

**BANGLADESH ECONOMIC ZONES AUTHORITY (BEZA)
CHIEF ADVISOR'S OFFICE**

NSEZ DEVELOPMENT PROJECT (PRIDE)

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
of
National Special Economic Zone (NSEZ)
(Zone 5-7, 11-13, 16-19 & 24), Mirsharai, Chattogram



Volume II: Annexure

Prepared By



BCL Associates Limited
Consulting Engineers & Planners

October 2025

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Annex- 1: Approval of the ToR

Government of the People's Republic of Bangladesh
Department of Environment
Paribesh Bhaban, E-16, Agargaon, Sher-
E-Banglanagar, Dhaka 1207
www.doe.gov.bd

Date: 20/05/2025

Record No: 22.02.1500.207.072.038.25.1

Subject: Approval of Terms of Reference (ToR) for the EIA of the Development of Sub-zone 5-7, 11-13, 16-19 under National Special Economic Zone (NSEZ)
Reference: 22.02.1500.207.72.020.25.274; Dated: 21.04.2025

With reference to the subject mentioned above, the Department of Environment hereby gives approval of the Terms of Reference (ToR) for the Environmental Impact Assessment (EIA) of the **Development of Sub-zone 5-7, 11-13, 16-19 under National Special Economic Zone (NSEZ)** at Mirsarai, Chattogram by Khulna BEZA, subject to fulfilling the following terms and conditions:

- I. The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the ToR submitted to the Department of Environment (DoE). The EIA study shall be conducted as per the provisions laid down in the Environmental Conservation Rules, 2023.
- II. The EIA report shall be prepared in accordance with the guidelines provided in Schedule 11 and Rules 15, 16 of the ECR, 2023.
- III. Multidisciplinary experts are required in the study team to prepare the EIA report.
- IV. Consultation with Stakeholders/Public Consultation should be done in accordance with Rule 16 of the Environmental Conservation Rules, 2023.
- V. The project authority shall submit the EIA report to the Head Office of DoE in Dhaka.
- VI. Without approval of the EIA report by the Department of Environment, the project authority shall not make any land and infrastructure development.



20-05-2025
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Director, BEZA, Level 7-9, Plot # 6/B, Agargaon, Sher-E-Banglanagar, Dhaka 1207.

Record Number: 22.02.1500.207.072.038.25.1/1 (1)

Date: 20/05/2025

A Copy for has been sent consideration and necessary (if applicable) action :

1. Deputy Director, District Office, District Environment Office, Chattogram.

Annex- 2: Standards of the Environmental Quality Parameters as per ECR, 2023

i) Air Quality Standards

The air quality standards are described below following the Air Pollution (Control) Rules, 2022 and WHO standards:

Table -1: Air Quality Standards

Sl. No.	Parameters	Unit	Bangladesh Standard ^[1]	WHO standard	Standard Time (hrs.)
1	PM _{2.5}	µg/m ³	65	15	24
2	PM ₁₀	µg/m ³	150	45	24
3	SO ₂	µg/m ³	80	40	24
4	NO ₂	µg/m ³	80	25	24
5	CO	ppm	5	10	8
6	O ₃	µg/m ³	100	100	8

i) Noise Quality Standards

The noise level standards followed by Noise Pollution (Control) Rules, 2006 and IFC EHS Guidelines, 2007 which are given below:

Table 2: Level Standards

Sl. No.	Location setting (DOE/IFC)	Bangladesh Standard (dB(A)) ^[2]		IFC EHS Guideline (2007) ^[3]	
		Day	Night	Day	Night
1	Mixed Area/Commercial	60	50	70	70
2	Mixed Area/ Commercial	60	50	70	70
3	Commercial	70	60	70	70
4	Industrial/Commercial	75	70	70	70
5	Industrial/ Commercial	75	70	70	70
6	Silent/Institutional	50	40	55	45
7	Residential	55	45	55	45

iii) Surface Water Quality Standards

The surface quality standards are summarized below following the Environmental Conservation Rule (ECR) 2023, Schedule-2:

Table Error! No text of specified style in document.-2: Surface Water Quality Standards

