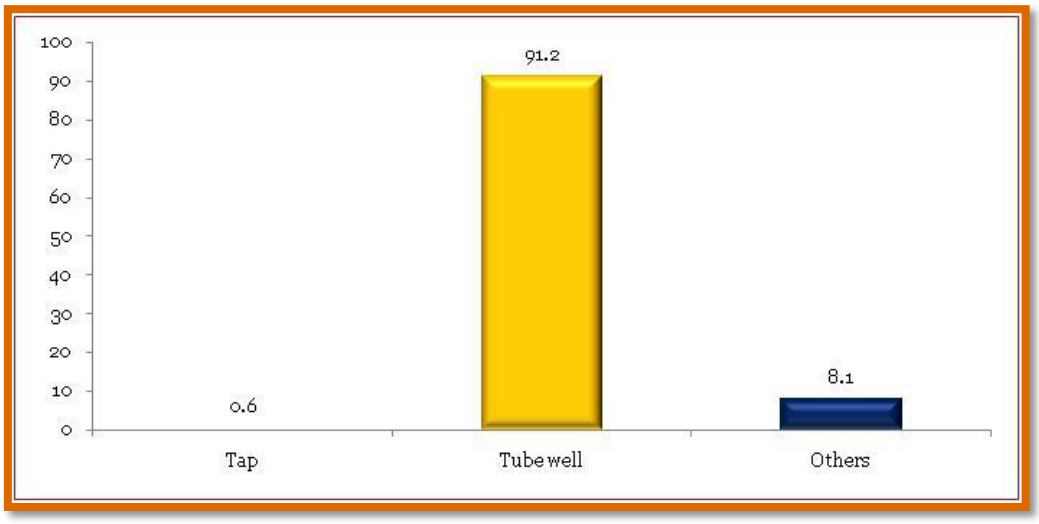


Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 86: Source of drinking water (in percentage) in Mirershorai Upzila

A review of the project area highlights the fact that scarcity of safe drinking water is an acute problem faced in the region. Tap water is available to only 0.6 percent of population. The majority 91.2 % of the population use Tube well and 8.1% relies on other sources for drinking water such as ponds. The scarcity of water intensifies during the summer season when the salinity of water increases and during cyclones when the water sources get damaged and, contaminated with saline water. In this situation people are forced to drink unsafe water or spend their limited financial resources on collecting or purchasing water

from other sources. Women and the vulnerable population are the most affected during this situation. Only 38% of the households of Isakhali Union have electricity connection.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 87: Source of drinking water (in percentage)

Other Infrastructure facilities

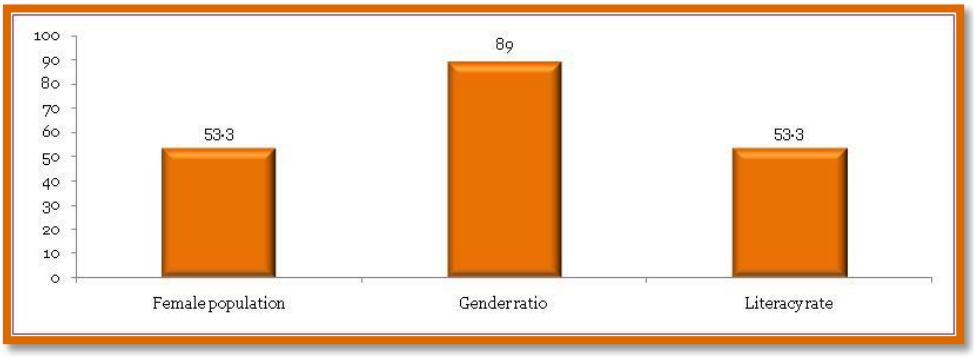
Transport is a major problem in the project area as there is no public service connectivity from the NH to the project site. People have to walk down 10 Km or to use the auto rickshaws for commutation. Further, health and education facilities are also not satisfactory as there are no schools or hospitals nearby.

5.11.5. Gender & Women

Women and employment status

Women in Bangladesh are at the forefront of awareness and empowerment on account of various interventions by the GoB. Though, Bangladesh has already achieved gender parity in primary and secondary education (Promote Gender equality and empower women, UNDP Bangladesh), the female population, gender ratio, access to labour markets and the role of female in decision-making still leave gaps and this call for an improvement. This is especially true in the rural areas where women currently lack adequate access to resources and opportunities. Being a patriarchal society, the men exercise control over women's access to labour and their income and assets. The following graphs depict the status of women in Mirershorai Upzila & Isakhali union.

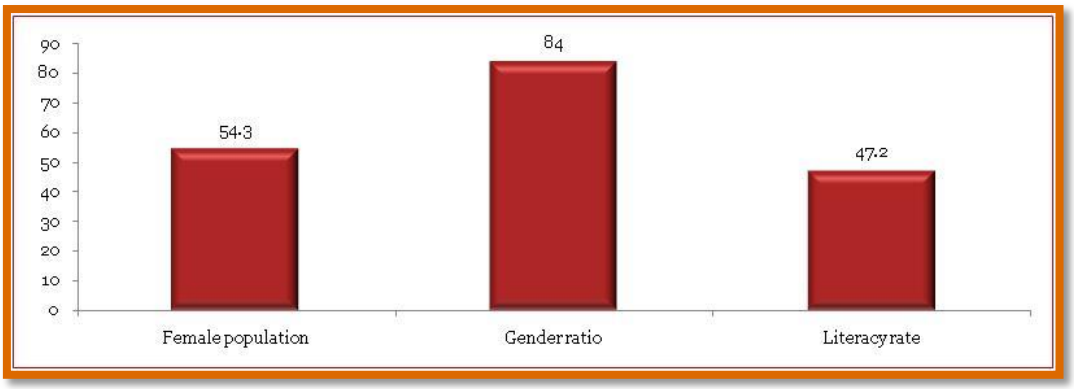
The female population in the Mirershorai Upzila constitute 53.3%of the total population. The gender ratio of 89 which has been tremendously decreased in 2011 as against 99 males in 2001, and female literacy rate of 53.3% is below the satisfactory level.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 88: Female Population (percent), Gender ratio (no. of males per 100 female) and Female Literacy rate (percent) in Mirershorai Upzila

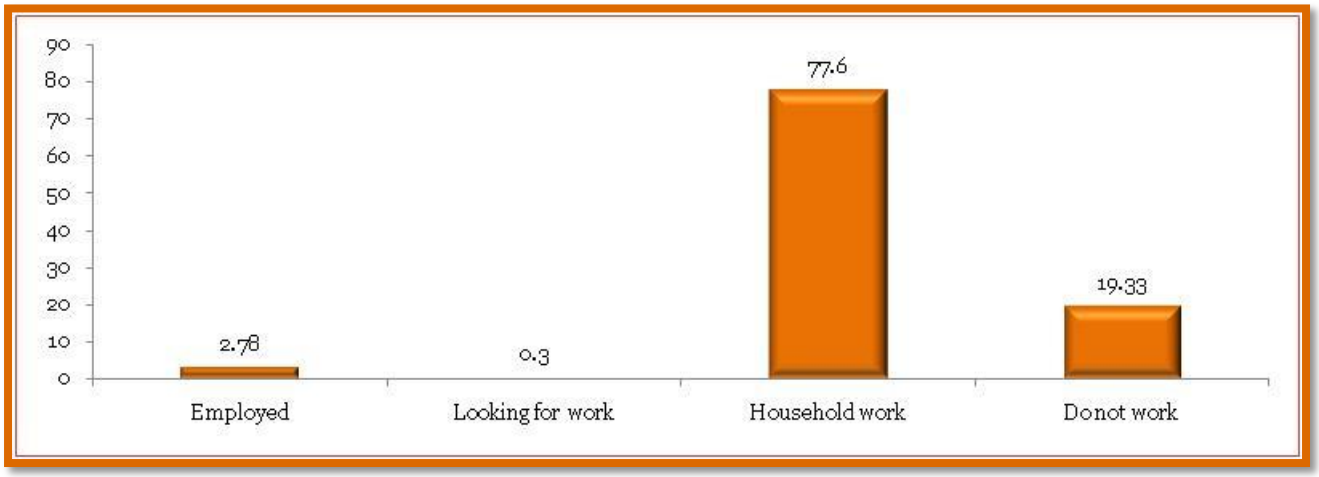
The female population in the Isakhali Union constitute 54.3 % of the total population. The gender ratio of 84 which has been tremendously decreased in 2011 as against 99 males in 2001, and female literacy rate of 47.2% is below the satisfactory level. The figure 89 below indicates that women have out-numbered men in Isakhali Union. Thus, it appears that increased job opportunities within the localities for women will lead to women's economic empowerment and the economic up-grade of their families and the locality as a whole.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

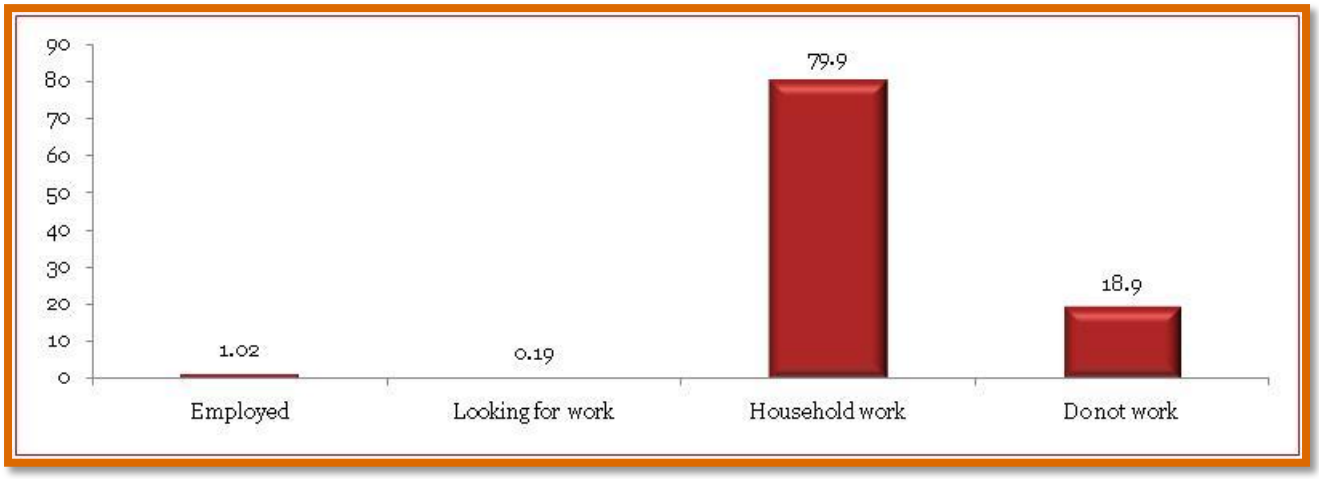
Figure 89: Female Population (percent), Gender ratio (no. of males per 100 female) and Female Literacy rate (percent) in Isakhali Union

At the national level, female participation in the labour market is low (57.2%) in comparison to that of men (84.3%). The trend shows almost similar pattern in the Upzila. Women here are mainly engaged in household work (77.6%) and a mere 2.78% are employed. Women's participation in the other sectors including industry and agriculture employment is negligible. The trend is even worse in the Isakhali Union. Women here are mainly engaged in household work (79.9%) and a mere 1% are employed.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 90: Female Employment status (percentage) in Mirershorai Upzila



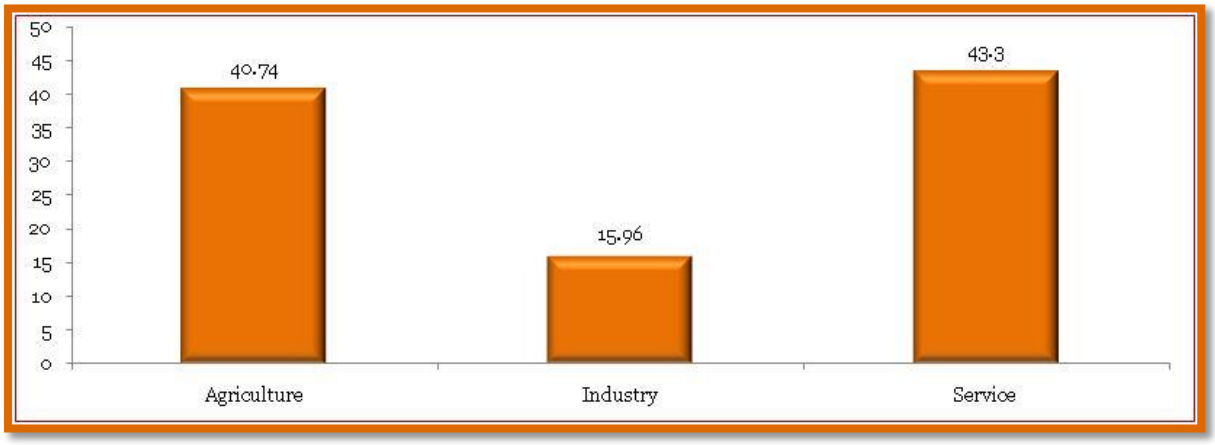
Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 91: Female Population (percent), Gender ratio (no. of males per 100 female) and Female Literacy rate (percent)

Women's presence is very poor in all the major fields of activities such as agriculture, industry and service sectors. One of the reasons may be that when women work as domestic labourers in agriculture, their economic contribution is not counted. It is rather counted as domestic work which seriously undermines women's productive role.

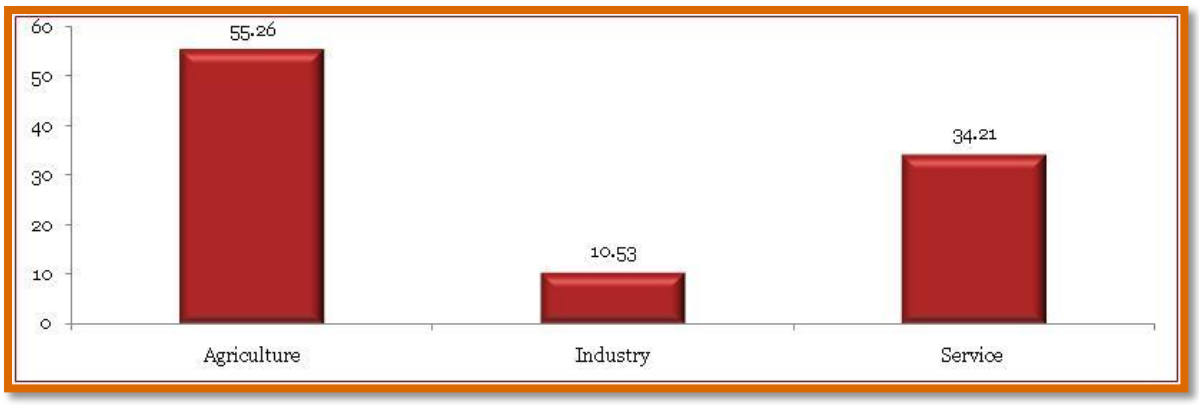
Women's involvement in the EZ industrial zone will not only make their contributions visible in the productive sector, it will also empower them in all senses and will eventually have a positive impact on their own lives and that of their family members, particularly their children.

The occupation of women in Upzila is mainly centred upon the service and agriculture sector: 43.3% and 40.74% respectively in Mirershorai Upzila. The scenario also depicts that the presence of about 16% women in industry sector which is very low. Scenario is even worst in Isakhali union. Of the mere 1% employed females in Isakhali Union, the total number for which is only 38. Of whom 21 females are involved In Agricultural activities, only 4 in Industry sector and 13 in Services sector.



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 92: Field of Activity of women in Mirershorai Upzila (percentage)



Source: Population and Housing census 2011, Community report: Chittagong, BBS

Figure 93: Field of Activity of women in Isakhali Union (percentage)

Traditionally, employment opportunities for women outside the homestead are very limited. Majority of the labour activities performed by women at household level (e.g. in rice milling, weaving etc.), has been displaced by technological changes and mechanisation. Organised food for work and other employment schemes provide some employment for impoverished rural women, but are limited in scope and duration. Hence, the development of EZ will be an opportunity for the women in Mirershorai Upzila to access employment opportunities.

5.11.6. Common Property Resources

No common property resources exist is within EZ zone and proposed access road alignment thus no CPRs are being affected with the project development

5.11.7. Conflict of Interest and Law and Order Situation

No conflict of interest is associated with the EZ site or development of any other off-site facility.

5.11.8. Historical, Cultural and Archaeological sites

There is no archaeological resource present within EZ zone and access road alignment. Details of archaeological structures within Mirershorai Upzila & Chittagong District are discussed in section 5.6.1

6. Identification and Analysis of Key Environmental Issues

6.1. Environmental Sensitivity Investigation

Environmental impact assessment has been carried out considering the impacts of proposed interventions with associated activities on important components of the environment and society. Firstly, all of the environmental components sensitive to proposed activities were identified during reconnaissance field visit based on expert observation, local people's perception and worldwide practice of EIA. The scoping process, followed to identify the environment and social sensitive features included professional judgments of the multi-disciplinary EIA team members and public consultation. The preliminarily identified environmental and social sensitive components are listed in sections below.

6.2. Environmental Asset

Environmental assets identified in the study area are listed below:

1. Air Quality of the area
2. Noise level of the area
3. Transportation system of the area
4. Fisheries of the study area
5. Ecosystem of study area
    a. River Feni, Isakhali canal & Bamon Sundar Canal
    b. Mangroves Plantation Forest
    c. Agriculture land and Aquaculture pond

Identified environmental assets of the project are likely to be impacted due to development of Economic Zone at all the pre-construction, construction and operation stages of the project. Project activities which may have an impact on the environmental assets and the associated impacts are listed in table 54 below**.** The detailed impact identification and mitigation measures are given at Chapter 7.