Sl. No.	Parameters	Unit	Bangladesh Standard ^[4]
1	DO	mg/L	≥5
2	TDS	mg/L	1000
3	TSS	mg/L	-
4	EC	µS/cm	-
5	Turbidity	NTU	-
6	Ph	-	6-9
7	Salinity	ppt	-
8	COD	mg/L	50
9	BOD	mg/L	≤6
10	Mercury	mg/L	-
11	Lead	mg/L	0.1
12	Cadmium	mg/L	-

Sl. No.	Parameters	Unit	Bangladesh Standard ^[4]
13	Oil and grease	mg/L	-
14	Fecal Coliform	MPN/100ml	2.0 indicates (Absent) as per BDS Standard 1240:2021
15	Total Coliform	MPN/100ml	2.0 indicates (Absent) as per BDS Standard 1240:2021

iv) Drinking Water Quality Standards

The standards of Drinking Water Quality following the ECR 2023 are given below:

Table Error! No text of specified style in document.-3: Drinking Water Quality Standards

Sl. No.	Parameters	Unit	Bangladesh Standard ^[5]
1	TDS	mg/L	1000
2	EC	µS/cm	-
3	Turbidity	NTU	5.0
4	pH		6.5-8.5
5	Salinity	ppt	-
6	Total Hardness as CaCO ₃	mg/L	-
7	Iron	mg/L	0.3-1.0
8	Arsenic	mg/L	0.05
9	Manganese	mg/L	0.4
10	Odor	-	-
11	Fecal Coliform	MPN/100ml	2.0 indicates (Absent) as per BDS Standard 1240:2021
12	Total Coliform	MPN/100ml	2.0 indicates (Absent) as per BDS Standard 1240:2021

^[1] Air Pollution (Control) Rules, 2022

^[2] Ministry of Environment, Forest, and Climate Change. (2006). Noise Pollution (Control) Rules, 2006 (S.R.O. No. 212-Law/2006). The People's Republic of Bangladesh.

^[3] Guidelines are for noise levels measured outside. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

^[4] Bangladesh Environment Conservation Rules, 2023- Schedule 2 (Standards for Inland Surface Water, Water Usable for Fisheries).

^[5] Bangladesh Environment Conservation Rules, 2023, Schedule-2(B).

Annex- 3: Detail Environmental Baseline Condition

A. PHYSICAL ENVIRONMENTAL BASELINE

Climatic factors: Temperature, Wind, humidity, and rainfall

1. Climatological factors like temperature, wind direction, meteorology, rainfall, humidity, temperature, and natural hazards like seismicity, etc. have been considered as VCs because subproject activities have direct interactions with these factors. The project area experiences a humid subtropical climate, marked by substantial fluctuations between summer and winter temperatures. The project area falls within the South-eastern region of the country. Specifically, it is classified under the South-eastern zone (A), encompassing the Chattogram sub-region. From a climatic point of view, the project area experiences a humid subtropical climate, marked by substantial fluctuations between summer and winter temperatures. Nearby meteorological station from the project area under the Chattogram division is Sitakunda, so this station is considered for the analysis. The climate can be categorized into four distinct seasons:

- Summer/Pre-monsoon: March to May
- Rainy Season/Monsoon: June to September
- Post-Monsoon: October to November
- Winter Season: December to February

Temperature

Table 1: Monthly Average Minimum Temperature (°C) in Sitakunda Station (2015 to 2024)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2015	11.4	14.2	18.8	22.9	24.5	26.1	25.4	25.7	25.3	23.5	18.4	14.4
2016	11.9	17.7	21.4	26.6	24.9	25.8	25.6	25.8	25.8	24.2	18.6	14.9
2017	12.2	15.4	19.3	23.4	25.6	25.5	25.7	25.6	25.4	23.8	19.0	15.0
2018	12.6	17.2	21.2	23	23.8	25.7	25.7	25.8	25.5	22.4	17.1	13.5
2019	12.5	15.6	20.1	23.4	25.7	26.4	25.7	26.3	25.9	24.1	20.0	14.5
2020	***	***	***	***	***	***	***	***	***	***	***	***
2021	15	21.5	23.8	24.1	25.3	25.3	25.7	25.6	26	25.3	19.4	15.7
2022	14.1	13.9	20.3	25.8	25.3	25.9	26.3	26.3	25.7	24.1	19.3	14.7
2023	10.5	11.0	14.0	19.1	21.0	23.5	25.5	24.0	23.5	18.8	15.6	12.0
2024	9.0	10.6	11.5	20.5	19.0	22.5	24.6	24.0	24.6	22.5	15.0	11.1
Average of 10 Years	12.13	15.23	18.93	23.20	23.90	25.19	25.58	25.46	25.30	23.19	18.04	13.98

Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda) (Note: *** means data missing)

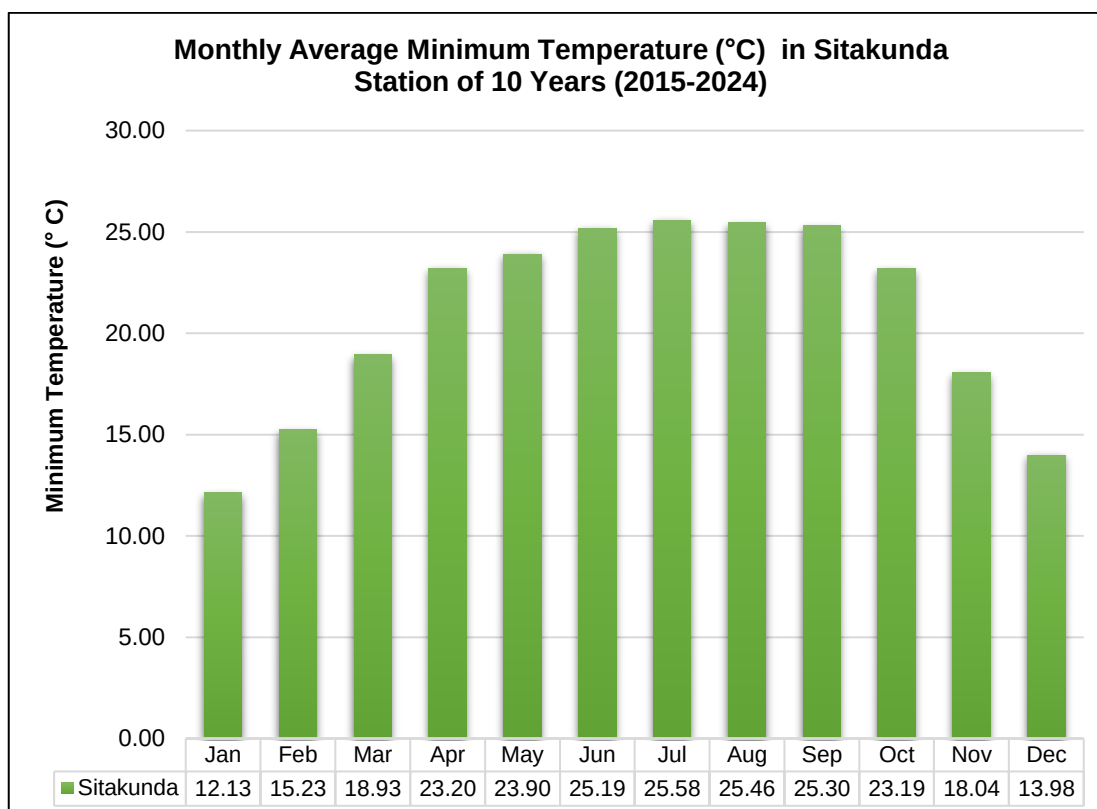


Figure 1: Monthly Average Minimum Temperature (°C) in Sitakunda Station
Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda)