Table 44: Environmental Assets of the project area

S. No.	Environmental Assets	Impact	Related Project Activity
Pre-Construction & Construction Phase			
1	Air Quality of Study Area	Degradation	Site clearance/ preparation Construction activities Excavation Exhaust from construction vehicles/machinery
2	Noise Level of Study Area	Increase in Noise levels	Construction activities Movement of construction vehicles/machinery
3	Transportation System	Traffic congestion on the village road (Abu Torab road,	Increased nos. of vehicles carrying construction raw

		Project road, BWDB & CDSP bund)	material and construction debris
4	Fisheries of Study Area	Increased sedimentation of water body	Increase in run-off from construction/excavated site. Construction of sluice gate on Isakhali channel may impact the fishing activities
5	Eco-system of Study area: River Feni, Isakhali Channel & Bamon Sundar Channel	Increased sedimentation of water body	Increase in run-off from construction/excavated site
6	Eco-system of Study area: Agriculture and Aquaculture activity	Loss of agriculture & aquaculture land	EZ area is Char land (Govt. Land) and is used seasonally by people to carry out aquaculture and agriculture activities
Operation Phase			
1	Air Quality of Study Area	Air pollution	Industrial emissions and movement of vehicular access
2	Noise Level of Study Area	Increase in Noise levels	Increased traffic movement and industrial operations
3	Transportation System	Traffic congestion	Increased nos. of vehicles carrying industrial raw materials and workers for existing roads. Access roads required to be widened further to accommodate the expected vehicles during operational stage of EZ.
4	Fisheries of Study Area	Improvement Entry of pollutant into the Isakhali Channel & other water bodies from upcoming industries in EZ zone may impact the aquatic life Restricted fishing activity in Isakhali Channel within EZ site after development of EZ Local people will not be able to collect mud crabs from EZ site	Setting up of aquaculture based industries may improve the Fisheries activities in the area Construction of Sluice gate to control flow of water in Isakhali channel may restrict fish movement in Isakhali channel
5	Eco-system of Study area: River Feni & Isakhali Channel	Degradation of Water Quality & Aquatic life	Discharge of effluents from the industries which are proposed to be located in

			economic zone
6	Eco-system of Study area: Mangroves Forest	Loss of Mangroves Plantation	Air emissions from the industries and vehicular emissions are likely to create air pollution. It may have significant impact on Mangroves forest adjacent to EZ site Construction of bund to protect EZ site may also have impact on Mangroves plantation as it may restrict entry of sea water during high tide in the Mangroves plantation
7	Eco-system of Study area: Agriculture and Aquaculture	Improvement of agriculture and aquaculture production	Setting up of agriculture & aquaculture based industries may improve the agriculture and aquaculture activities in the region Development of paved surfaces may deplete the mud crabs species from EZ area, however 5 m wide zone of no development will be developed along Isakhali zone within EZ site.

6.3. Environmental Hotspot

EZ site and site for proposed off-site facilities lies in Mirershorai Upzila of Chittagong District& Division. EZ site does not lie within Eco-sensitive/Ecological critical area. Mangroves plantation carried out by Forest department along the coastline is adjacent to upcoming EZ site. Mangrove plantation exists in NW & SE direction of EZ site. Major 3 varieties of Mangroves are planted within this zone which comprises of Gewa, Bain & Keora. Construction of bund & EZ may restrict flow of sea water in Mangroves in some portion which may have impact on the Mangroves plantation. But the impact will be insignificant as bund will be constructed along the exposed boundary of EZ only and water from sea may enter Mangroves from all other sides.

Also effluent and emissions from industries may impact these Mangroves thus only non-polluting industries are proposed for EZ zone which are light engineering, food processing & textiles. It will be ensured that the environmental management measures should be taken as per proposed EMP.

Other ecological fragile natural features are Isakhali channel and Feni River. No development zone of 5 m width & retaining wall will be developed all along the Isakhali channel within EZ site to prevent direct exposure of industries to Isakhali channel. Also it will be ensured that no waste or effluents are discharged into Isakhali channel & River Feni.

6.4. Likely Beneficial Impacts

The project involves development off-site facilities for EZ. These off-site developments will make the site accessible and suitable for setting up of the industries. Development of the off-site infrastructure will attract the investors for setting up of the industries in the upcoming economic zone. Vicinity of the site to Chittagong Dhaka highway and well developed inland water transportation system further makes area suitable for EZ development. The likely benefits from the proposed development are listed as below :

1. Rapid Economic development (including enhancement and diversification of Industries, Enhancement of investments)
2. Large scale direct and indirect employment generation- improved quality of life
3. Development of infrastructure facilities
4. Technological enhancement for management of environmental management (like roads, water treatment, waste management, power supply, green belt, environmental monitoring)

6.5. Community Recommendations

No resettlement & rehabilitation is involved in land development for EZ zone and access road and other proposed off-site facilities. As per the focused group discussions carried out with people, it was learned that people are in favour of development of EZ. They are expecting development in their due to development of EZ. Also they expect large scale employment will be generated in the area for both male and females which will enhance their standard of living.

Some of them also shared that they expect development of infrastructure facilities like power supply, roads, water supply, educational facilities, and hospitals in the area which will further enhance standard of living. People suggested that only non polluting industries should come up in the region and all industries should take pollution control measures so that EZ development does not have negative impact on environment and their health. Also they demanded that local people should be considered for provision of employment preferably.

Focused group discussions were carried out with the villagers of Charshardh village, Nayapara Village, YPSA NGO and Government Officials of REB, Mirershorai, BWDB & Forest Department to discuss their view on the project development, the benefits and the negative impact of the project on their life and their expectations from the project.

People also suggested that agro based and aquaculture industries should come up in this region so as it could be beneficial for people engaged in aquaculture activity.

6.6. Alternate Analysis

Various sites have been identified by BEZA or development of economic zone. Pre-feasibility study for various sites has been carried out to analyze suitability of site for EZ development by BEZA. As per pre-feasibility study it was found that Mirershorai is one of the most potential & suitable zone for development of EZ. Strength and weakness of the site are well discussed in Chapter 4. Sites considered for development of the economic zone other than Mirershorai are listed below:

- Area of app. 205 acres in Mongla Upzila, Bagerhat District
- Area of app. 353 acres in Sherpur, Maulvi Bazar
- Area of app. 1390 acres in Anwara, Chittagong

These sites are analyzed on basis of location, accessibility, potential for industrial growth, availability of raw material, infrastructural development, availability of man-power,

vulnerability to natural and man-made disasters, availability of the basic amenities and utilities for industrial development. After analysis ranking has been done for these sites. As per ranking it is found that Mirershorai has potential to be developed as EZ site due to its strategic location on Dhaka Chittagong Industrial Corridor. Mongla has already being approved for development of EZ. Factors responsible for selection of Mirershorai as site for development of economic zone are given below:

1. Contiguous stretch of Government Land (Trisected by Isakhali Canal). Sufficient land area for development of EZ (550 acres of development area)
2. No Resettlement & Rehabilitation Issues
3. Located outside city Corporation, Municipality and Cantonment Board Area
4. Located Near to Chittagong Port (app. 70 km)
5. Close proximity to Feni River and also well-developed inland water transport. Isakhali Canal and Bamon Sundar Canal connects site to Feni River and Sea
6. Close vicinity to Dhaka Chittagong Highway (10 kms) connected through Abu Torab Road
7. Railway station close by (app 13 kms)
8. Project site does not lies within any eco-sensitive zone or ecological critical area
9. Availability of large nos. of un-skilled and semi-skilled labour

Alternatives considered for development of EZ in Mirershorai

Alternative 1

As per the planning and pre-feasibility study carried out by BEZA, it was decided to develop app. 7500 acres of area as EZ. However, due to involvement of large land acquisition, displacement of people, resettlement and rehabilitation issues, large nos. of tree cutting, it was decided to develop EZ in phases as per requirement. Map showing the area measuring 7500 acres is given below in figure 94 below. However to avoid all above mentioned issue, at present BEZA has decided to develop phase 1 of Mirershorai EZ. Most of the portion of identified 7500 acres of land is private land. BEZA has proposed to develop the phase 1 in south portion of identified 7500 acres of land. Identified land for development of phase 1 is Govt. Land and does not involve any land acquisition, resettlement & rehabilitation issue. Also tree cutting is reduced to nil for the current phase 1 site (610 acres-current EZ site) as per planning. It was also planned to construct two approach road, i.e. Abu Torab Road/BWDB bund/CDSP bund and Project road to provide access to EZ. But now only CDSP bund will improve to provide access to the EZ through Abu Torab road. This has further minimized tree cutting and land acquisition. During development stage and initial stage of EZ, this road would provide as approach road for EZ. New road may be developed in future as per requirement for which feasibility study should be undertaken with environment and social point of view.

Alternative 2

To develop the phase 1 of EZ site, it was initially decided to develop EZ on 1000 acres of land. These 1000 acres includes forest area of app. 250 acres. Map showing location of 1000 acres EZ site & 610 acres EZ site (current site) is given in figure 95 below. In this case, it was planned to construct bund all along the EZ site to protect the site from sea. This bund would have restricted entry of sea/fresh water to these 250 acres of forest land and would have led to drying up of this forest area. But after consultation with forest department & ecological and bio-diversity experts, it was decided to squeeze the EZ area to 610 acres. Current EZ site excludes Mangrove plantation area thus minimizing the impact of the project on Mangrove plantation.

Also very less mangrove plantation area may become water deficient in case of current EZ site. Measures have also been provided to minimize this Mangrove impacted area to nil in the EMP.

Figure 94: Map Showing Initially considered 7500 Acres EZ site & Current 610 acres Phase 1 EZ site

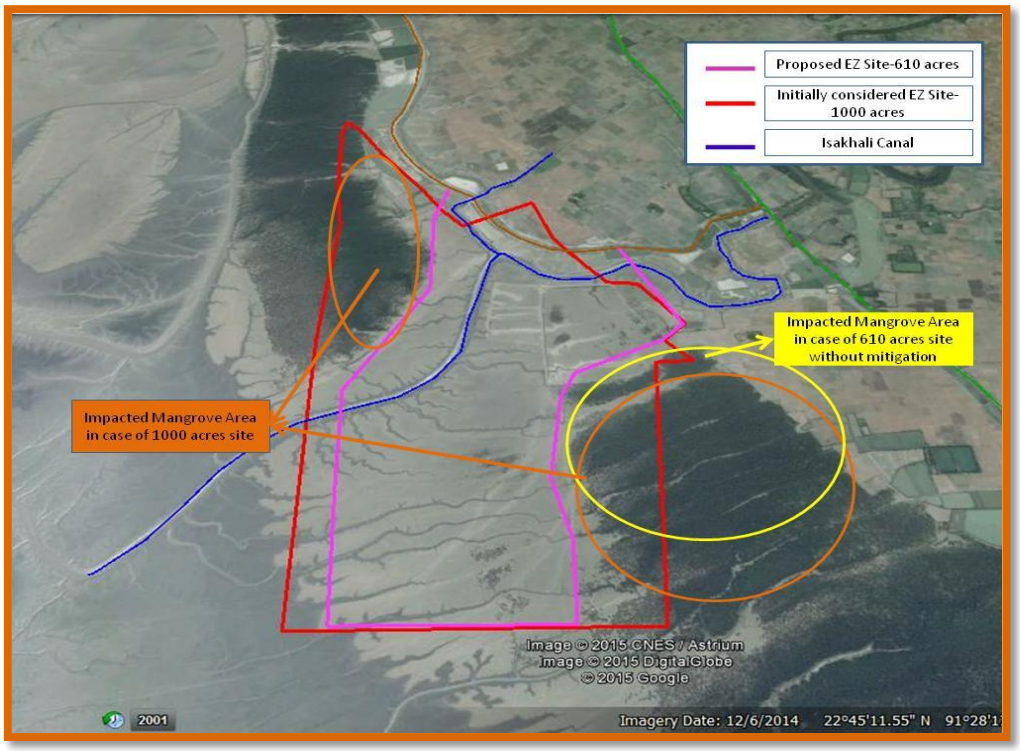


Figure 95: Map Showing Initially considered 1000 Acres Phase 1 EZ site & Current 610 acres Phase 1 EZ site

As mitigation measure to minimize the impacted Mangrove area due to deficiency of water, it is suggested to retain a drain connecting the Isakhali canal and Mangrove area. If this drain will be retained then no mangrove area will be water deficient due to the project development.

Alternatives considered for construction technology

Alternative options are considered for selection of construction material and technologies of construction. Options considered are for construction of compound wall and administrative building as given below:

The soil investigation report necessitates minimum 30 m depth of pile foundation for administration building and minimum 8 m depth of pile foundation for compound wall. Considering the soil conditions, the nature of utilization, and the following alternate technology has been suggested for successful ground modification / improvement which will be determined depending upon the difficult soils, liquefaction potential, slope stability, bearing capacity and settlement, and seepage instability. The ground improvement include loading conditions and allowable deformations for the facility, as well as an assessment of the impacts of natural hazards, such as floods, earthquakes or hurricanes, and the performance required during these events.

- Unsliced Lime slurry filling on the pile bore before casting pile concrete for a depth of 2m instead of providing pile for a depth of minimum 6 m for compound wall
- Soil stabilization through lime injection at the bottom of the foundation for administration building.
- The above measures have brought down the project cost substantially apart from reduction in wastes of natural resources for the heavier foundation structure.

7. Environmental and Social Impacts

7.1. Introduction

Environmental impacts assessment was carried out considering present environmental setting of the project area, and nature and extent of the proposed activities. Proposed project involves development of EZ and off-site facilities for upcoming Economic Zone at Mirershorai. Potential environmental impacts associated with EZ and each of the proposed EZ is classified as: (i) impacts during design and construction phase and ii) impacts during operation phase/Post-construction phase. Sensitive environmental and social components were identified during the site visits and qualitative and quantitative techniques have been applied for direct and indirect assessment of impacts on the identified environmental and social sensitive components. Impacts are classified as being insignificant, minor, moderate and major.

Some of the important impacts associated with the proposed EZ and off-site facilities for economic zone will be associated with land use (diversion of land use), land stability (soil erosion), soil compaction and contamination, water availability, water quality of river/stream/canal, ground water contamination, waste and wastewater disposal, ambient air quality, ambient noise levels, vegetation, tree cutting (including Mangroves plantation by Forest Department), fauna (terrestrial and aquatic), drainage pattern, hydrology, socio economic, places of social/cultural importance (religious structures, community structure), construction material sourcing and occupational health and safety. Adequate mitigation measures are devised to mitigate/minimize all likely environmental impacts and the same have been presented along with the impacts.

During the field study, consultations were also held within study area including local people and Govt. authorities like Rural Electricity Board, Bangladesh Water Development Board, NGOs etc. Outcome of these consultations were used in impact assessment and devising mitigation measures.

7.2. Impact Identification

During the site visit, various environment and socially sensitive features were identified which may potentially be impacted by the project at various stages. Identified impacts of the project activities on the environment and social components are given below in table 55 along with the activities associated.

Table 45: Impact Matrix for Proposed Off-site Infrastructure & Economic Zone

S. No.	Activities	Impacts	Negative Impact		Positive Impact		Not Applicable
			Short Term	Long Term	Short Term	Long Term	
A	**Pre-Construction Phase**						
i	Site Preparation (conversion of wetland for EZ development and filling of land)	• Change in land cover and development of EZ zone • Increased Run-off in surface water bodies • Loss of floral and faunal diversity of the area • Impact on Aesthetic aspects		√ √ √ √			
B	**Construction Phase**						

i	Development of EZ and Construction of Boundary wall, Access Road, administration building & bund	Loss of Top soil		√			
		Soil contamination due to spillage of material	√				
		Surface water contamination	√				
		Air pollution	√				
		Noise pollution	√				
		Increase in traffic	√				
		Un pleasant view	√				
		Impact on Health & safety	√				
		Social impact	√			√	
		Felling of Trees (if any)		√			
C	**Operational Phase- Offsite Infrastructure**						
i	Development of EZ and Construction of Boundary wall, Access Road, administration building & bund	Air Quality Improvement due to rod development				√	
		Economic Development				√	
		Accessibility				√	
		Improved drainage				√	
		Improved health and sanitation facilities				√	
		Increased Run-off		√			
		Generation of Employment				√	
		Natural drainage pattern	√				
		Mangroves		√			
D	**Operational Phase- Economic Zone**						

i	Operation of Industries	• Air pollution		√			
		• Noise pollution		√			
		• Potential for river & canal water pollution from industrial waste discharges		√			
		• Ground water depletion		√			
		• Rain water harvesting				√	
		• Health & Safety				√	
		• Employment Generation				√	
		• Potential for land contamination from industrial waste disposal		√			
		• Change in Land Use of nearby areas		√			
		• Development of Infrastructure				√	
		• Improved Connectivity & Accessibility				√	
		• Better Safety from Natural Disasters like Cyclone				√	
ii	Green Buffer development around each industrial plot	• Improved Ecology				√	
		• Air Quality Improvement				√	
		• Aesthetics				√	

7.3. Impact of Development of Economic Zone & Off-site Facilities

7.3.1. Pre-construction & Construction Phase

Development of the economic zone and the off-site facilities, i.e. access road, site filling, construction of bund, boundary wall and administration building will involve clearance of site vegetation, leveling of site by filling and cutting, civil construction activities, storage of raw materials like fuel, sand, aggregates, cement, reinforcement etc., storage of debris, excavation of soil etc. All these activities have potential to impact the environment in one or other way. These activities can directly and indirectly impact the environment. Direct & indirect impact of development of EZ and off-site facilities during pre-construction & construction phase are listed below

- ***Impact on air quality*** due to generation of dust and other gases like SO_2, NO_x & CO from construction activities, loading & unloading of material, operating construction equipment & vehicles, operating pumps for filling activity, transportation of men & material, storage of raw material and debris etc. Impact on Air Environment during construction phase due to development of EZ & Off-site facilities are discussed in detail in section 7.4.1 & 7.4.2 below

- ***Impact on water resources*** due to withdrawal of water for construction activities from the nearby surface water bodies Feni River & Isakhali Canal or usage of ground water for meeting the water requirement of construction labour. Detailed impacts are discussed in section 7.6.1 below