Table 2: Monthly Average Maximum Temperature (°C) in Sitakunda Station (2015 to 2024)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2015	25.8	27.7	30.8	31.5	32.7	31.5	29.7	34.7	31.7	31.3	29.9	26.6
2016	26.4	30.2	32.9	32.8	33.5	32.7	30.9	31.6	32.9	32.7	29.9	29.2
2017	28.5	30.9	30.3	31.4	34.2	31.9	30.6	31.4	32	32.4	31.7	28.2
2018	25.8	29.3	31.7	33.5	31.9	31.6	31.8	32.5	33.1	31.3	31	27.8
2019	27.9	28.7	31.3	33.4	33.4	33	31.5	32.6	32.1	32.1	30.6	25.8
2020	***	***	***	***	***	***	***	***	***	***	***	***
2021	29.5	33.1	34	34.3	33.9	31	32	31.7	32.8	33.2	31.3	28
2022	26.4	28.4	33.4	32.6	32.6	31.5	33.3	33.3	32.5	33.2	32	29.2
2023	31.5	33.8	37.0	37.6	37.0	37.0	36.0	35.0	37.2	36.0	35.8	32.1
2024	29.5	33.0	36.1	39.7	39.1	36.0	36.0	35.2	38.2	35.0	34.8	33.0
Average of 10 Years	27.92	30.57	33.06	34.09	34.26	32.91	32.42	33.11	33.61	33.02	31.89	28.88

Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda) (Note: *** means data missing)

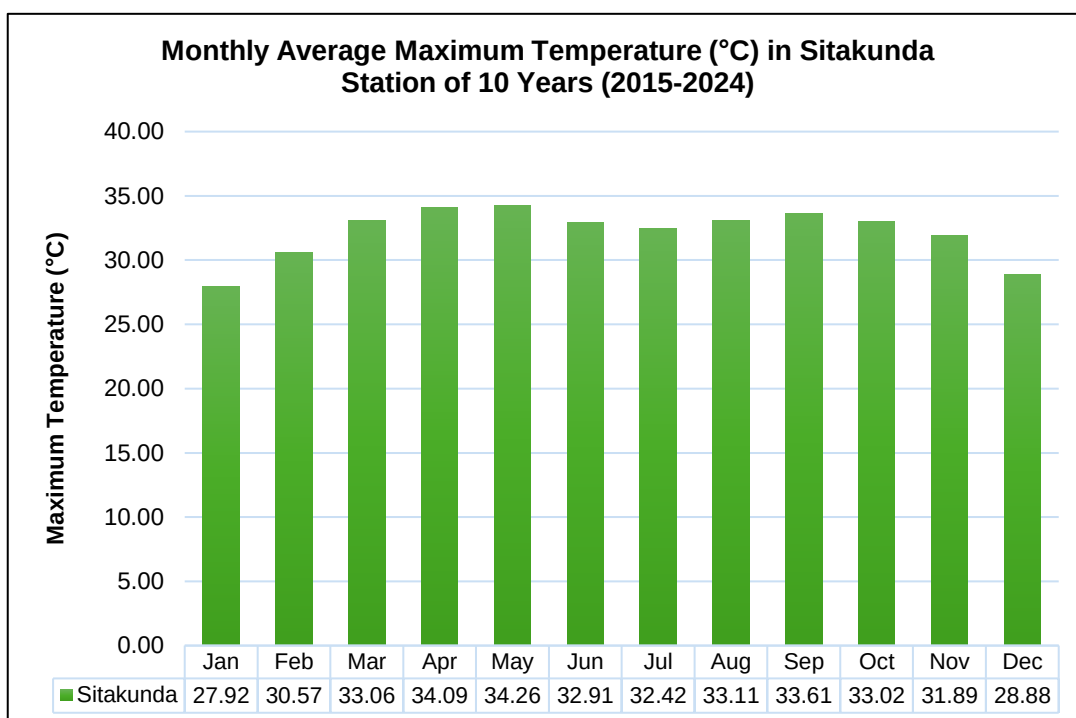


Figure 2: Monthly Average Maximum Temperature (°C) in Sitakunda Station
Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda)

2. During the environmental baseline monitoring in the subproject area, the air temperature, relative humidity, air pressure, wind speed, and direction have also been monitored at ambient air quality measurement locations as shown in the table below to understand the current climatic situation of the study area. There is no such kind of standard in Bangladesh for climatic variables. However, the study showed that the air temperature ranges between 23.30 and 34.12°C. The relative humidity is mostly dependent on the temperature and the air vapor. The monitoring data showed reasonable relative humidity during summer. Air pressure in the study area varied from 1001.56 to 1014.15 hPa, which is indicative of the previously recorded air pressure (BMD Database 2015-2024) of the respective locations on summer days.