- ***Impact on surface water quality*** due to entry of contaminated rainfall run-off. Rainfall run-off will contaminants on mixing with sediments/silt from excavated site, raw material & debris storage site, with fuel in fuel storage area and pump operation area etc. Detailed impacts are discussed in section 7.6.1 below
- ***Impact on hydrology & drainage*** due to filling activity. Site is intersected by various streams and small channels draining into Isakhali canal which is finally draining into Sea. These small channels carry water from Isakhali canal to Mangrove forested area and to EZ site during high tide/monsoon season and viceversa during low tides and post-monsoon season. These channels will be filled up impacting the drainage pattern at site significantly. The impact on hydrology & drainage is discussed in detail in section 7.6.1 below
- ***Impact on noise environment*** due to increased noise generation at EZ site and nearby area. At present EZ site is vacant land, seasonally used by some villagers to carry out agriculture/aquaculture activity. EZ site is connected through CDSP bund which is only road connectivity. CDSP bund upto 6 kms from EZ site is non-motorable and only autorikshaw can travel on that road only in non-rainy season. Thus no noise generation sources are there in the EZ site. During pre-construction and construction phase noise levels will significantly increase due to construction activities and transportation of materials. Detailed impacts are discussed in section 7.5.1 below
- ***Impact on Migratory Birds*** due to filling of the site and construction of bund. At present site is exposed to sea and water from sea enters the site through Isakhali canal. Tributaries of the Isakhali canal cover the whole site and provides water supply to the Mangrove plantation in the adjacent land parcels. Whole site is wetland area and provide home to various migratory birds especially during Winter Season. After development of EZ site, i.e. filling and construction of EZ site EZ site cannot serve as landing site for the migratory birds. However due to availability of large wetland area adjacent to EZ site, impact would be insignificant. Detailed impacts are discussed in section 7.10.1 below
- ***Impact on Mangroves Plantation*** will not be significant as no Mangrove is proposed to be removed or cut for development of the project. Mangroves are planted by forest department in areas adjacent to EZ site and along the Bamon Sundar canal area. These are planted to protect the EZ site from cyclone hazard. Mangrove plantation may be impacted due to discharge of exhaust gases from vehicles, pump, DG sets and construction machinery and disposal of wastewater & construction debris in mangroves plantation area. Thus air, water and solid waste management plan is required to be prepared for pre-construction and construction phase of the project. Detailed impact and mitigation measures are listed in section 7.10.1 below
- ***Impact on flora & fauna*** due to development of EZ will not be significant as EZ site is devoid of flora & fauna. No tree cutting is proposed to be undertaken for development of EZ and off-site facilities. Mud crabs are found on the EZ site in the areas close to Isakhali canal. Habitat of mud crabs will be affected due to development of EZ. But development of the no development zone of 5 m width all along the length of the Isakhali canal will minimize this impact as this zone will continue to serve the habitat for mud crabs. Also plantation will be carried out in this zone by developer. Detailed impacts are discussed in section 7.10.1 below.
- ***Impact on Land Use, drainage & hydrology*** due to diversion of large area of wetland into industrial use. This land is under water during high tides and monsoon season. However after development of EZ, wetland will be replaced by paved structure disturbing the natural drainage pattern, run-off and hydrology of the site. Detailed impacts on land use are discussed in section 7.7.1 below.
- ***Impact on topography, soil quality, soil erosion & geology*** due to filling & leveling of site. Detailed impacts are discussed in section 7.7.1 below.`

- ***Impact on Socio-Economy*** due generation of employment. Skilled & unskilled labour will be employed for development of the project. Thus it may involve immigration of people from nearby area for work purpose in this area. Detailed impacts are discussed in section 7.11.1 below
- ***Impact on marine & riverine Eco-system*** due to deep sea dredging can occur. Deep sea dredging involves extracting sediments from sea floor which may impact the benthos habituating on the sea floor and other aquatic organisms. These organisms may be significantly impacted due to deep sea dredging process and generation of high amount of sediments. Thus a detailed study should be undertaken to assess the eco-sensitivity of marine environment for dredging and transportation of the sand. Further disposal of wastewater & waste material in river/sea may contaminate the water quality of river & sea. Mixing of wastewater, waste material and raw material with run-off may also lead to pollution of the rivers and the sea water as it will directly mix with river & sea water due to close proximity of site with sea & river. Detailed impacts are discussed in section 7.10.1 below.

7.3.2. Operation Phase

After development of economic zone, it is expected that industries will start coming up in this region and EZ may reach its full capacity in 4-5 years time. Construction and operation of the industries may have impact on the environment and society. The impacts which could affect environment and society are listed below:

- ***Impact on Mangroves*** due to construction of bund may be significant. After development of the bund some of the area of mangrove plantation in East direction of EZ site may become water deficient. As this area receives water through drains connected to Isakhali canal. These drains will be filled after development of EZ. Thus small portion of Mangrove plantation is expected to go dry or affected due to EZ development. Further Mangroves may also be impacted due to exhaust air from industries, DG sets and disposal of wastewater by industries in mangroves area or water bodies. Detailed impact on Mangroves and mitigation measures required are discussed in section 7.10.1 & 7.10.2 below
- ***Impacts on Air Quality*** due to discharge of exhaust gases from industries and vehicles. Textile, food processing and light engineering industries may come in the planned EZ. All these industries generate exhaust gases and can pollute the air quality. Detailed impacts are discussed in section 7.4.3 below.
- ***Impacts on Noise Level*** due to increase vehicular movement and industrial operations are anticipated. Detailed impacts are discussed in section 7.5.2 below.
- ***Impacts on Water Quality*** due to discharge of effluents/sewage from textile, food processing & light engineering industries. This can impact the ground and surface water quality by contaminating it and making it unfit for drinking and aquatic life. Detailed impacts are discussed in section 7.6.2 below.
- ***Impacts on Ground Water Resources*** due to extraction of water from ground to fulfill the daily water demand of the industries. This will highly impact the ground water aquifers by lowering the ground water level. Also ground water is the only source of water for domestic use other than rain water harvesting ponds. Thus depletion of ground water resources will have significant impacts on the people also. Detailed impacts are discussed in section 7.6.2 below.
- ***Impacts on Socio-economy*** due to shifting of population from nearby areas in search of jobs. Due to high level of unemployment, it is expected that large nos. of people may migrate to the project area from nearby areas changing the demographic profile of the area. This will exert pressure on existing resources and may degrade the environmental quality of the area. EZ will provide large scale employment for all skilled, semi-skilled and unskilled labour. This will

improve the quality of life of the people in the nearby areas. Detailed impacts are discussed in section 7.11.2 below.

- ***Impact on Land Use*** due to development of EZ and off-site facilities is expected. At present, it is proposed to develop CDSP bund as pakka road to serve as approach road. This will increase the pressure on existing village road. Also it is apparent that this road will not be sufficient for EZ thus it may be required to built more and wider road to provide connectivity to EZ. Also it is expected residential apartments, commercial hubs, hotels, restraints may come up in nearby areas to provide services to the industries set up in EZ. These developments will significantly alter the land use of nearby area in coming future. Detailed impacts are discussed in section 7.7.2 below.
- ***Impact on Agriculture Resources*** are anticipated due to development of EZ. Agricultural land will be diverted for other uses like commercial, residential, industrial, roads and urban area etc. Also it is proposed food processing industries may come in EZ which will give boost to agricultural activities. Detailed impacts are discussed in section 7.8.2 below.
- ***Impact on Fisheries*** is anticipated due to development of EZ but not very significant. Isakhali canal within the EZ site will be closed for fishing activity. However, fishing will not be restricted in upstream and downstream areas of canal. Also large nos. of canal and water bodies area present in study area so there will not be any significant impact on fisheries. Also a sluice gate is proposed to be developed on Isakhali canal to control amount of water entering Isakhali canal. Sluice gate will be closed only during high flow time & monsoon season. Detailed impacts are discussed in section 7.9.2 below.

7.4. Impact on Air Environment

7.0

7.1

7.2

7.4.1. Pre-construction Phase

Pre-construction phase will involve site clearance, leveling & filling activities for development of EZ, and access road. Clearance of site will involve removal of vegetation, land leveling & filling activities. These activities will lead to dust generation. But these emissions will be limited to the site only and have impact for short duration only during clearance activity. To minimize the dust generation, water should be sprinkled regularly at the site and low sulphur diesel should be used in land leveling equipments to control the SO_2 emissions.

7.4.2. Construction Phase

The proposed project involves construction activities like site development, civil construction, construction material handling and stocking, and construction vehicle movement will generate fugitive dust and vehicular emissions. However, these ground sourced generation will be limited to the construction site and the impact will be short duration that too during construction activities only. The likely emission from construction vehicle, machinery, and generators is likely to be insignificant as the pollutant emission activities (point and area sources) will be limited within the project boundary and the activities will be short term (only for construction period). However, this impact may further be minimized by adopting following mitigation measures.

Mitigation Measures

- Sprinkling of water at construction site and haul roads

- Covering the scaffolding (in case of administration building) to reduce the dust emission in outside environment
- Provision of face mask to workers to minimize inhalation of dust particles
- Construction vehicles and machinery should be regularly serviced and check for pollution control
- Low sulphur diesel should be used for running construction equipment and vehicles
- Adequate parking space should be provided for the construction vehicles so as to prevent idling of the vehicles and the emissions generating from them
- Vehicles carrying construction material and debris should be covered with tarpaulin cover
- Raw materials, excavated soil and other debris should be stored under covered sheds
- Green buffer should be developed all along the EZ boundary
- Plantation should be carried out along the both side of access road

7.4.3. Operation Phase

Offsite Facilities: Development of BT access road will reduce the dust emissions that results from movement on the earthen roads. No adverse impact is anticipated on air quality during operation phase due to development of off-site infrastructure.

EZ operation: Post development of the economic zone & setting up of industries, there could be some impacts on the air quality of the area. Industrial development will involve generation of emissions, and increased vehicular movements. These altogether may have overall negative impact on the air quality of the site and the nearby areas. The industries proposed as per the pre-feasibility study are light engineering, food processing and textile industries.

Significant air emissions result from light-engineering industries. These are particulate matter, sulphur dioxide, metals and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide. Lead may be generated in some of the processes.

Air emissions from food processing industry will contain some volatile organic compounds but do not contain any hazardous compounds. These industries emit low process-air emissions. Most processes uses electrical power and rarely emit harmful compounds to environment. But air emissions from water treatment plant of these industries are a major concern. Mal odour from these water detoriate the air quality and disturbs the living condition in the area. No significant air emissions are generated from textile industries.

Mitigation Measures

Provision shall be made for peripheral green belt all along the EZ boundary. No development zone of 5 m width & retaining wall will be developed all along the EZ zone. Green buffer will be developed in this no development zone. Green belt shall have minimum of three rows of local variety of tree. Tree species shall be selected such that first inside row is of smaller height, middle row of tree is of medium height and last row of tree is of higher height so that green belt formed appears like a canopy.

- Development of thick green belt (10 m) and organized greens within each industrial plot
- Power Generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission.
- Process emission if any shall be control with the installation of adequate air pollution control systems
- No red category industries should be allowed within industrial zone

- All industries should obtain clearance from DoE, Bangladesh as applicable. Air pollution control measures shall be adopted by respective industries in line with DOE permission
- Air pollution monitoring should be carried out quarterly by all industries to check the air pollution level.
- Preference of usage of clean fuel like LPG, low sulphur diesel should be explored
- Energy conservation should be adopted by adopting the alternate energy options like solar power.
- Odour should be managed at the site using odour suppressant and planting fragrant flowering trees.

7.5. Impact on Noise Environment

7.5.1. Pre-construction and Construction Phase

Pre-construction phase will involve site clearance activity for development of off-site facilities, administration building and site preparation activities. Clearance of site will involve removal of vegetation and land leveling activities. Operation of different machineries and equipments for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period. The produced noise may have impact on existing acoustic environment of rural category defined in ECR, 1997. Local inhabitants may feel disturbed due to noise from line sources (traffic movement).

Mitigation Measures:

- Machinery to be used should comply with the noise standards prescribed by DoE.
- DG set shall be acoustic treated
- Workers shall be given PPE (ear plugs), if working in high noise area
- No noise generating activity shall be carried out in the night.
- No construction activities to be undertaken during night hours to prevent any disturbance to nearby residents and labours in labour camps.
- Acoustic enclosures should be provided with DG sets and machinery to control the noise levels at construction site.
- Temporary noise barriers should be provided near the high noise generating areas

7.5.2. Operation Phase

After construction of the road and upcoming economic zone, traffic in the area will increase which will increase the noise level of the area. Following mitigation measures should be taken to prevent noise pollution during operation phase

Mitigation Measures

- Avenue plantation should be developed along both the side of access road which will act as noise buffer
- Green buffer of 10 m should be developed all along the project boundary. Green buffer should compose of the 2-3 rows of plants of variable height and thick canopy so as to form continuous barrier. This will help in reducing the noise level significantly.

Apart from these after development of economic zone, noise will be generated from the construction of individual industries, operation within in industrial units, running DG sets in each units and traffic movement within EZ zone. Following mitigation measures are required to be taken to minimize noise pollution:

Mitigation Measures

- All industries should obtain clearance from DoEB before establishing industrial unit and should comply with all the conditions mentioned in the letter of environment clearance
- All industries should install the new machinery of modern make which complies with the noise standards prescribed by DoEB in ECA, 1995.
- Acoustic treatment and temporary noise barrier should be provided in area generating higher noise levels
- Job rotations should be practiced for workers in industry to prevent prolonged exposure to high noise level as it may lead to deafness, fatigue, head ache, nausea and drowsiness
- Honking should be prohibited within the economic zone

7.6. Impacts on Water Environment

7.6.1. Pre-Construction and Construction Phase

Impacts on Ground & Surface Water Resources:

Significant quantity of water will be required for various construction activities & domestic purpose. Source of water for these activities will be Feni River, temporary constructed storm water ponds by contractor or ground water. Excess withdrawal of ground water may lead to depletion of aquifers. Shallow water aquifers in the area are saline and fresh water is available at the depth of 210-270 m (700-900 ft). Measures should be taken to minimize the water extraction by reducing water consumption and wastage. Mitigation measures are given below.

Mitigation Measures

- Best management practices for conservation of water will be required to be adopted to minimize water wastage and water loss. Best management practices to be adopted are given below:
    - Temporary storm water drains and rain water harvesting ponds should be constructed so as to store rain water for construction activities.
    - Water for curing can be saved by carrying out curing in early morning or late evening and covering structures with gunny bag so as the moisture can be restored for longer time.
    - Regular inspections at site to monitor leakages in water storage tanks
    - Creating awareness among construction workers about the importance of water conservation
    - Adoption of the advance technologies and machinery which helps in minimizing water requirement for construction
    - Storing the curing run-off and waste from other construction activity and using the same for sprinkling.
    - Covering the water storage tanks at site to prevent evaporation losses.

Impact on Surface Water Quality

Run-off from the construction site may carry the higher quantity of sediments and oil which may pollute the surface water and impact the aquatic life. Thus measures are required to be taken to minimize the surface water pollution

Mitigation Measures

- To avoid excavation activities during rains
- To prevent piling up of excavated soil, raw material and construction debris at site by proper management and disposal
- Minimize run-off by using sprays for curing
- Maintaining appropriate flow of water sprinklers at site
- Construction of storm water drains along with sedimentation tanks with sand bags as partition as barrier for direct flow of run off to river.
- Collection & Reusing of curing over flow, tyre wash water etc within the site
- Construction of adequate nos. of toilets and proper sanitation system to prevent open defecation along the river banks/water supply lines
- Construction of soak pits/septic tanks to dispose-off the domestic waste water generated from labour camps to prevent disposal of sewage in surface water bodies
- Proper collection, management and disposal of construction and municipal waste from site to prevent mixing of the waste in run-off and entering the water bodies
- No debris/construction material should enter the aquaculture ponds and other water body in the area

Impacts on Ground Water Quality

Ground water is saline in shallow aquifers of the study area. No significant impacts are anticipated on the ground water quality due to development of the off-site facilities for economic zone.

Mitigation Measures

- No sewage or waste water should be accumulated in any unlined structure
- Timely disposal of the construction/chemical/haz. waste so as to prevent leaching of any pollutant to ground

Impacts on Drainage Pattern & Hydrology

EZ site is bounded by CDSP bund in North & NE direction. Thus storm water from villages in up streams is drained only through Isakhali canal and Bamon Sundar canal. These canals will not be impacted due to development of EZ zone. However a sluice gate is proposed to be developed at Isakhali canal at point of entry of canal in EZ site from sea side. This gate will control level of water entering Isakhali canal and will be closed only during high tide and high flow times and allowing the water movement in rest of the time.

EZ site is wetland and is trisected by Isakhali canal. Site is connected with Feni River & Sea through Isakhali canal and Bamon Sundar canal. Dense drainage of Isakhali canal runs through the EZ site. Construction of EZ site will disrupt this natural drainage pattern on EZ site. However 5 m wide zone of no development and retention wall will be developed along the Isakhali canal. Canal will be retained and will not be disturbed either during construction or operation phase. One drain connecting Isakhali canal and Mangrove forest in east direction will also be retained so as the water supply to Mangrove forest is not affected. Peripheral drains will be provided around the EZ site to drain off the storm water. These drains will be connected to Isakhali canal. Wastewater streams will not be allowed to mix with Isakhali canal and other storm water drains. Thus no significant impact on drainage is anticipated due to development of the off-site development.

Aquaculture ponds exist all along the proposed access road/existing CDSP bund. Thus storm water from access road will flow into these ponds. Following mitigation measures shall be taken to prevent impact of off-site development of EZ on natural drainage pattern.

Construction of bund will restrict the flow of water from Feni River in upstreams during high tide and high flow. After construction of bund, this water will divert to adjacent area. Since the nearby area is wetland area there will not be significant impact of diversion of this water flow in nearby areas.

Mitigation Measures

- Natural drainage pattern should be maintained. Run-off assessment shall be made of catchment area and peripheral/garland drains shall be constructed around EZ site based on the assessment of catchment area (frequency, and storage area).
- Storm water drain shall have the provision of de-siltation before discharge to river.

7.6.2. Operation Phase

Impacts on Ground & Surface Water Resources:

Expected population for administration building is 112 Nos. Water requirement of 5.04 KLD has been calculated for administration building during operation phase considering criteria of 45 LPCD for staff members. This demand can be fulfilled by withdrawing water through water supply system developed for the project.

It is estimated app. 7.7 MLD of water will be required during operation phase after development of economic zone at Mirershorai. Source of water can be either water of Feni River which can be used only after desalination and ground water which is available at greater depths (700-900 ft) and is source of water for whole village. Water supply can be supplemented with rain water as annual rainfall in the area is very high. Rain water harvesting is practiced by all villagers to fulfill their daily water demand. Rain water can be harvested by constructing rain water harvesting ponds. Following Measures should be taken to minimize the impacts on water resources

Mitigation Measures

- Feasibility shall be explored by BEZA of installing the desalination plant for the use of surface water.
- Rain water harvesting system and storage should be developed to minimize ground water construction
- Adoption of best management practices to prevent water wastage and minimize water loss
    - Usage of water conservation fixtures to minimize water consumption
    - Installation of leakage detection system to minimize the water loss
- Ground water aquifer assessment studies may be undertaken to assess the ground water potential. Peizometer shall be installed to monitor variation in ground water level in the area.

Impacts on Surface Water Quality

Industries are likely to generate domestic and industrial effluent. Liquid waste which can be generated from light engineering industries will include waste acid, waste alkali, grease, used/spent oil, liquid metal, spent solvents etc. Wastewater is not generated in significant amount from these industries. Majorly domestic and cleaning waste is likely to be generated. No significant liquid waste is generated from textile industry.

Food processing industries similarly generate both liquid and solid waste. Concern with wastewater from the food processing industry is high BOD levels, high TSS, excessive nutrient loading like nitrogen and phosphorus compounds and pathogens. This water is to be treated essentially to achieve DoEB standards

to prevent the soil, water and air quality pollution. Discharge of wastewater in soil will degrade its fertility and increase the toxicity which will make it unsuitable or growth of plants and survival of micro/macro organisms. If this water is discharge into water system, will pollute the water quality and have potential to threat the aquatic life. Uncontrolled discharge of these effluents to river may severally pollute the river water quality.

Pollutants from these industries may be discharged into Isakhali canal and may be carried away to Feni river estuary system which supports diverse variety of fish. Run-off may significantly increase post development of economic zone. It is required to manage storm water which will be generated from EZ site post development. Measures should also be taken to prevent contamination of storm water with any industrial pollutant. Following measures should be adopted during operation phase to minimize impacts of development of Economic zone on surface water quality:

Mitigation Measures

- Each industry should obtain consent of DoE Bangladesh before construction and operation and should comply to the conditions laid by them
- Each industry should treat the effluent and sewage generated by them so as to achieve zero discharge and no untreated effluent should be discharged into any water body
- Provision shall be made for Common Effluent Treatment Plant (CETP).
- Common STP (in modules) should be constructed within the EZ to treat sewage from residential and commercial areas
- Proper management of waste should be done to prevent any contact between the waste and storm water
- Common waste disposal sites should also be developed within EZ site as per the standards and prior permission of DoE should be taken before development.
- Each industry should practice rain water harvesting to minimize the water consumption and reduce run-off from the site
- Storm water drains should be lined separate from effluent drains
- Storm water system should be inspected & cleaned before monsoon every year
- Peripheral drain shall also be lined and shall not be connected to internal storm water drainage system.
- The top soil shall be preserved and used for covering the sand layer at EZ site. Vegetation turffing shall be made at the side slops of the EZ areas to prevent erosion and siltation in the river.
- River water quality shall be monitored periodically.

Impacts on Ground Water Quality

No impact on ground water quality is anticipated during operation phase due to off-site developments. After development of economic zone there may be some ground water pollution due to industrial activities. Following measures should be taken to minimize the ground water pollution.

Mitigation Measures

- Each industry should treat the effluents and sewage and should not discharge into ground.
- No leachate, waste water and waste material should be stored in pervious unlined area/pond.
- Ground water quality shall be monitored periodically.

7.7. Impacts on Land resources

7.7.1. Pre-construction and Construction Phase

Impact on Land Use

EZ site is spread over an area of 610 acres (development area 550 acres) and access road to be developed will be 6 km long and 5 m wide. Efforts have been made to minimize the change in land use and acquisition of agriculture land by making use of Government/Khas land. EZ site is Govt. land classified as Char/Wetland. Land use of this land will be change after development of EZ. Land has now been transferred to BEZA and land documents are attached as Annexure II. Access road will be developed on existing CDSP bund. Thus no land acquisition is involved for the project. Administration building will be developed within the economic zone site. Economic zone will be developed after appointing the developer by BEZA and obtaining permission from DoEB. Some of the measures are taken to prevent any impact on change in land use

Mitigation Measures

- Tree cutting will be avoided while constructing access road and development of EZ
- If any tree cutting is undertaken then compensatory plantation should be done in minimum ratio of 1:2
- Measures will be taken that no structure along the access road should be affected due to development of EZ

Impact on Topography & Geology

Site will be filled with deep sea sand to level of 75 cm from existing level. This will impact the topography of the site by raising its existing level. Impact will be not be significant as the impact is restricted to EZ zone.

Impact on Top Soil and Soil Quality

Development of the structures and construction of the access road may disturb the soil profile of the area. Site will be filled to level of 75 cm with deep sea sand. Land will be filled and compacted after filling. Also sand will be required for construction of bund, access road and administration building which will be sources from nearby markets or Sand Mohal of Mirershorai. Sand should be purchased from authorized vendors only to minimize the illegal mining and dredging activities

Storage of raw material, fuel and construction debris may contaminate the soil thus measures should be taken to prevent the soil pollution. Mitigation measures to be adopted are mentioned below. Contractors are required to take all the proposed mitigation measures. PMC and BEZA will ensure that all the proposed mitigation measures are being incorporated in the bid document issued to the contractor and the implementation of the same during construction.

Mitigation Measures

- No piling of raw material at site
- Raw material will be stored under covered sheds and paved surface
- Fuel storage area should be paved
- Adoption of best management practices to prevent any spillage of raw materials

- Construction debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites
- Waste from labour camps can be segregated at site. Food waste/wet waste should be composted in pits within the camp site. Recyclable waste should be sold to the authorized dealers and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area.

Impact on landscape and scenic beauty

All construction activities for administration building, bund, land filling & boundary wall will be carried out within economic zone site and will not cause any impact on landscape and scenic beauty. A green buffer of 10 m (minimum three rows of trees) will be developed all around the project site which will enhance the scenic beauty of the area

Constructions activities involved in construction of access road may change the visual landscape of the project area. Site clearance activities and piled construction materials, machinery and camp establishment on green field site may impact the scenic beauty. Nevertheless, the impact is for a short duration, and reversible as the project plan includes landscape planning, green belt development as well.

7.7.2. Operation Phase

Impact on Soil Quality

No impact due to off-site developments is anticipated on soil quality of the project site during operation phase.

After development of economic zone, disposal of industrial domestic and process waste may contaminate land and soil quality of the area. The impact can be significant and long term in case of uncontrolled discharges. Improper disposal of waste (hazardous and non-hazardous waste) may degrade soil, water, noise, air quality and ecology of the area. As per the preliminary planning, it is planned that industries like light engineering, textile and food processing will come up in the EZ zone. These industries are not heavily polluting like tanneries, distilleries etc but generate significant waste both hazardous and non-hazardous in nature, which can pollute the environment if not managed properly. Nature of the waste which can be generated from these industries are discussed below.

Waste to be generated from the light engineering industries can be solid and liquid in nature. Solid waste will include packaging waste, metal pieces, damaged electrodes, ends of coils, wires and spools, flux cored electrodes, greased clothes/cotton, damaged rods, burnt rods, scrap flux, slag (residue from flux reaction and composed of metal and non-metal oxides), Dross (oxidized metal expelled during thermal cutting and gouging operations), metal dust, dust collected in filter ventilation systems/air pollution control devices, floor sweepings, coal ash (if coal used as fuel), solid waste recovered from treatment of wastewater like sludge etc.

Solid waste from the food processing industries includes both organic and packaging waste. Organic waste, that is, the rinds, seeds, skin, and bones from raw materials, results from processing operations. Inorganic wastes typically include excessive packaging items that are, plastic, glass, and metal. Solid waste from textiles majorly composed of resins, fabric, apparel, dye, discarded machinery and fibres. These waste required to be collected and disposed off periodically. Lub. oil/waste oil is generated from the machineries as hazardous waste. Mitigation measures are required to be adopted to prevent soil pollution of the area.

Mitigation Measures

- Provision shall be made for proper storage and disposal of industrial waste by receptive industries.
- Common waste storage areas shall be designated for industrial domestic waste.

- Waste should be segregated at source into hazardous and non hazardous waste. Further the waste should be segregated into recyclable and rejected waste. Recyclable waste should be sent to authorize vendors for recycling and rejected waste should be disposed off as per the norms specified by DoEB for the particular waste.
- Industrial waste generated should be stored on sealed surfaces and should be disposed off as per guidelines of DoE, Bangladesh.
- No chemical/hazardous raw material should be allowed to spill over the land and should be operated in covered systems
- Excessive packaging should be reduced and recyclable products such as aluminum, glass, and high-density polyethylene (HDPE) are being used where applicable.
- Organic waste should be resold to value addition industries or can be feeded to live stock.
- Advanced wastewater treatment should be adopted by industries
- Use of advanced techniques to control specific portions of the manufacturing process to reduce wastes and increase productivity.
- Use of radiation to kill pathogenic microorganisms.
- Reduction or total elimination of effluent from the manufacturing process
- At present no common hazardous waste handling and disposal unit exists in Bangladesh. Industries thus have to install the incinerators in the unit to dispose hazardous waste. The incinerator further should use the clean fuel and required air quality management measures should be adopted.
- A site for disposal of hazardous waste can be identified within the EZ and it should be developed as per the norms of DoEB and upcoming Hazardous Waste Management rules of Bangladesh.

Impact on Land Use

Land use of EZ site is wetland which will be changed to industrial land use after development of EZ site. No major change in land use is associated with the development of the EZ zone and other off-site facilities. No impact due to off-site developments is anticipated on land use of the study area during operation phase.

However, post development of economic zone significant change in land use is anticipated in the near-by area. At present there is no significant infrastructure at the EZ site and nearby areas. Majorly land use is agricultural land, wetland and Mangrove plantation area. Development of EZ will attract more infrastructural development around the project site to facilitate industrial growth changing the land use area from agriculture to industrial land use. Some of the other developments including construction of roads, housing facility, commercial areas including hotels, hospital, restaurants, schools, ancillary industries, cottage industries, etc may also occur in nearby areas. This will lead to change in land use but will lead to significant development of the area.

7.8. Impacts on Agriculture resources

7.8.1. Pre-construction and construction Phase

No agriculture land is proposed to be acquired for development of proposed off-site activities as well the economic zone. Thus no significant impact on agriculture activities/resources is anticipated due to the project development.

7.8.2. Operation phase

No impact on agriculture resources is anticipated from off-site infrastructure during operation phase. Some agro based or aquaculture based industries may come up in proposed economic zone. These industries will have positive impacts favouring the growth of agriculture and aqua culture.

7.9. Impacts on Fisheries

7.9.1. Pre-construction and construction phase

Spillage or disposal of waste or wastewater in the canals and river may significantly impact the aquatic life of the area. Thus adequate measures should be taken to prevent any impact on fisheries which are listed below. No impacts on fisheries due to off-site developments are anticipated during the pre-construction phase. No significant impacts on fisheries are anticipated during construction of the proposed off-site developments.

Mitigation Measures

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

7.9.2. Operation Phase

Sluice gate will be developed on Isakhali canal to regulate flow of sea water in canal. This may impact the movement of fishes while gates are closed. Gates will be closed only during high tide and flood season thus no significant impacts are anticipated on fisheries due to development of off-site development during operation phase.

After development of economic zone, some of the aquaculture based industries may come up. This will help in boosting the aquaculture activities & fisheries development in the region.

The fisheries may get severely impacted if untreated industrial effluent or hazardous waste is discharged to river. Therefore effluent management system shall be implemented strictly. Fish kill may happen due to contamination of water due to discharge of untreated effluent. Effluent may contain toxic components like heavy metals etc which leads to fish poisoning and may lead to large scale fish death. Also fishes contaminated with these pollutants if consumed may affect the consumer health (birds/biger fishes/humans).

Mitigation Measures

- Adoption of adequate wastewater and industrial effluent management technology so no untreated sewage is discharged into surface water body
- Industrial, municipal and hazardous waste should be managed such that no waste is dumped or disposed in surface water body

7.10. Impacts on Eco-system

7.10.1. Pre-construction and construction Phase

Impact on Terrestrial Flora & Fauna at EZ Site

There is no significant vegetation at the economic zone site. Thus no vegetation removal will be required for construction of administration building, bund and boundary wall. ***Mud crabs were observed at the site during visit along the canal area.*** Site filling may have impact on existence of these mud crabs. However a zone of 5 m will be left undeveloped along the Isakhali canal which will minimize the impact on habitat of these mud crabs.

Impact on Avifauna (Migratory Birds at EZ Site)

During FGDs it was learned that migratory birds are seen on EZ site areas especially along the canal during winter season. After development of EZ zone, migratory birds will not be able to use the EZ site. However various water bodies and large wetland area is available in surroundings which can continue to serve as habitat for these birds. Within 10 kms radius area around EZ site, app. 35 sq km area is under wetland. EZ site measures only 2.5 sq km. Thus only small fraction of the wetland area is getting impacted due to EZ development. Migratory birds will shift to these neighbouring sites without being impacted significantly. Impact on the loss of wetland and habitat for migratory birds has also been assessed on the district level.

As per District gazetteer Chittagong, total geographical area of Chittagong district is 5282.98 sq km. Out of this 1159 sq km area is wetland area, which means 21.9% area of district area is wetland which is quite a large proportion. Wetland areas provides home to various migratory birds especially during winter season. Project site comprises of 610 acres area, i.e 2.5 sq km, which is 0.2% of the total wetland area of the district. Thus large wetland area is available in the district which provides habitat to the migratory birds.

Mitigation Measures:

- Twice the nos. of trees to be cut should be planted as compensatory plantation in affected areas to minimize the impact on the eco-system.
- Tree cutting should be minimized
- No development zone of 5 m should be maintained throughout the length of the canal within EZ site
- No development zone should be planted with Mangroves and other native species

Impact on Aquatic Flora & Fauna of EZ Site

Run-off from construction site may contain sediments or contaminant which may pollute water quality of Isakhali canal which will impact the aquatic life of Isakhali canal.

Mitigation Measures:

- No solid or liquid waste shall be discharged in water bodies
- Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal in water body
- Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas.

- Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration
- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off
- Diesel, paints, cements etc should not be stored near the canal/water bodies

Impact on Mangroves Plantation in Buffer Area (Bund Construction)

Project boundary has been designed so as to bypass all the Mangroves in the adjacent areas. No Mangrove tree cutting will be undertaken for development of EZ. Mangroves are developed all along the coastline of Chittagong district and along the canals by forest department to protect the inland area. These mangroves will not be disturbed for development of the project. ***However after development of bund, there may be few mangrove planted area adjacent to the EZ site may become water deficient.*** This area may not receive the amount of water it is currently receiving due to construction of bund and development of EZ site. Area to be impacted due to bund development is given in figure 96 below

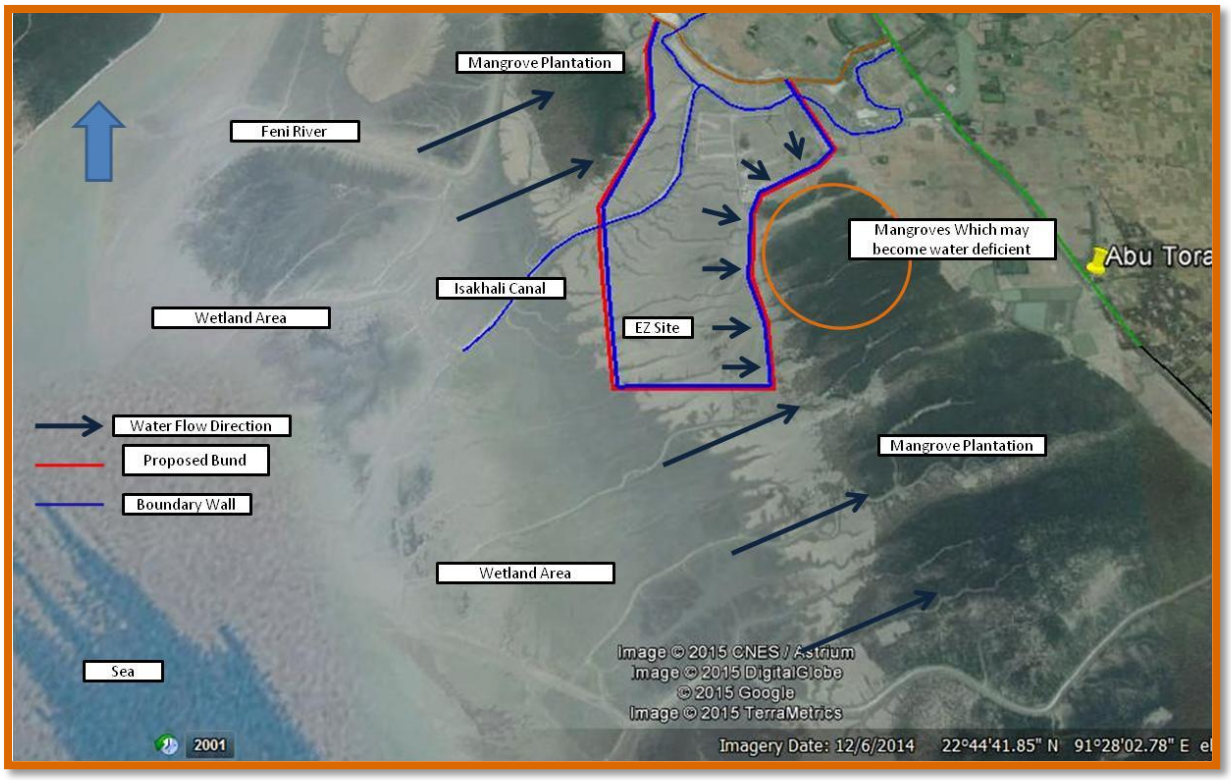


Figure 96: Map Showing Impacted Mangrove Area

Area circled in orange currently receives water from streams within the EZ site which drains into Isakhali canal. Mangroves in this area may be impacted due to reduction in amount of water reaching this area. This may lead to drying up of these trees. Following mitigation measures should be taken to prevent damage to the neighboring Mangrove area.