Table 3: Air temperature, air Pressure, and wind monitoring results

Sl. No.	Monitoring Station Code	Air Temperature (°C)	Relative Humidity (%)	Air Pressure (hPa)	Wind Speed (ms ⁻¹)	Wind Direction (Degree)
1	AAQ1	29.94	46.72	1013.98	2.28	106.57 (ESE)
2	AAQ2	30.14	53.43	1011.41	1.11	106.81 (ESE)
3	AAQ3	32.66	63.84	1001.56	1.06	48.27 (NE)
4	AAQ4	23.30	79.31	1012.11	0.06	286.04 (WNW)
5	AAQ5	23.98	61.68	1012.01	0.21	236.78 (WSW)
6	AAQ6	28.78	54.77	1011.30	1.10	106.81 (ESE)
7	AAQ7	34.12	45.20	1014.15	2.72	105.51 (E)
8	AAQ8	33.12	40.20	1012.15	2.22	100.51 (E)

Source: Primary Data Collection by the Environment Team of Field Survey by BCL Associates Limited, December, 2023

Rainfall

Table 4: Monthly Total Rainfall (mm) in Sitakunda Station (2015 to 2024)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2015	3	0	41	149	190	750	1324	685	438	214	3	5
2016	3	56	140	14	336	337	771	493	312	247	102	0
2017	0	0	113	291	261	940	1316	812	790	173	1	41

Table 4: Monthly Total Rainfall (mm) in Sitakunda Station (2015 to 2024)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	18	0	0	259	270	1158	1087	444	157	227	0	3
2019	18	37	40	199	274	226	1589	420	337	151	117	14
2020	***	***	***	***	***	***	***	***	***	***	***	***
2021	0	0	0	0	94	1051	587	656	211	129	0	66
2022	6	24	6	79	439	743	197	123	535	147	0	50
2023	0	0	132	85	139	473	192	1249	322	100	12	0
2024	2	0	10	41	300	343	742	1517	229	132	1	0
Average of 10 Years	5.6	13	53.6	124.1	255.9	669.0	867.2	711.0	370.1	168.9	26.2	19.9

Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda) (Note: *** means data missing)

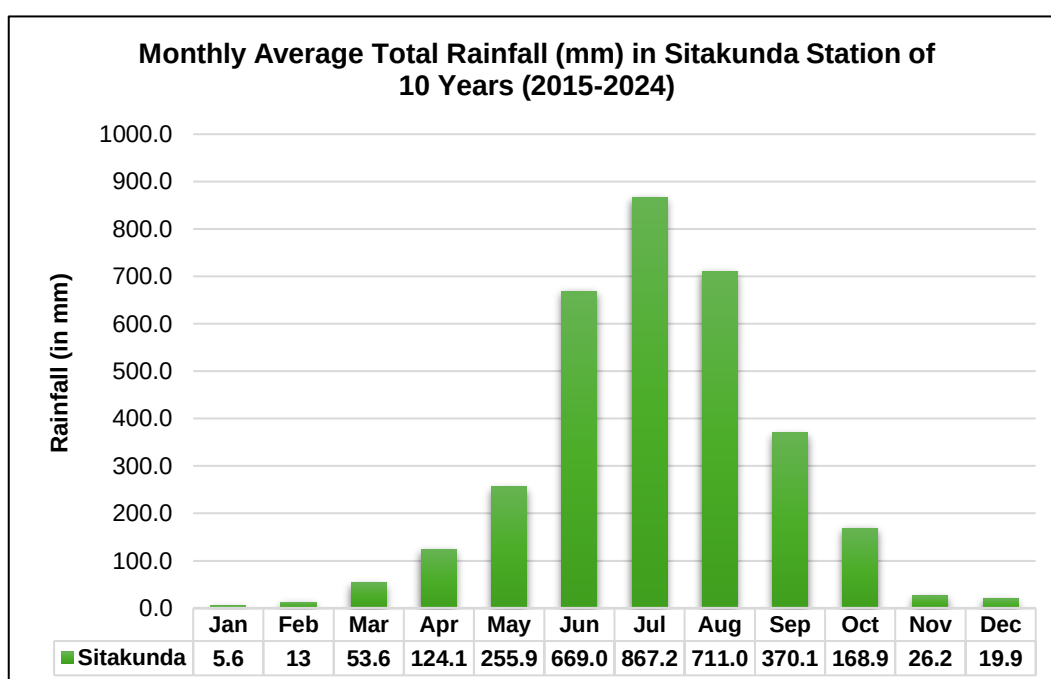


Figure 3: Monthly Average Total Rainfall (mm) in Sitakunda Station

Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda)

3. The data shows that the rainy season in the project area prevails mainly from May to September. Like other coastal regions of the country, the monsoon season is very important in this region.