Mitigation Measures:

- Connectivity of minimum one drain should be retained to connect Isakhali Canal to the Mangrove Area in the East direction of the EZ site. Water level in this drain should be controlled through sluice gate. This drain will ensure entry of water in the Mangrove area which may become water deficient after development of EZ site.
- No Mangrove cutting should be undertaken without prior permission of forest department
- No wastewater, construction waste and municipal waste should be dumped within the Mangrove area or nearby areas. Sewage generated should be treated through septic tank/soak pits, wastewater from construction site should be collected & re-used within the site. Construction & other waste should be disposed off to the site identified for waste disposal

Impact on Nearby River & Marine Eco-System

Development of off-site facilities and EZ site will involve excavation, filling, storage of raw material, storage of debris, establishment of site for machinery and equipment etc. These activities may lead to contamination of rainfall run-off due to mixing with excavated material, debris, raw materials like paints, fuel, rusting of iron etc. Site being in close vicinity to river and sea, rainfall-runoff water from site will directly enter to river & sea. This may impact the quality of the river & sea water and thus supported aquatic life. Thus it is required to minimize contamination of rainfall run-off to minimize impact on water quality & aquatic life supported by the water bodies. There are no marine protected areas within 10 km radius area of EZ site. No sensitive aquatic species like dolphins are also reported in the Feni River stretch within 10 kms radius of the EZ site.

Mitigation Measures:

- No solid or liquid waste shall be discharged in river, sea and any other water body
- Septic tanks/soak pit should be provided at construction site & labour camp to treat sewage to be generated from labour camps and prevent its disposal in water body
- Toilets should be provided at construction site & labour camp to prevent contamination of water due to open defecation in nearby areas.
- Vehicle washing/equipment cleaning should not be allowed near water bodies
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose and should not be allowed to enter the water bodies
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration
- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off

Impact Due to Deep Sea Dredging

Site is intersected by various streams and small channels draining into the Isakhali Canal. These small drains are to be filled up so as to achieve a constant level of the site. It has been estimated that average filling of 0.75 m will be required for the whole development area, i.e. 550 acres for which app. 16 lakh cum of sand will be required. Being large amount of sand requirement, it is difficult to obtain the sand from dredging the river & other water bodies and excavation of land. Thus deep sea dredging has been opted to obtain this large amount of sand. Deep sea dredging can significantly impact the marine eco-system by disturbing the benthos (dwelling on sea floor) especially to sessile organisms attached to sea floor/other physical structures and the submerged vegetation. Also deep sea dredging may release large amount of sediments causing high turbidity in the surrounding waters. High turbidity will impact the

visibility of marine organisms, may choke gills of fishes and other aquatic organisms and significantly impacts the oxygen level of surface layers by forming barrier between the water and the atmosphere.

Locations for deep sea dredging have not been finalized yet by BEZA. Thus site specific assessment of sensitivity and impacts cannot be taken in detail at present. Thus it is recommended to carry out detailed marine environmental study to assess the environmental sensitivity of the location decided for dredging and the sand transportation path after finalization of the locations for dredging.

7.10.2. Operation Phase

Green buffer of 10 m all around the project site will include most of the native plant species, which will significantly improve the ecology of the area. This green buffer will provide habitat for the avifauna, reptiles and small mammals and will enhance ecology of the area. Twice the number of trees fell, if any should be planted. Also zone of 5 m will be left as no development zone along the length of Isakhali canal within EZ site. This zone will also be developed as green buffer.

Post development of the economic zone & setting up of industries, there could be some impacts on the ecosystem of the area. Industrial development will involve generation of emissions, effluents and increased vehicular movements. These altogether may have overall negative impact on the eco-system of the site and the nearby areas as the air pollutant will impact the existing vegetation and avifauna in the area. But the industries proposed as per the pre-feasibility study are light engineering, food processing and textile. These industries are not heavily polluting. If appropriate measures for preventing air, water, soil and noise pollution are taken there will be no significant impact on the eco-system of the area.

Mitigation Measures:

- Periodic monitoring shall be carried out as per the monitoring plan for air, water, noise and soil and ensure that no impact
- No waste shall be discharged in water bodies, i.e. Isakhali canal, Feni River, Bamon SUndar canal, Sea, Aquaculture ponds etc.
- All industries should install STP & ETP to treat the effluent generated and to re-use and recycle it completely. No treated and untreated effluent should be discharged in water bodies, i.e. Isakhali canal, Feni River, Bamon SUndar canal, Sea, Aquaculture ponds etc.
- Tree survival rate shall be monitored
- Native species should only be planted in the region
- Minimum twice the no. of tree fell (if any) should be planted

7.11. Impacts on Socio-Economy

7.11.1. Pre-construction and construction Phase

Loss of Livelihood & Displacement of Families

No Resettlement and rehabilitation or land acquisition is involved for development of off-site facilities and EZ development. Thus no displacement of families is involved with the project development. EZ site is seasonally used by locals for agricultural and aquaculture purpose. Fishing activities will be restricted in Isakhali canal within EZ after development of EZ. However various canals and river exists within study area thus there will not be any significant impact on livelihood of people.

Impact on Health, Aesthetics and Hygiene

Construction activities lead to generation of dust, unpleasant view, obstruction in access of public properties due to excavation etc which may impact the society significantly. Adequate waste management

plan, air, soil, noise and water pollution controls are required to be adopted to prevent any impact on society. Also various health hazards are associated with construction activity which may significantly impact the workers if not taken care.

Impact on Infrastructure& Utilities

No sensitive feature like religious structures, school, hospital etc are located along the proposed access road. No impact is anticipated on social sensitive receptors due to construction of access road. Development of EZ will increase pressure on existing facilities and utilities. Traffic on village road will increase during construction phase so it should be ensured that construction vehicle should move only during non-peak hours. Ground water should not be used for construction phase as villagers are dependent on ground water for fulfilment of daily water demand.

Impact on Demographic structure

The demographic profile of Mirershorai Upzila would not undergo any changes during the construction phase of the EZ, because the inflow of daily labourers would be mainly be from Mirershorai Upzila or from some other nearby areas. However, during the commissioning phase, a large number of inward migrations are expected. The inward migration along with the infrastructure development in Mirershorai Upzila may lead to changes in the demographic profile of Mirershorai Upzila

Generation of Employment

Employment opportunities will be ensured through three channels (i) direct employment for unskilled labour, (ii) indirect employment to the local community; and (iii) employment of women workers. Direct employment includes site clearance, excavation, loading and offloading of materials and deliveries, mason and construction works. Further, the construction labour force will be requiring food and other items, which is expected to be supplied by the local eateries, retail shops and the local community. The local community members can take advantage of these opportunities. Employment generation benefits improve the quality of life of the labourers and enhance their productivity and living standards. Employment generation, both direct and indirect, through Mirershorai EZ will have a tremendous impact on human development and poverty reduction in the Mirershorai area.

Furthermore, as an enhancement measure, it is recommended that equal employment opportunities should be given to women in the EZ, especially those who are now unemployed or are working in the service sector as daily wage workers. These recommendations should be included as a requirement in the contract to be prepared by BEZA for the construction works related to the proposed EZ. EZs further create an important avenue for young women to become part of the formal economy at better wages compared to agriculture and domestic services. Employment opportunities within the EZ will increase their employability and position in the household. In addition, Mirershorai EZ is expected to assist women in changing their occupation pattern and accessing better job opportunities and wages. But the child labour should not be encouraged in the area. Thus BEZA should make strict rules for industries and contractor for not employing child labour and there should be imposition of heavy fine, if anybody is found guilty.

Skill Enhancement of Local people

As the both skilled and un-skilled labour will be required during both construction and operation phase of the EZ, but Mirershorai and nearby area lack the skilled labour due to low literacy rate. BEZA should provide the skill enhancement training to locals to carry out specific tasks and enhance the skill of local people so that they can be given employment.

Mitigation measures are required to be taken to minimize the impact of projects on the society and they are given below:

Mitigation Measures

- Provision of proper training to all workers for handling the construction equipment

- Provision of cautionary and guiding signage in local and English language indicating the hazard associated with the site
- Employment should be provided preferable to local & affected people
- Entry to the fuel storage area and construction equipment rooms should be restricted and should be allowed for trained personnel
- Wastewater from the toilet should be disposed off in septic tanks and soak pits and should not be allowed to accumulate at labour camp site or construction site
- Dustbins should be provided at labour camps for collection of waste and waste should be regularly disposed off through the concerned agency
- Temporary storm water drainage system should also be provided at camp site so as to drain the storm water and prevent accumulation of storm water at site and thus breeding of mosquitoes/flies
- Arrangement of fire-fighting should be made at site and workers should be trained to use the system in case of fire
- Provision of personal protective equipment like safety jackets, helmets, gumboots, gloves, face mask, ear buds, goggles, safety shoes etc as per requirement and nature of job in which they are involved
- Job rotation should be carried out for workers exposed to high noise and dust areas
- Provision of First aid facility at the site and the labour camp
- Labour camps should be located at neat and clean location with no water logging issues
- Proper sanitation facility including toilets, bathing facility and washing facility should be provided at site and at labour camps for workers
- Clean drinking water supply should be provided to labour
- Crèche facility should be provided for kids if female workers are employed
- Regular inspection for hygiene and safety in labour camps should be done
- Compensation should be given to the people as per the policy for the planted tress
- Construction debris should not be allowed to enter into aquaculture ponds located along the road
- Entrance to any road/structure should not be blocked for laying pipeline and construction of access road
- A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people.

7.11.2. Operation Phase

Impact on Health

Post development of the economic zone & setting up of industries, there could be some impacts on the Socio-economic conditions of the area. Industrial development will involve generation of emissions, effluents, waste and increased vehicular movements. These altogether may have overall negative impact on the health of the people and aesthetics of area. But the industries proposed as per the pre-feasibility study are light engineering, food processing and textile industries. These industries are not heavily

polluting. If appropriate measures for preventing air, water, soil and noise pollution are taken there will be no significant impact on the society.

Poverty alleviation and diversification in livelihood

Vast employment opportunities potentially created by the EZ will reduce poverty via increased income through various livelihood options. By means of industrialization and related trades, diversification of livelihood will occur for all strata of people. Diverse livelihood options for the locals and better wages for the employees of the industrial zone will reduce poverty for many poor households and will contribute to reducing the poverty level in the locality. So, this will enormously benefit cross section of population and both gender.

The investments required in the commissioning of Mirershorai EZ will directly enhance the local economy of the area by increasing cash flow which in turn will increase the purchasing power of the local population. Increased cash flow will create more employment opportunities for the local communities in Mirershorai EZ

Employment opportunities are expected to increase throughout the region during the commissioning phas. This will provide employment to high unemployed population of the area.

Education for children including Girls' Education

Due to the establishment of the EZ and better economic changes in the locality, the child education rate is likely to increase leading to a reduction in children's informal or agriculture-based labour.

Women's empowerment

Women are mostly in household work category. Thus, employment opportunities for women created by the proposed EZ directly or indirectly are expected to provide them better socioeconomic status. Through employment women will be empowered economically by being self-reliant and may become more socially aware. This could lead to their having more decision making power in their respective families and communities. This will also encourage the parents to send their children to schools and withdraw them from wage earning activities. At the same time girl's education due to parents' better economic condition and awareness will prevent early and child marriage as girls' education will automatically retain them in school and will make social awareness and pressure of not marrying them off at early age and drop out for that.

Access to civic amenities and communication

The households that will be settled adjacent to the EZ area will access better civic amenities. However, due to the EZ construction overall traffic may be congested over the years. But industrialization will ensure better livelihood and increase ability to access better civic facilities.

Social mobility

With improved employment opportunities and higher and secured income, impoverished people will be able to move up the social ladder.

8. Public Consultation and Disclosure

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8.1. Introduction

Public consultation is one of the key components of the environmental assessment. The EA team conducted public consultations in project and study area. The approach involved a mix of conventional as well as participatory/ rapid rural appraisal (PRA/ RRA), focus group discussions (FGD) and one-to-one interviews. Accordingly, as first step, the literature and secondary data was reviewed. Local people and concerned Govt. officials were consulted. Public consultations were held during the site visit in May, 2015.

The public consultations were conducted with the following objectives: (i) to intrude awareness of the stakeholders about the project and to collect their opinion, suggestions for planning and designing of the project (ii) to identify the need and concern of the public, (iii) to assess cultural patterns and behavior of local communities. Stakeholder consultation was targeted at people/communities who may – directly or indirectly, positively or negatively- be affected by the outcomes of a project. The consultations were conducted at two different tiers of stakeholders: local people and Government Officials. Stakeholders concerns are summarized in the following two parts: (i) consultations with Government officials and (ii) consultation with local people

8.2. Approach and Methodology of Pubic Consultation and Disclosure Meeting

Consultations were conducted on informal and interview based. No questionnaire/ brochures were supplied to the participants. The discussions were primarily focused on receiving maximum inputs from the participants regarding their acceptability and environmental concerns arising out of the project. Consultation was started with the short description of the upcoming EZ projects and proposed off-site developments for EZ project. The objectives, proposed developments and the possible impacts of the project and the connectivity links of the study area with the project were also explained. The study team recorded their perceptions, demands and recommendations, about the project.

8.3. Location of Public Consultation Meetings

Locations where focused group discussion and consultations were taken up are given in table 56 below.

Table 46: Location of Stakeholder Consultation

Location	Proposed Development	Remarks	Date
Village Nayapara	Economic zone, Bund construction, access road & land filling	Nearby Village	23.05.2015
Village Charsharad		Nearby Village	23.05.2015
NGO YPSA		NGO working in area to assist people in finding livelihood to reduce dependency on Mangrove forest	24.05.2015
BWDB		Water development	22.05.2015

		Board, managing Feni River Water	
REB, Mirershorai		Rural Electricity Board, to know the status of electricity and availability	22.05.2015
Forest Department		Carrying out Plantation work in Mangroves forest adjacent to EZ site	24.05.2015

8.4. Pubic Consultation and Disclosure Meetings

Discussions carried out during public consultation meeting, response of local people and government officials and conclusions are given below in table 57. Photographs of public consultation are also presented in this report in figure 97. Attendance sheet of the participants of Public consultation held at villages Nayapara & Charshardh are attached as Annexure III.

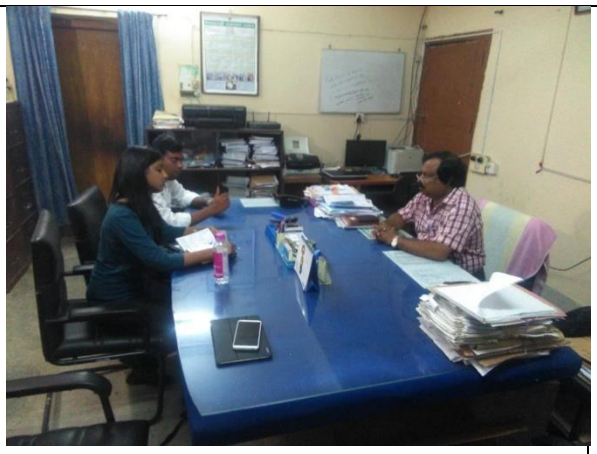
Table 477: Proceedings of Public Consultation and Disclosure Meetings

S. No.	Village	Villagers comment	Conclusion
1	NayaPara Village	• It is nearby village with 700 HH & 100% Muslim population. Major occupation of people is agriculture/aquaculture, small business and jobs like drivers etc. Av. Income per family is 5000-6000 TK/month. Most of the HHs rear poultry and cattle. • No factory emitting bad odour should come up in the EZ area like CB factory (poultry farm & feed factory) • Local people should be provided employment in the industries in upcoming EZ preferably • Skill enhancement training should be given to villagers by industries so that they can work in those industries • People expect agro based industries to come up in region which will help them selling their products easily. Also they expect upcoming industries will train them to enhance their productivity by using HYV seeds and modern equipments • Only non-polluting industries should come up in this region and measures should be taken by industries to control the pollution levels	People are aware about the upcoming EZ project. Source of information is surveys carried out by SIA team and newspapers. Majority of people have positive attitude towards the project People expect employment generation for them from upcoming EZ project People also expect infrastructure development such as good roads, water supply, power supply in their area after coming up of EZ zone People expects overall development of the area after development of EZ project People expects coming up of less polluting industries so as no pollution related problems are observed in the area.
2	Charsharadh Village	• It is nearest village with 1400 HH & app 45% families are Muslims and rest are Hindu families. 1-2 Buddhist families also resides in this village. Major occupation of people is agriculture/aquaculture, small business and jobs like drivers etc. Av. Income per family is 5000-6000	

		TK/month. Most of the HHs rear poultry and cattle. Agriculture is rain fed and heavy crop losses occur due to heavy rains and delays in rains • People are educated. Most of the people obtain basic education minimum but high level of unemployment is in the area • People are aware about the project and expect good employment generation from the EZ • They emphasised that polluting industries should not be set up in the EZ zone • Pollution should be managed by upcoming industries so that no health hazards should be generated for local people • Employment should be given to women also as they are educated and interested in working	
3	NGO YPSA	• This NGO works in Mirershorai region for assisting people in adopting alternative livelihood like cattle/poultry rearing, small business like rope making, handicrafts etc so as to reduce their dependency on forest for earning livelihood. NGO aware people about the importance & purpose of Mangrove plantation in their region. • NGO is aware about the upcoming EZ zone and have positive attitude towards it will provide employment to people and will further reduce their dependency on forest for livelihood • But NGO has shown concern over the pollution emitting from industries. They suggested only non-polluting industries should come in the region • Also all industries should take approval from DoE before establishing and should take all measures to control pollution levels • BEZA should take strict action towards the industries non-complying to DoE conditions and should shut down such units • Pollution from these industries will have bad impacts on mangrove plantation and health of nearby people • NGO suggested no tree should be cut from planted Mangrove forest and if it is required prior permission from forest department should be taken • If any tree cutting will be carried out, double the nos. of tree cut should be planted before cutting the trees • Also one more project of Mangrove	As per NGO, development of EZ is essential for growth of region and its people but should be done in manner that it should not cause any harm to environment, aesthetics and health of people. Planted Mangroves forest has been planted by Foirest department to act as natural barrier for the hazards ehich may be caused by action of Sea.

		plantation is coming up in the region near to proposed EZ under title "Climate Resilience Participation Afforestation" (CRPA). Under this villagers will be involved in plantation works and this will effectively protect the inland areas of region from sea. Thus care should be taken up while developing EZ, that no impact on this project should be there from EZ development • Minimum disturbance to fishing and other livelihood actions should be done while &v after development of EZ	
4	Bangladesh Water development Board	• XEN, Feni, BWDB • Discussion was carried out with XEN, Feni, BWDB to identify possible source of water for the upcoming EZ project • He informed that fresh water in Feni River is available in upstreams and is completely utilized for irrigation purpose and cannot be shared for EZ purpose • Saline water ingress in upstreams of Feni River is controlled through regulators • Ground water and rain water can be used to meet daily water demand as done by villagers • Isakhali channel is source of irrigation and fishing for many villages so water quality should not be affected due to upcoming EZ zone •	Conjunctive use of water should be undertaken. Desalination of saline water of Feni River can be also considered for fulfilling daily water demand of EZ project
5	Rural Electricity Board, Mirershorai	• Capacity of Substations in Mirershorai is 30 MVA out of which app 27 MVA is utilized. • Capacity of Mirershorai substation can be increased from 20-30 MVA if approval from National Electricity Board is obtained and then 10 MVA can be supplied to EZ for fulfilling initial electricity demand of EZ • Option for power supply should be selected and confirmed before development of EZ so that crisi on power should not happen in later stage • TPP can also be established within EZ but clearance from DoE should be obtained for that and all pollution control measures should be taken • BSRM is also developing TPP within their zone, so possibility of availing power supply from BSRM can also be explored by BEZA • Development of EZ will be beneficial for area as it will provide employment to the people and will enhance the infrastructure of the area	Insufficient power supply available in Mirershorai. Coming of industries will enhance the infrastructure in the area.

		• No major impact on environment expected as there are no major polluting industries in the region and also it should be ensured by BEZA that all industries comply with the conditions given by DoE	
6	Forest Department	**Forest Guard, Coastal Office, Mirershorai (Mr. Irfan & Mr. Ali)** • Development of EZ is good for society as it will provide employment to the people and will also reduce dependence on Planted and natural forest • But the Mangroves are adjacent to the EZ zone and pollutants from industries may impact these forest • Construction of bund may also impact the mangroves by restricting the entry of water in forest to some extent • Only non polluting industries with all pollution control devices should come up in the zone • No waste should be allowed to be thrown in canal, river and sea by industries **Sr. Forest Officials, Mirershorai** • Forest officials of Mirershorai Coastal Zone Office appreciated the project but they said it cannot be allowed to cut even a single Mangrove tree • They suggested project boundaries should be so delineated that none of mangroves are required to be cut • Also they suggested to take appropriate environmental pollution control measure while construction of off-site facilities and EZ so as minimum damage is caused to Mangroves in adjacent land parcels and quality of water of Feni River & Sea • They also suggested that industries should not be allowed to discharge any waste or wastewater into Mangroves, nearby land, water bodies and other area and proper waste disposal & management mechanism should be followed by industries	EZ will be beneficial for the region as it will lead to overall development of the area. But measures should be taken during development and operation phase of EZ so that impact on environment and forest can be minimized. Tree cutting from forest should be avoided to extent possible. In line with the suggestions of the forest officials, boundary of project site is delineated to avoid Mangrove tree cutting. At present no Mangroves are required to be cut for development of off-site facilities and EZ. Also EMP has been prepared for both construction and operation phase which details pollution prevention plan.



Discussion with BWDB

Discussion with YPSA NGO

Forest Department, Mirershorai I

Forest Department, Mirershorai II

Discussion with REB, Mirershorai

Discussion in Charsharadh Village

Discussion in Village Nayapara

Figure 97: Photographs of Stakeholders Consultation

9. Environmental Management Plan and monitoring indicators

9.1. Introduction

The Environmental Management Plan (EMP) is the synthesis of all proposed mitigation and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. EMP is a plan of actions for avoidance, mitigation and management of the negative impacts of the project. Environmental enhancement is also an important component of EMP. A detailed set of mitigation measures have been compiled in view of the likely impacts associated with the proposed Mirershorai EZ.

9.2. The Environmental Management Plan

The EMP consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction and operation (post-construction) stages of the project. The EMP has been designed keeping in view the regulatory and other requirements to ensure the following:

- Minimum disturbance to the native flora and fauna
- Compliance with the air, water, soil and noise quality norms.
- Conservation of water to the extent possible through rain water harvesting, wastewater recycling

9.3. Mitigation Plan

The proposed EZ development may have some impacts on the environment and society such as change in land use, removal of vegetation, increased dust emissions etc. Health & Safety Plan along with the EMP has been drafted. Details of which are given below. All offsite facilities shall be constructed by BEZA. EMP implementation shall also be BEZA who will in turn implement it through contractor. EZ will be developed by the developer appointed by BEZA and shall be responsible for implementation of EMP during development

9.3.1. Mitigation Plan for Site Development & Administration Building

Site development works includes land filling & levelling, bund construction and construction of boundary wall. Bund will be constructed to protect site from sea. Bund proposed to be constructed is 6.5 km app in length and will be constructed all along the site boundary. Site will be filled with deep sea sand upto 75 cm. Boundary wall is proposed to be constructed all along the EZ site. Length of boundary wall is 6.5 kms. Administration building will cover an area of 3600 sq m. Ground coverage of administration building is 560 sq m. G + 2 level will be developed so that office space and related facilities will be there on ground and first floor and guest rooms at second floor.

Impacts associated with site development and construction of administration building along with proposed mitigation measures are given below. No impacts are anticipated during operation phase. The Contractor shall take up all mitigation and enhancement measures (including those related to mitigation of air/noise/water pollution; drainage/traffic congestion) as specified in the EMP tabulated below in table 58.

Table 58: Environmental Impacts and Mitigation Plan for Site Development & Construction of Administration Building

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
Removal of Vegetation	• Vegetation which has been identified & approved to be removed shall only be removed for site clearance • No tree should be cut without taking prior permission of BEZA & PMC • No Mangrove plants should be cut without permission of Forest Department	Pre-construction phase	Contractor	BEZA/PMC
Setting up of construction camps/labour camps	• The construction camps should be at least 500 m distance from habitations from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. • Location for stockyards for construction materials will be identified at least 1 km from water sources • Store house for haz material like diesel should be at distance from construction labour camps. • The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the resident engineer • All sites used for camps will be adequately drained. They will not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures • The camps will be located such that the drainage from and through the camps will not endanger any domestic or public water supply • All sites will be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance • Construction camps shall be	Pre-construction phase	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
	provided with sanitary latrines (1 per 25 pax), bathing facility and urinals. • Construction camps should be electrified and well ventilated • No electrical wire should be left on the floor of camp or site. Proper system should be developed and entry to the site of electricity meter should be restricted and should be allowed for authorized personnel only • Sanitary latrines shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings • Adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labour employed therein. • Sewerage drains will be provided for the flow of used water outside the camp. • Drains and ditches will be treated with bleaching powder on a regular basis. • The sewage system for the camp will be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. • Clean potable drinking water facility should be provided at the site and the water quality should be monitored regularly • Crèche facility should be provided for children if female workers are employed • First aid facilities should be made available at construction camp. First aid box should contain small, medium and large sized sterilized dressings, sterilized burns dressings, 2 % alcoholic solution of			

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
	iodine, bottle containing salvolatile, snakebite lancet, , bottle of potassium permanganate crystals, scissors, Ointment for burns & surgical antiseptic solution • 1 first aid box should be available per 50 labour • A person trained in first-aid treatment shall be made in charge who shall always be readily available during the working hours at the work place • A suitable motor four wheeler transport shall be kept readily available to carry injured or ill person to the nearest hospital.			
Identification of dumping sites for debris	• The dumping sites shall not be located within designated Forest/protected areas • Residential facility or sensitive facilities like hospitals, schools etc shall not be located in downwind direction of the identified dumping sites • Dumping shall not impact natural drainage courses • Dumping sites should be located at least 1 km from sensitive locations • Permission from concerned local body should be taken before finalizing the location • Agriculture lands should be avoided & waste lands should be preferred • Selected site should not support significant vegetation • The area should be sprinkled with water to suppress the dust emissions • Plant species suitable to grow in that conditions should be planted at the time of closure	During Construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
Soil Erosion and Sedimentation control	• To avoid soil compaction along the transportation routes, only identified haul roads would be used for transportation. • Sedimentation tanks should be provided in line with storm water drains to trap the sediments from run-off. Sand bags can be used to trap sediments more effectively	During Construction	Contractor	BEZA/PMC
Disposal of Debris and any waste generated	• Waste from construction camp should be segregated at site. Food/wet waste should be composted in pit at the site, recyclable should be send to authorized recyclers and rejected waste should be disposed regularly through responsible agency in the area • Dustbins should be provided at the site and construction camps to prevent littering of waste • Storage area of minimum 2 days should be provided at construction camp for storage of the waste generated from labour camps • Construction debris should also be segregated at the site. This debris should be used for filling to the extent possible. Recyclable waste should be sold through authorized dealers and reject waste should be sent to the identified debris disposal site • All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental. • Construction debris should be stored under covered sheds on paved surfaces to prevent leaching • Any hazardous waste generated during	During Construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
	construction activity shall be stored at suitable place and then disposed off in consultation with the guidelines. • Contaminated runoff from storage areas shall be captured in ditches with an oil trap at the outlet. • Utmost care shall be taken to ensure that the Municipal Corporation norms are met for the safe collection, transport and disposal of construction waste and debris.			
Dust Generation	• Routes for transportation of material within the site should be covered with brick bed so as to minimize the dust generation • Inventory of the material entering and going outside the site should be maintained at site. This will help in knowing the raw material available and prevent piling up of raw material and thus dust generation • Raw material stored should be covered. Debris and excavated soil should also be kept covered. • Cement and sand should be stored under covered sheds only • Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. • Compaction of prepared site to re-strain the fugitive emissions. • Water should be sprayed in the cement and earth mixing sites as well as after compaction. • Clearing and grubbing to be done, just before the start of next activity on that site • In high dust areas, workers should be provided and encouraged to use masks. • Regular maintenance, servicing of the vehicles and	During Construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
	periodic emission check for equipment and machinery would be carried out in conformity with the Central Motor Vehicles Rules, 1989. • Water will be sprayed on the haul road. • All the vehicles entering the project site will be checked for Pollution-Under-Control Certificates. • Air quality monitoring to be carried out during construction phase to check the pollutants level in the air			
Contamination of surface & ground water	• Isakhali canal at site should be retained and no waste should be disposed off in the canal • A drain connecting Isakhali canal to Mangrove plantation area in East direction of the site should be retained to ensure flow of water into the Mangrove forest. • Material mixing, material storing, washing of equipment and vehicles and other activities close to water bodies shall be avoided • Car washing / workshops near water bodies will be avoided. • Avoid excavation during monsoon season • Loosened soil will be stabilized by Contractor through landscaping and developing vegetation, wherever possible, once construction activity is completed at any site. • Sanitation facility with septic tank followed by soak pit will be developed. Common toilets will be constructed on site during construction phase and the waste water would be channelized to the septic tanks and soak pits in order to prevent waste water to enter into the water bodies.	During Construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
	• Provision of oil & grease traps upstream of storm water drains • Surface run off due to construction activity will not be discharged in open without treatment. It should be collected and re-used for wheel washing and spraying at site for dust suppression • Provision of garland drains around the excavated area to prevent entry of storm water into the excavated area • Temporary storm water drains should be provided for whole site. These drains should be connected to Isakhali canal. These drains should be provided with stilt trap so as to arrest sediments from run-off before discharging into canal. • Stilt should be removed periodically from these stilt traps to avoid choking and overflow. • Septic tank & soak pit should be provided to dispose off the sewage to be generated from temporary toilets constructed for labour usage			
Noise from Vehicles, Plants and Equipment	• Construction activities would be carried out in the daytime only. • The construction equipment would be provided with adequate noise control measures and should comply with the noise standards as prescribed by DoE • Regular maintenance of vehicles and equipment would be carried out and corrective action taken in case of any deviation. • Ear muff/ear plug shall be given to the workers working around or operating plant and machinery emitting high	Throughout construction		

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
	noise levels. • DG sets if installed should be provided with acoustic enclosures • Labour working in noise prone area should be provided with ear plugs and job rotation should be practiced to prevent the prolonged exposure of any workers to high noise levels • Honking should be prohibited at site • Speed limits for vehicles should be restricted			
Accidents	• Safety officer should be appointed at site to ensure all the safety guidelines are being followed at site • Cautionary guidance should be provided at site to aware people about the associated risk with the area. Entry to the fuel storage room or machinery operation room should be restricted only to authorized trainer personnel • All Accidents shall be reported immediately and incident analysis, preventive measures shall be implemented. • A gate should be provided at site and record for entry & exit of vehicles should be maintained at the site • Fuel should be stores at site away from construction camps • Adequate lightning should be provided at site especially during night time	During Construction	Contractor	BEZA/PMC
Clearing of Construction Camps & Restoration	• Contractors shall prepare site restoration plans. The plans shall be implemented prior to demobilization. • On completion of works, all temporary structures shall be cleared, all rubbish burnt, excreta or other disposal pits or trenches filled in and sealed and the site left clean and tidy,.	Post Construction	Contractor	BEZA/PMC
Occupational Health & Safety	• All construction worker should wear a safety jacket	During Construction	Contractor	BEZA/PMC

Activity/Impact	Mitigation Measures	Time Frame	Implentation of Mitigation Measures	Supervision & Monitoring
Plan	and other protective equipment like helmet, gloves, gum boots, ear plugs, mask while working at the site • Workers should be made aware about the health issues related with open defecation • Training to workers should be provided for handling the construction equipment and machinery • Training to the workers should be provided to handle the emergency situations like fire, floods etc. • First aid facility and sufficient nos. of trained personnel should be available at all the time at construction camp • Cautionary signage and notice should be displayed in local language and English at the required places like fuel storage area so that hazards can be avoided. A security guard should be deputed in these areas and entry should be restricted			
Disaster Management	• All reasonable precaution should be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. • Fire-fighting facility, i.e. sand filled buckets and portable fire extinguishers should be available at site • Workers should be trained how to use fire extinguisher • Workers should be made aware of nearest located cyclone shelter and measures to be taken by them in case of cyclone or flood. • No construction activity should be taken during rainy season	During Construction	Contractor	BEZA/PMC

9.3.2. Mitigation Plan for Access Road Construction

It is proposed to develop existing CDSP bund as access road. Section from Abu Torab junction to upcoming Mirershorai EZ sit will be developed as access road. Access road measures 6 km in length and 5 m in width and will connect EZ site to Dhaka Chittagong Highway through Abu Torab Road

Impacts associated with construction of access road e along with proposed mitigation measures are given below**.** The Contractor shall carry out all mitigation and enhancement measures (including those related to mitigation of air/noise/water pollution; drainage/traffic congestion) as specified in the Environmental Management Plan (EMP) as below in table 59.

Table 59: Environmental Impacts and Mitigation Plan for Access Road

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
Pre-Construction					
Removal of Vegetation	• Removal of as little vegetation as possible during the development and re-vegetation of bare areas after the project. • Tree cutting should be minimized (if any). Twice the nos, of tree cut should be planted	RoW	Pre-Construction	Contractor	BEZA/PMC
Procurement & Setting up of Crushers, Hot-mix plants, other Vehicles, Equipment and Machinery	• Specifications of crushers, hot mix plants and batching plants, other Construction Vehicles, Equipment and Machinery to be procured should comply to the relevant Standards/ norms and with the requirements of the relevant current emission control legislations • Hot mix plants, crushers and batching plants shall be located	Areas in vicinity of construction site	Pre-Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	at distance of app. 1 km from nearest habitation, archaeological site, sensitive areas, forests etc. • Residential facility or sensitive facilities like hospitals, schools etc shall not be located in downwind direction of the identified plant site • Aadequate stack height and emission control devices such as bag house filters, cyclone separators, water scrubbers etc., should be attached with HMP • Impervious platform for storage of bituminous and other liquid hazardous chemical • Pollution control measures for Diesel Generator (DG) set i.e. stack height, acoustic enclosure etc. • Proper lighting arrangement shall be made around plant site if the plants are				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	operated during dark hours. • Provision of readily available first aid kit, fire fighting equipments at the plant site at appropriate location to respond in case of accident. • Periodical monitoring of air quality and noise levels as per conditions stipulated under the statutory clearance from DoE. Whenever the emission exceeds the permissible level the plants should be stopped and necessary repairing works of faults should be done to bring down the emission levels.				
Setting up of construction/ labour camps	• The construction camps should be at least 500 m distance from habitations from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. • Location for stockyards for construction	Areas in vicinity of construction site	Pre-construction phase.	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	materials will be identified at least 1 km from water sources • Store house for haz material like diesel should be at distance from construction labour camps. • The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the resident engineer • All sites used for camps will be adequately drained. They will not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures • The camps will be located such that the drainage from and through the camps will not endanger any domestic or public water supply • All sites will be graded, ditched				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	and rendered free from depressions such that water may get stagnant and become a nuisance • Construction camps shall be provided with sanitary latrines (1 per 25 pax), bathing facility and urinals. • Construction camps should be electrified and well ventilated • No electrical wire should be left on the floor of camp or site. Proper system should be developed and entry to the site of electricity meter should be restricted and should be allowed for authorized personnel only • Sanitary latrines shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings • Adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	contract labour employed therein. • Sewerage drains will be provided for the flow of used water outside the camp. • Drains and ditches will be treated with bleaching powder on a regular basis. • The sewage system for the camp will be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. • Clean potable drinking water facility should be provided at the site and the water quality should be monitored regularly • Crèche facility should be provided for children if female workers are employed • First aid facilities should be made available at construction camp. First aid box should contain small, medium and large sized sterilized				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	dressings, sterilized burns dressings, 2 % alcoholic solution of iodine, bottle containing salvolatile, snakebite lancet, , bottle of potassium permanganate crystals, scissors, Ointment for burns & surgical antiseptic solution • 1 first aid box should be available per 50 labour • A person trained in first-aid treatment shall be made in charge who shall always be readily available during the working hours at the work place • A suitable motor four wheeler transport shall be kept readily available to carry injured or ill person to the nearest hospital.				
Identification of debris dumping sites	• The dumping sites shall not be located within designated Forest/protected areas • Residential facility or sensitive	Waste lands in nearby area	Pre-Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	facilities like hospitals, schools etc. shall not be located in downwind direction of the identified dumping sites • Dumping shall not impact natural drainage courses • Dumping sites should be located at least 1 km from sensitive locations • Permission from concerned local body should be taken before finalizing the location • Agriculture lands should be avoided & waste lands should be preferred • Selected site should not support significant vegetation • The area should be sprinkled with water to suppress the dust emissions • Plant species suitable to grow in that conditions should be planted at the time of closure				
CONSTRUCTION STAGE					
Land					
Soil Erosion and	• Contractor should plan the	Throughout Project	During Constructio	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
Sedimentation control	activities so that no naked / loose earth surface is left out before the onset of monsoon. • Top soil from debris disposal sites & along the road side should be stripped and kept under covered shed for plantation • After the construction activity is over, top soil will be utilized for landscaping activity. • To avoid soil compaction along the transportation routes, only identified haul roads would be used for transportation. • Along sections abutting Isakhali canal, no development should be carried out and a retaining wall should be constructed • Retaining wall should be constructed all along the Isakhali canal section running through EZ site • Bund embankments should be provided with turfing & longitudinal	Corridor, Service roads and equipment storage sites, etc.	n		