Relative Humidity

Table 5: Monthly Average Normal Relative Humidity (%) in Sitakunda Station (2022 to 2024)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2022	75	72	74	78	81	85	87	86	85	83	80	78
2023	60	62	62	65	66	72	71	76	71	70	66	65
2024	65	59	59	63	73	79	78	81	70	70	74	68
Average of 3 Years	66.7	64.3	65.0	68.7	73.3	78.7	78.7	81.0	75.3	74.3	73.3	70.3

Source: BMD & BBS-Statistical Yearbook 2022 to 2024 (Station: Sitakunda) (Note: *** means data missing)

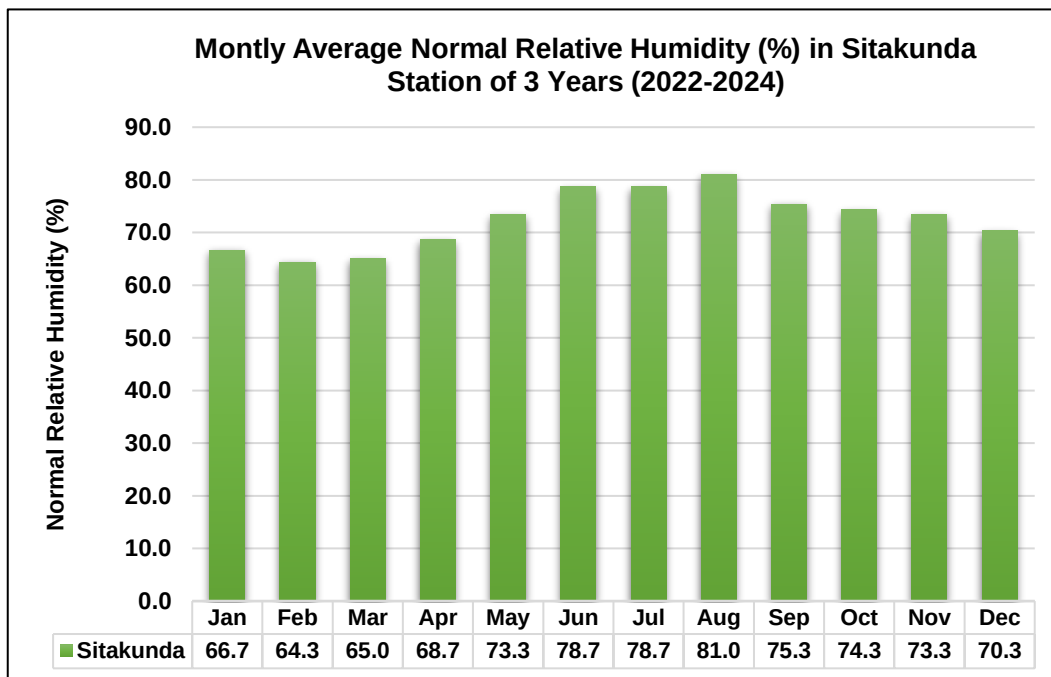
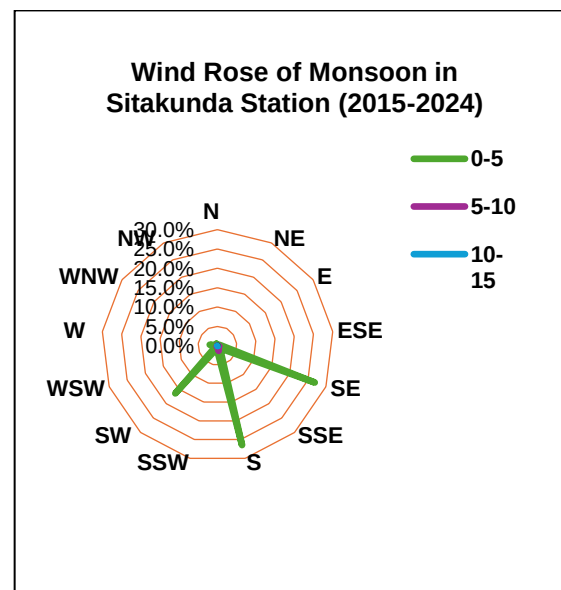
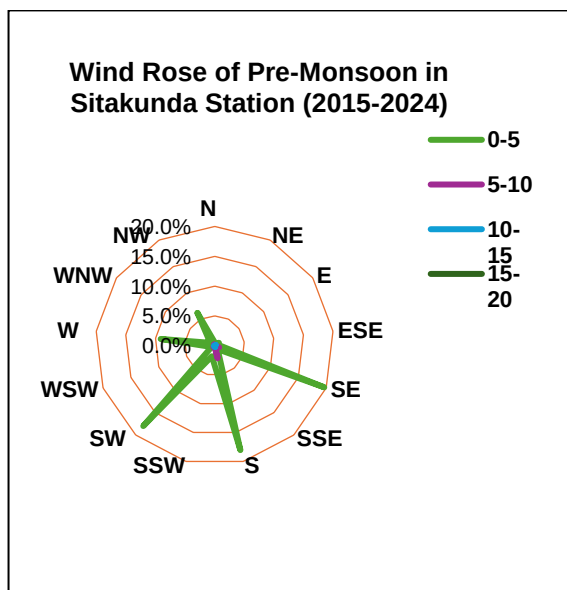