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	drains to minimize erosion • Turfing of low embankments and plantation of grasses and shrubs should be done in slope stabilization. • Soil erosion checking measures as the formation of sediment basins, slope drains, etc, should be carried out. • Construction of Side Slope of Filled Land of 1:2 by suitable soils with proper compaction as per design. Slope surface should be covered by top soils/ cladding materials and grass turfings with suitable grass.				
Contamination of soil	• Impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform will be appropriately provided at construction camp, servicing area and liquid fuel and lubes at storage areas.	At fuel storage areas – usually at construction camps, temporarily acquired site.	During Construction.	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	• Proper management of waste from labour camps and construction site • Proper disposal of wastewater generated from labour camp and construction site				
Material sources	• Adequate safety precautions shall be ensured during transportation of quarry material from quarries to the construction site. • Vehicles transporting the material shall be covered to prevent spillage. • No excavation of earth should be carried out prior obtaining permission from DoEB	Nearest Quarry Site	During construction	Contractor	BEZA/PMC
Disposal of Debris	• Waste from construction camp should be segregated at site. Food/wet waste should be composted in pit at the site, recyclable should be send to authorized recyclers and rejected waste should be disposed regularly through	Identified debris disposal location during preconstruction phase	During Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	responsible agency in the area • Dustbins should be provided at the site and construction camps to prevent littering of waste • Storage area of minimum 2 days should be provided at construction camp for storage of the waste generated from labour camps • Construction debris should also be segregated at the site. This debris should be used for filling to the extent possible. Recyclable waste should be sold through authorized dealers and reject waste should be sent to the identified debris disposal site • All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	incidental. • Construction debris should be stored under covered sheds on paved surfaces to prevent leaching • Any hazardous waste generated during construction activity shall be stored at suitable place and then disposed off in consultation with the guidelines. • Rubbish, debris and bitumen wastes remaining after blacktop works shall be cleaned and disposed off in a safe place. • Contaminated runoff from storage areas shall be captured in ditches with an oil trap at the outlet. • Utmost care shall be taken to ensure that the Municipal Corporation norms are met for the safe collection, transport and disposal of construction waste and debris.				
Air					
Dust Generation	• Routes for transportation	Throughout Project	During Constructio	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	of material within the site should be covered with brick bed so as to minimize the dust generation • Inventory of the material entering and going outside the site should be maintained at site. This will help in knowing the raw material available and prevent piling up of raw material and thus dust generation • Raw material stored should be covered. Debris and excavated soil should also be kept covered. • Cement and sand should be stored under covered sheds only • Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. • Compaction of prepared site to re-strain the fugitive emissions. • Water should be sprayed in the cement and earth mixing sites as well as after	Corridor, all access roads, temporarily acquired sites.	n Phase		

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	compaction. • In laying sub-base, water spraying is needed to aid compaction of the material. After the compaction, water spraying should be carried out at regular intervals to limit the dust to below • Every equipments and machinery will be fitted with dust suppression devices such as water sprinklers, dust bags, cyclone etc. as appropriate. • Road surface should be cleaned with air compressor and vacuum cleaners prior to the construction works. Manual labour using brooms should be avoided, if used labour to be provided masks. • The Contractor shall take every precaution to reduce the level of dust emission from the hot mix plants and the batching plants. • Contractor will ensure that all				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of DoEB • The Contractor will submit PUC certificates for all vehicles/ equipment/ machinery used for the project. Monitoring results will also be submitted to 'PIU' through the 'Engineer'. • Air quality monitoring to be carried out during construction phase to check the pollutants level in the air				
Water					
Loss of water bodies/ surface / ground	• No waste to be disposed off in Isakhali canal, Feni River and aquaculture ponds along the CDSP bund and BWDB bund • No excavation from the bund of the water bodies. • No earth will be excavated for development of any off-site	Near all water bodies	During construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	facility • No debris disposal near any water body. • Prior written permission from authorities is required for use of water for construction activity. • Construction labours to be restricted from polluting the source or misusing the source. • Labour camps will be located away from water bodies. • Open defecation should not be allowed. Sanitary toilets should be provided at the site & in labour camps. • Bathing & Washing should not be done near waterbody, whereas proper facility should be provided for this purpose • Provision of the septic tank with soak pit to dispose off the water from construction labour camp • Surface run-off due to construction activities should be collected & re-used for wheel				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	washing & sprinkling for dust suppression • All raw material, excavated soil & debris to be kept covered so as they do not mix with rain water during rains and does not contaminate the rainfall run-off which may enter the nearby water bodies • No excavation work t be undertaken during monsoon season				
Drainage and runoff	• The Contractor will always clear all the cross drainage structures and natural drainage before onset of monsoon in order to keep all drainage unblocked Earth, stones, wastes and spoils will be properly disposed off, to avoid blockage of any drainage channel. • All necessary precautions will be taken to construct temporary or permanent devices to prevent inundation or ponding.	Throughout the stretch	During Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
Silting / sedimentation	• Silt fencing shall be provided around aquaculture ponds & Isakhali canal along the access road to prevent runoff of sediment from construction site • Sedimentation tanks should be provided in line with the storm water drains to prevent soil loss/erosion	Throughout Project Corridor and at all locations of water bodies	Construction Phase	Contractor	BEZA/PMC
Contamination of water	• Construction activities & material storage close to water bodies (Isakhali canal, Bamon Sundar canal & Feni River)shall be avoided • Car washing / workshops near water bodies will be avoided. • Wastewater generated from labour camp and construction sites should not be discharge in water bodies and should be channelized to septic tanks/soak pits • Construction wastewater can be re-used for sprinkling and curing	Throughout Project Corridor and at all locations of water bodies	Construction Phase	Contractor	BEZA/PMC
Noise					
Noise from	• All vehicles and	Throughout	During	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
Vehicles, Plants and Equipment	equipment used in construction will be fitted with exhaust silencers. • Noise standard at processing sites, eg. hot mix plant , machinery will be strictly monitored to prevent exceeding of noise standards. • Workers in vicinity of loud noise, shall wear earplugs and working time should be limited as a safety measure. Job rotations should also be carried out to prevent continuous exposure • Construction activities to be taken up during day time only • Servicing of all construction vehicles and machinery should be done for exhaust silences and should be checked and if found defective should be replaced. • No noisy construction activities should be permitted around educational	Project Corridor and at all construction sites, hot mix plant etc.	Construction		

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	institutions/health centers (silence zones) up to a distance of 100 m from the sensitive receptors. • Monitoring shall be carried out at the construction sites • Environmental Expert will be required to inspect regularly to ensure the compliance of EMP.				
Flora and Fauna					
Loss or damage to vegetation	• No tree cutting should be carried out for construction of access road without permission from BEZA & PMC • Compensatory plantation should be carried out in the ratio of 1:2 minimum • Plantation should be carried out all along the access road	Throughout Project Corridor	During Construction Phase	Contractor	BEZA/PMC
Compaction of vegetation	• Construction vehicles, machinery and equipment will move or be stationed in the designated area only (RoW or CoI, as applicable), to prevent compaction of vegetation outside the	Throughout Project Corridor	During Construction Phase	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	RoW. • While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil and damage to naturally occurring herbs and grasses will be avoided.				
Loss, damage or disruption to fauna	• Construction workers will be directed not to disrupt or damage the fauna. • Construction vehicles will run along specified access to avoid accidents to cattle.	Throughout Project Corridor	During Construction Phase	Contractor	BEZA/PMC
Socio-Economic Environment					
Accidents	• Safety officer should be appointed at site to ensure all the safety guidelines are being followed at site • Cautionary guidance should be provided at site to aware people about the associated risk with the area. Entry to the fuel storage		During Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	room or machinery operation room should be restricted only to authorized trainer personnel • All Accidents shall be reported immediately and incident analysis, preventive measures shall be implemented. • A gate should be provided at site and record for entry & exit of vehicles should be maintained at the site • Fuel should be stores at site away from construction camps • Adequate lightning should be provided at site especially during night time				
Occupational Health & Safety					
Construction Safety	• All construction worker should wear a safety jacket and other protective equipment like helmet, gloves, gum boots, ear plugs, mask while working at the site • All workers employed on mixing	Entire Project site.	During Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. • Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals • Workers should be made aware about the health issues related with open defecation • Training to workers should be provided for handling the construction equipment and machinery • Training to the workers should be provided to handle the emergency situations like fire, floods etc. • First aid facility and sufficient nos. of trained personnel should be available at all				

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	the time at construction camp • Cautionary signage and notice should be displayed in local language and English at the required places like fuel storage area so that hazards can be avoided. A security guard should be deputed in these areas and entry should be restricted • A register of all toxic chemicals delivered to the site shall be kept and maintained up to date. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.				
Disaster Management	• All reasonable precaution should be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. • Fire-fighting facility, i.e.	Entire Project site	During Construction	Contractor	BEZA/PMC

Impact	Mitigation Measures	Location	Time Frame	Implementation of Mitigation Measures	Monitoring & Supervision
	sand filled buckets and portable fire extinguishers should be available at site • Workers should be trained how to use fie extinguisher • Workers should be made aware of nearest located cyclone shelter and measures to be taken by them in case of cyclone or flood. • No construction activity should be taken during rainy season				
Clearing of Construction of Camps & Restoration	• Contractors shall prepare site restoration plans. The plans shall be implemented prior to demobilization. • On completion of works, all temporary structures shall be cleared, all rubbish burnt, excreta or other disposal pits or trenches filled in and sealed and the site left clean and tidy.	All Workers' Camps		Contractor	BEZA/PMC

9.3.3. Mitigation Plan for EZ

The detailed plan shall be prepared by prospective developers. However following measures shall mandatorily form part of EMP for EZ development and operation:

- Separate environment clearance should be taken by developer before developing economic zone from DoEB

- Industries should obtain environment clearance individually from DoEB prior to establishment and commencement.

Measures that should be taken by developer and individual industrial owners vehicle development and operation phase is tabulated in table 60 & 61 below

Table 60: Mitigation Measures Suggested for Developer

Impact	Mitigation Measures During Construction Phase
Identification of Site for Disposal of construction Debris, construction labour camp and plant site	• Site identified should be 1.0 km away from settlement, sensitive locations, like school, hospital, religious structures, reseve forest and any other eco-sensitive zone etc. • Site identified should be approved by BEZA and PMC • Site should be located in downwind direction from settlement area • Fertile agricultural land and community land should be avoided for setting of these facilities
Air Pollution	• Sprinkling of water during construction phase on all unpaved roads, site and haul roads • Avoiding excess pilling of raw material and debris at site • Storage & transportation of raw material and debris in covered conditions • Cutting of only identified trees after obtaining permission of forest department • Regular cleaning of site • Provision of adequate parking space at site so as to prevent idling of vehicles during construction phase • Up keeping and maintenance of all the construction vehicles, machinery and equipment used for construction purpose • All vehicles entering the EZ site should carry PUC • Guiding signage should be provided at the site for vehicles entering the site to minimize the movement of vehicle within the site • Timings of the construction material vehicles should be fixed and should be during non-peak hours to prevent traffic congestion and traffic jams • Speed limits should be restricted within the site for all the construction vehicles • Usage of low energy intensive building material like fly ash mix cement and bricks • Usage of low sulphur diesel for running DG sets, construction vehicles and equipments • Obtaining temporary electricity connection during construction phase and operating DG sets only during power failure • Provision of wheel washing facility at exit point of site • Adequate air pollution control measures like provision of bag filters, stacks of adequate height should be provided with WMM, hot mix plant, batching plant etc. • Open burning of wood or any other material should be prohibited at site and all the workers should be made aware about the same • Zonation of EZ should be carried out such that high polluting industries should be located in downwind direction
Water Pollution & water Conservation	• Minimizing the run-off from the site by construction of sediment basins for collection of storm run-off and re-using that water for curing purpose and wheel washing • Curing of structures to be done by spraying and during early

Impact	Mitigation Measures During Construction Phase
	morning and evening hours only to minimize the water requirement • Maintaining the flow of water sprinklers so as to avoid wastage of water • No debris should be thrown or disposed off in any water body like river, pond, canal etc or ground water source like functional or abandoned well • Excavation should not be carried out during monsoon • Provision of temporary storm water drainage system during construction phase to drain the storm water and should be connected to nearest surface water body • Excavated pits should be provided with garland drains to prevent entrance of water inside the pit • Provision of oil & grease traps with the storm water drains draining the parking and fuel storage area • Provision of septic tanks and soak pits at the site & labour camps for disposal of sewage generated by construction labour • Waste generated by construction camps should be disposed off regularly at the identified site for debris disposal • Provision of cross drainage structures like balancing for maintaining the drainage pattern • Stone & bricks should be purchased only from licence vendors • Keeping provision of land for development of CSTP and CETP in future. CETP should essentially be developed to ensure treatment of 100% of the wastewater as all industries may not be able to provide efficient systems for treatment of their effluent • Rain water harvesting tank should be developed at the site so as that water can be used for meeting daily water demand • Tank alarms should be installed so as to prevent overflow of water • CETP & CSTP should be atleast 30 m away from the water pipeline, water storage tank and rain water storage tank
Soil Quality	• Top soil, if excavated from the project site should be stored in covered condition and should be used later for landscaping purpose • Storage of raw materials, debris and fuel on paved surfaces • Training the workers to handle the material so as to minimize spillage of material on soil • Provision of cross drainage structures to prevent water logging and soil erosion • Stone pitching with grass turfing should be done for the high embankment close to water body • Disposal of construction debris, municipal waste from labour camps and hazardous waste from site should be disposed off at the identified site • Keeping provision of land for development of solid waste management facility within the EZ site • No open area should be left without the vegetation to protect the soil. • Mulching of soil should be done regularly to prevent direct exposure of soil to wind and water
Noise Pollution	• Construction vehicles, machinery and equipment used for construction purpose should meet the standards prescribed by DoE • Upkeeping and regular maintenance of all the construction

Impact	Mitigation Measures During Construction Phase
	vehicles, machinery and equipment used for construction purpose • Speed limits should be restricted for all construction vehicles and equipment • Honking should be prohibited at the site • Provision of acoustic enclosures, noise mufflers, silencers etc with the DG sets and any noise generating machinery • Provision of temporary noise shield/barrier in areas where more noise will be generated
Ecology	• Only identified trees (if any) should be fell down after obtaining permission from forest department • Compensatory plantation should be carried out in ratio of min 1:2 under guidance of forest department • Development of 10 m (minimum) thick green buffer all along the periphery of EZ • Boundary should be constructed around the EZ site to prevent trespassing of the animals • Native plant species requiring should be considered for plantation • Timber should be purchased only from authorized vendors • No water body should be filled outside the EZ site
Socio-economy and aesthetics	• All proposed air, water, noise and soil pollution control measures should be taken • Provision of employment opportunity during construction phase to local people • Provision of personal protective equipment to all the workers • Job rotation should be practiced for workers exposed to high noise levels • Site should be covered from all the site during construction phase • Drinking water facility, adequate nos. of toilet, septic tank/soak pit, bathing facility, lighting should be provided in labour camps • Storm water drainage system should also be provide in labour camps to prevent water ponding and breeding of mosquitoes • LPG should be provided as fuel in the labour camps • Provision of facility like guest house, community building, commercial area, ATM, Bank, hospital and parking should be made within the EZ site
Disaster and Risk Management	• Provision of first aid kit and first aid room and well trained first aid practioner at the site all the time • Ambulance facility should be provided at the site • Tie-ups with local hospital should be made to handly emergency case, if any • Availability of safety officers and supervisors at all the time on the site • Workers should be given training for handling construction vehicles, equipment and handling emergency situations like fire, floods, earthquake and cyclone • Cautionary signage should be provided in the areas associated with risks like storage of explosives, fuels, heavy construction material etc. Entry for only trained authorized personnel should be allowed in such areas with adequate safety measures • Emergency handling cell & room should be developed at the site and should be headed by project & safety manager • Contact no. of nearest fire-station and hospitals should be

Impact	Mitigation Measures During Construction Phase
	displayed within the emergency handling room

Table 61: Mitigation Measures Suggested for Individual Plot Owners

Impact	Mitigation Measures During Construction Phase	Mitigation Measures During Operation Phase
Air Pollution	• Sprinkling of water during construction phase on all unpaved roads, site and haul roads • Avoiding excess pilling of raw material and debris at site • Storage & transportation of raw material and debris in covered conditions • No trees should be fell down without permission of BEZA and forest department • Regular cleaning of site • Provision of adequate parking space at site so as to prevent idling of vehicles during construction phase • Upkeeping and maintenance of all the construction vehicles, machinery and equipment used for construction purpose • All vehicles entering the EZ site should carry PUC • Guiding signage should be provided at the site for vehicles entering the site to minimize the movement of vehicle within the site • Timings of the construction material vehicles should be fixed and should be during non-peak hours to prevent traffic congestion and traffic jams • Construction vehicles should follow the speed limits set up for EZ zone • Usage of low energy intensive building material like fly ash mix cement and bricks • Usage of low sulphur diesel for running DG sets, construction vehicles and equipments • Obtaining temporary electricity connection during construction phase from BEZA and operating DG sets only during power failure • Provision of wheel washing facility at exit point of site • Open burning of wood or any other material should be prohibited at site and all the workers should be made aware about the same	• Installation of air pollution control devices like Electro-static precipitator, bag filters, separators, cyclones, multi-level condensers & evaporators, scrubbers, quenchers, stacks of height as per DoE norms • Disposal of the waste material at the designated site for waste disposal in covered condition • All the roads within the plot should be paved & water sprinkling should be practiced to minimize dust generation. • Adequate stack height should be provided for dispersion of the emissions • Chemicals having potential to release VOCs should be stored, handled and used in closed system • Quarterly monitoring should be carried out for testing ambient air quality • Development of thick green belt of 10 m all along the industrial plot periphery

Impact	Mitigation Measures During Construction Phase	Mitigation Measures During Operation Phase
Water Pollution & water Conservation	• Minimizing the run-off from the site by construction of temporary storm water drainage, sediment basins for collection of storm run-off and re-using that water for curing purpose and wheel washing • Curing of structures to be done by spraying and during early morning and evening hours only to minimize the water requirement • Maintaining the flow of water sprinklers so as to avoid wastage of water and ponding of water • No debris should be thrown or disposed off in any water body like river, pond, canal etc or ground water source like functional or abandoned well • Excavation should not be carried out during monsoon • Excavated pits should be provided with garland drains to prevent entrance of water inside the pit • Provision of septic tanks and soak pits at the site for disposal of sewage generated by construction labour • Waste generated during construction should be disposed off regularly at the identified site for debris disposal • Stone & bricks should be purchased only from licensed vendors	• Provision of ETP & STP for treatment of sewage and industrial effluent • Provision of dual plumbing system so as treated water from STP can be re-used for flushing, horticulture and cooling purpose • Separation of the effluent streams depending on the nature of pollutants • Monitoring the quality of sewage, treated water, drinking water quality and ground water quality regularly • Tank alarms should be installed so as to prevent idle running of pumps • Provision of storm water drainage system at site and it should be connected to rain water harvesting system. Storm water drains should also be connected to the nearest surface water body to drain excess flow, if any • Provision of rain water harvesting system so that water can be collected and used to meet daily water demand. • Provision of oil & grease traps with the storm water drains draining the parking and fuel storage area • Leakage detection system should be provided and the water supply system should be regularly inspected to detect leakages • Distance of STP/ETP and RWH pits should be minimum 30 m to prevent contamination of collected storm water • Untreated effluent should not be discharged into surface water body or any abandoned ground water source or to ground. • No hazardous waste, municipal waste, industrial waste should be disposed off in the water bodies or in ground • Leachates, if any or untreated sewage should be stored only in lined ponds to prevent contamination of ground water
Soil Quality	• Top soil, if excavated from the project site should be stored in covered condition and should be used later for landscaping purpose • Storage of raw materials, debris and fuel on paved surfaces • Training the workers to handle the material so as to minimize spillage	• All industries should use best technologies for optimal utilization of the raw material and re-use & recycling of waste material in the process to reduce waste generation as well as raw material demand for the project. • All industries should be responsible

Impact	Mitigation Measures During Construction Phase	Mitigation Measures During Operation Phase
	of material on soil • Disposal of construction debris, municipal waste and hazardous waste at designated sites	for management of the solid and hazardous waste generated from their plots. Industries should be liable to pay penalty in case of non compliance of conditions laid down by DoE • It should be mandatory for all industries to provide storages for different category waste, its processing and safe disposal. Options for composting of compostable waste, segregation and selling recyclable waste should be opted • Waste storage area should be paved surfaces and covered • No open area should be left without the vegetation to protect the soil. • Haz. Waste should be disposed off through authorized vendors only. However, no TSDF and haz. waste recycling units exists in Bangladesh. But as the EZ development and coming up of industries may take time of app 3-4 years so by then haz waste rules will be formed in Bangladesh (in draft form at present) and some facilities may come up in Bangladesh for managing hazardous waste. Else all industries should incinerate the hazardous waste generated by them taking the required air pollution control measures.
Noise Pollution	• Construction vehicles, machinery and equipment used for construction purpose should meet the standards prescribed by DoE • Upkeeping and regular maintenance of all the construction vehicles, machinery and equipment used for construction purpose • Speed limits should be restricted for all construction vehicles and equipment • Honking should be prohibited at the site • Provision of acoustic enclosures, noise mufflers, silencers etc with the DG sets and any noise generating machinery • Provision of temporary noise shield/barrier in areas where more noise will be generated	• Usage of machineries of modern make and adoption of latest available technology which compiles to noise levels standards laid by DoE • Provision of personal protective equipment to workers exposed to noisy operations. Audiometric tests should be carried out for workers exposed to high noise levels. Job rotation should be practiced to prevent continual exposure. • Noise levels in industries should be monitored regularly using noise meters. • Minimal usage of horns within industrial plot. Specification of speed limits on roads made by BEZA should be followed. Provision of speed breakers at regular intervals to regulate speed of vehicles • Regular maintenance of vehicles & construction machinery involved in industrial operation

Impact	Mitigation Measures During Construction Phase	Mitigation Measures During Operation Phase
		• Noisy operation should be taken up in covered conditions so that no disturbance due to noise is caused • Thick green belt should be developed within each industrial plot that will act as noise barrier..
Ecology	• Only identified trees should be fell down after obtaining permission from forest department • Compensatory plantation should be carried out in ratio of min 1:2 under guidance of forest department • Native plant species requiring should be considered for plantation • Timber should be purchased only from authorized vendors	• Green belt of 10 m thickness should be developed all along the periphery of the industrial plot • Native plant species requiring should be considered for plantation
Socio-economy and aesthetics	• All proposed air, water, noise and soil pollution control measures should be taken • Provision of employment opportunity during construction phase to local people • Provision of personal protective equipment to all the workers • Job rotation should be practiced for workers exposed to high noise levels • Site should be covered from all the site during construction phase • Drinking water facility, adequate nos. of toilet, septic tank/soak pit, bathing facility, lighting should be provided for construction labour • Storm water drainage system should also be provide at site to prevent water ponding and breeding of mosquitoes	• Social welfare activities shall be carried out by each industrial owners in nearby areas of EZ like development of cattle sheds, arranging trainings for villagers for best agriculture practices, providing skill generation training to locals so as they can be employed in industries • Providing employment to local people preferably • Adoption of all proposed air, noise, soil and water quality measures
Disaster and Risk Management	• Provision of first aid kit and first aid room and well trained first aid practioner at the site all the time • Ambulance facility should be provided at the site • Tie-ups with local hospital should be made to handling emergency case, if any • Availability of safety officers and supervisors at all the time on the site • Workers should be given training for handling construction vehicles, equipment and handling emergency situations like fire, floods, earthquake and cyclone • Cautionary signage should be provided in the areas associated with risks like storage of explosives, fuels, heavy construction material etc. Entry for only trained	• Provision of first aid kits at the site • Tie-ups with local hospital should be made to handling emergency case, if any • Regular medical check-ups of the employees • Training should be given to workers for handling the equipment and managing emergency situations • Material safety data sheets of chemicals to be used should be displayed on local languages at work station • Provision of personal protective equipment to the workers as per requirement • Cautionary signage should be provided in the areas associated with risks like storage of chemicals, explosives, fuels etc. Entry for only

Impact	Mitigation Measures During Construction Phase	Mitigation Measures During Operation Phase
	authorized personnel should be allowed in such areas with adequate safety measures • Emergency handling cell & room should be developed at the site and should be headed by project & safety manager • Contact no. of nearest fire-station and hospitals should be displayed within the emergency handling room	trained authorized personnel should be allowed in such areas with adequate safety measures

9.4. Enhancement Plan

The proposed project involves development of EZ and off-site facilities for the upcoming Mirershorai EZ. These off-site facilities will be developed by BEZA. Development of these off-site infrastructure facilities will attract the investors and make the proposed site location more accessible for trading and business. Proximity of the proposed project site to the Chittagong Dhaka Highway and an already existing inland water transportation system further adds to the suitability of site for setting up the industries. As enhancement plan, it is proposed that BEZA should develop a thick green belt all around the EZ site, proper storm water drainage to prevent flooding and rain water harvesting system to harvest rain water and use it to meet daily water demand and reduce pressure on ground water resources. A no development zone will be developed along the Isakhali canal. This zone will be site for migratory birds during winter season.

9.5. Contingency Plan

In order to be in a state of readiness to face adverse effects of accidents, a Contingency Plan is required to be prepared which includes on-site and off-site emergency plan by the individual industry and industrial estate. BEZA is committed to develop a Contingency Plan in consultation with district authorities and industry association.

The Contingency Plan will have the following minimal components:

- Accidents preventions procedures/ measures
- Fire prevention planning and measures
- Fire water storage and foam system
- Accident/emergency response planning procedure
- Communication
- Emergency control centre
- Emergency information system with role & responsibility and command structure
- Recovery procedure
- Assessment of damages and rectification
- Evaluation of functioning of disaster management plan
- Accident investigation
- Clean-up and restoration

9.6. Compensation Plan

No families are being affected and displaced due to development of EZ & off-site facilities at present. Thus no compensation is required to be given to any person. If any, land is required to be acquired in

future then it should be done as per the law of land and resettlement action plan should be developed for that. Compensation should be given to affected people as per the RAP.

9.7. Monitoring Plan

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. A monitoring schedule has been sketched based on the environmental components that may be affected during the construction and operation of the project and is given below in table 62.

Table 62: Environmental Monitoring Plan

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
1.0	**Construction Phase**					
1.1	Local Manpower Absorption	Construction Works	Contractor's report No. of people working in the project	Monthly	Civil Contract Awardees	BEZA & PMC
1.2	Soil Erosion	Excavation, disposal, cut & fill and land clearing activities for site levelling and internal roads, disposal	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	During Rainy Season	Contractor	BEZA & PMC
1.3	Greenbelt Development	-	Survival rate of species planted; Density of vegetation	Half Yearly	Contractor/BEZA	BEZA & PMC
1.4	Air Quality	Transportation of construction materials, road construction, construction of utilities	Survey & observations; Levels of PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO	Once in each season for twice a week for two weeks at 3 locations		BEZA & PMC
1.5	Waste Management	Restoration of disposal sites and construction areas	Status of protection measures	Quarterly	Contractors	BEZA & PMC
1.6	Noise Level	Noise levels compliance with respect to industrial standards	Ambient Equivalent continuous Sound Pressure Levels (L_{eq}) at day and Night time at 6 to 8 locations	Daily	Contractors	BEZA & PMC
1.7	Drinking Water	Contamination	All physio-chemical & biological parameters	Once in month	Contractor	BEZA & PMC
2.0	**Operation Phase**					
2.1	Noise Levels	Noise levels	Ambient	Once in	Individual	BEZA & PMC

S. No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency	Executing Agency	Enforcement Agency
		compliance with respect to industrial standards	Equivalent continuous Sound Pressure Levels (L_{eq}) at day and Night time at 6 to 8 locations	every month	Industrial Units	
			Plant periphery and near noise generation sources	Monthly	Individual Industrial Units	BEZA & PMC
2.2	Biological Environment	Horticulture/ Greenbelt Development	Survival rate of plants and shrubs	Quarterly	BEZA	BEZA & PMC
			Survival rate of plants and shrubs at individual unit	Quarterly	Individual unit	BEZA & PMC
2.3	Surface & Ground Water Quality	Isakhali Canal and Feni River and bore well at site or in nearby areas. Threat due to disposal of effluents and waste by industries	Quality of surface & ground water as per standards of DoE mentioned in ECR, 1997	Quarterly	BEZA	BEZA

9.8. Monitoring Indicators

The physical, biological and social components which are of particular significance to the proposed project are listed below:

- Air quality
- Water quality
- Noise levels
- Solid & Hazardous Waste Management
- Re-plantation success / survival rate
- Soil Erosion

These indicators will evaluated periodically based on the monitoring results, baseline conditions, predicted impacts and mitigation measures.

9.9. Institutional Arrangement

BEZA has developed Environmental Management Framework with the help of World Bank. The institutional arrangement is aligned as per this framework. BEZA will have an Environmental and social cell which will coordinate with site engineers and PMC.

10. Cost Estimation for Environment Mitigation Measures and Monitoring

10.1. Environment Management Cost

Environment management cost includes the cost of mitigation measures as proposed under impact identification chapter. Most of the costs are part of construction costs. Detailed cost breakup for the project is given below in the table 63.

Table 63: Environment Management Cost of Project during Construction and Operation phase

S. No.	Environment Management Measure	Capital Cost	Recurring Cost	Responsible Institution
Construction Phase				
1.	Provision of Personal protective Equipment to all labour involved in construction of proposed off-site developments	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
2.	Construction of Labour camps	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
3.	Construction of Toilets & Septic Tanks/Soak Pits	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
4.	Construction of Temporary storm water drainage system	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
5.	Construction waste management and disposal	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
6.	Provision of clean drinking water supply	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
7.	Water sprinkling	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
8.	Environmental monitoring • Air quality • Noise level • Drinking water quality	-	0.20 Tk Mn per annum	Contractor, PMC & BEZA
9.	Safety & Quality inspections	Included in construction cost	Included in construction cost	Contractor, PMC & BEZA
10.	Environmental Training	-	0.2 Mn per annum	Contractor, PMC & BEZA
Operation Phase				
11.	Environmental monitoring • Air quality • Noise level • Ground Water Quality at Nearby Villages • Ground Water level at 4 locations (withdrawing stations & nearby area)	-	0.30 Tk Mn per annum	BEZA

11. Conclusion and Recommendation

11.1. Conclusions

EZ project has been proposed by Govt. of Bangladesh for rapid economic development in the area including the backward and undeveloped areas. BEZA, formed under EZ Act, 2010 is overall agency for implementation of EZ projects. EZ will be developed following PPP approach. This will make development less reliant on Government fiscal subsidies. BEZA will invest in land and related on-site infrastructure development so as to make zone accessible and resourceful. Thereafter economic zone development will be responsibility of private developers. Off-site facilities proposed to be developed by BEZA include development of administration building, boundary wall, site filling, construction of bund, access road, retaining wall along Isakhali canal and sluice gate on Isakhali canal.

The project subject to its nature of activities falls under Red category as per ECA, 1995 and requires prior environment clearance from DoE, Bangladesh. To obtain approval of DoEB, an Initial Environment Examination (IEE) Report for development of Economic zone along with proposed Terms of Reference (ToR) was submitted vide letter dated 04.05.2015. Site clearance certificate for the project has already been obtained from DoE. Approved ToR was granted by DoE vide Memo No. DoE/Clearance/5341/2014/201 dated 14th May, 2015. EIA study has been carried out as per the approved ToR by DoE, World Bank guidelines and EMF of PSDSP.

Upcoming EZ lies in Mirershorai Upzila. EZ site of Government land and land use is Char Land (Wetland). Site is app. 10 km distance from Chittagong Dhaka highway and is connected to highway through Abu Torab road, BWDB bund and CDSP bund. EZ site is surrounded mainly by agricultural land, aquaculture pond and water bodies. Isakhali canal traverse whole length of site and divides into three parts. Flow in Isakhali canal is controlled by sluice gate and one more sluice gate is proposed to be constructed sea side to control flow of water in Isakhali canal. Administration building will be constructed within EZ site at this stage. Other developments include construction of bund which will protect site from sea water ingress & flooding, construction of boundary wall, site filling & levelling and construction of access road. At present only above mentioned off-site facilities will be developed. Remaining infrastructure and EZ development will be carried out in later stages.

To carry out impact assessment, baseline data was collected for the site and study area through the site visits, existing studies of the area and published literature. Detailed baseline of the project site and study area is given in Chapter 5 of the report. Project site and site for proposed off-site development is flat. EZ site is devoid of vegetation whereas naturally grown/planted trees exist on the CDSP bund. Mangrove plantation forest abuts the EZ site in NW & SE direction. No land acquisition thus no resettlement & rehabilitation is involved in this project.

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 on physical setting, impacts on air quality, impacts on water resources, impacts on land and agricultural resources, impacts on fisheries, impacts on ecosystem resources, and impacts on socio-economic environment.

Key impacts anticipated for the project are increased dust emission from construction activity, generation of employment, surface water pollution and change in land use. Being infrastructure project major impacts anticipated during construction phase are generally site specific & temporary i.e. exists for short period. No significant impacts are anticipated due to off-site developments on Mangroves plantation. But impact can be significant during operation phase if pollution control measures are not adopted by industries. Bund should be constructed in such a manner that Mangrove plantation should not be affected by bund construction. Isakhali canal should be retained and drainage connection should be

provided to Mangroves in East direction of EZ site so as they do not face water deficiency. Impacts identified are largely insignificant and can be mitigated with appropriate mitigation measures.

Management plan has been prepared to address the issues identified during impact assessment. Mitigation plan for the environmental and social issues is given in Chapter-9 of the report in detail.

11.2. Recommendations

Recommendations made for the project development on the basis of EIA study are given below:

- It should not be allowed to further develop the area beyond the CDSP bund after development of the EZ else, it will completely deplete the wetland area and will lead to loss of the fragile intertidal ecosystem of the area
- Isakhali canal should be retained in its natural position, leaving 5 m no development zone in both the sides throughout the length of the canal of the portion passing through the site. Also one drain connecting Isakhali canal and Mangrove forest in East direction should be retained so as to minimize the impacted mangrove area
- Material for bund construction should be selected taking in consideration the cyclone hazard at site
- Proposed environment management plan should be implemented strictly both during operation and construction phase of the project
- Compensatory plantation should be carried out for trees to be fell (if any) for off-site development minimum in ratio of 1:2
- Suggestions & requests made by public for employment shall be taken into consideration
- Proper training of maintaining environment, health and safety should be given to Project management unit in both construction an operation phase
- Provision of garland drain, thick green belt, CETP, STP, segregated storm water shall be adhered.
- Rain water harvesting should be carried out to reduce the pressure on surface and ground water resources.
- Construction activities for proposed off-site developed should only be started after obtaining environment clearance certificate from DoE, Bangladesh
- Environmental monitoring should be conducted as proposed in environment management plan
- Separate environment impact assessment study is to be carried out by developer for whole zone before developing the EZ.
- Separate environment feasibility study should be undertaken for deep sea dredging for procuring sand for filling EZ site. At present location of dredging are not finalized so no impact assessment study has been carried out or detailed in this report due to deep sea dredging.

Annexures

Annexure-I-ToR Letter

Annexure II- Land Documents

Annexure III-Attendance Sheets of PCM

Annexure IV- EIA Team

Annexure V- Tide Table, Chittagong Port, Bangladesh

Annexure VI-Master plan

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