Figure-4 Monthly Average Normal Relative Humidity (%) in Sitakunda Station
Source: BMD & BBS-Statistical Yearbook 2015 to 2024 (Station: Sitakunda)

Wind Speed



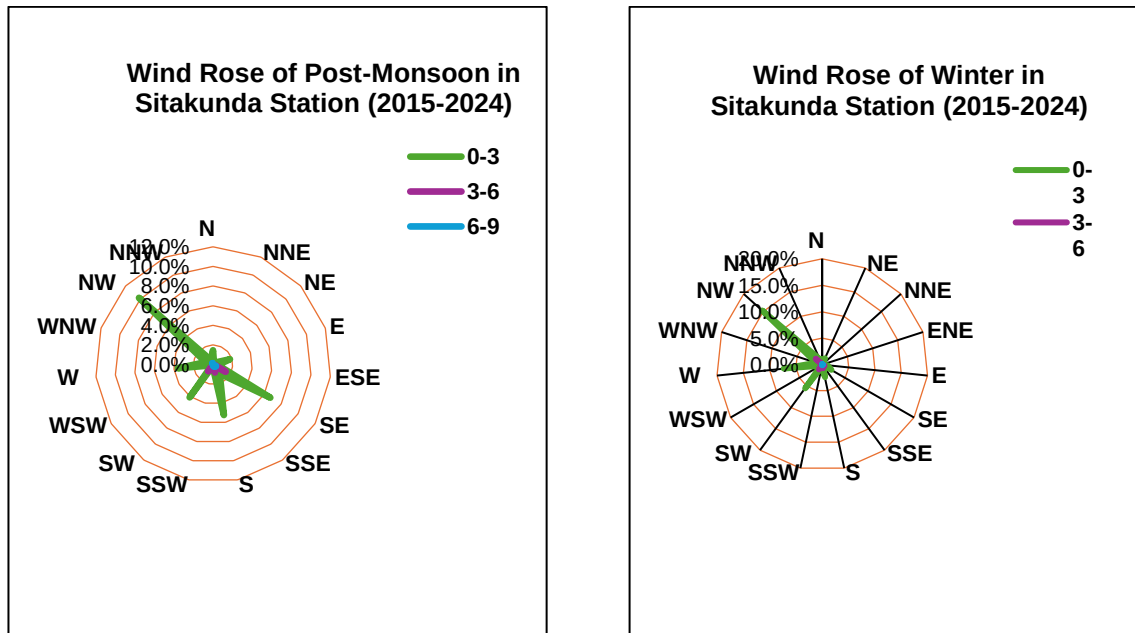
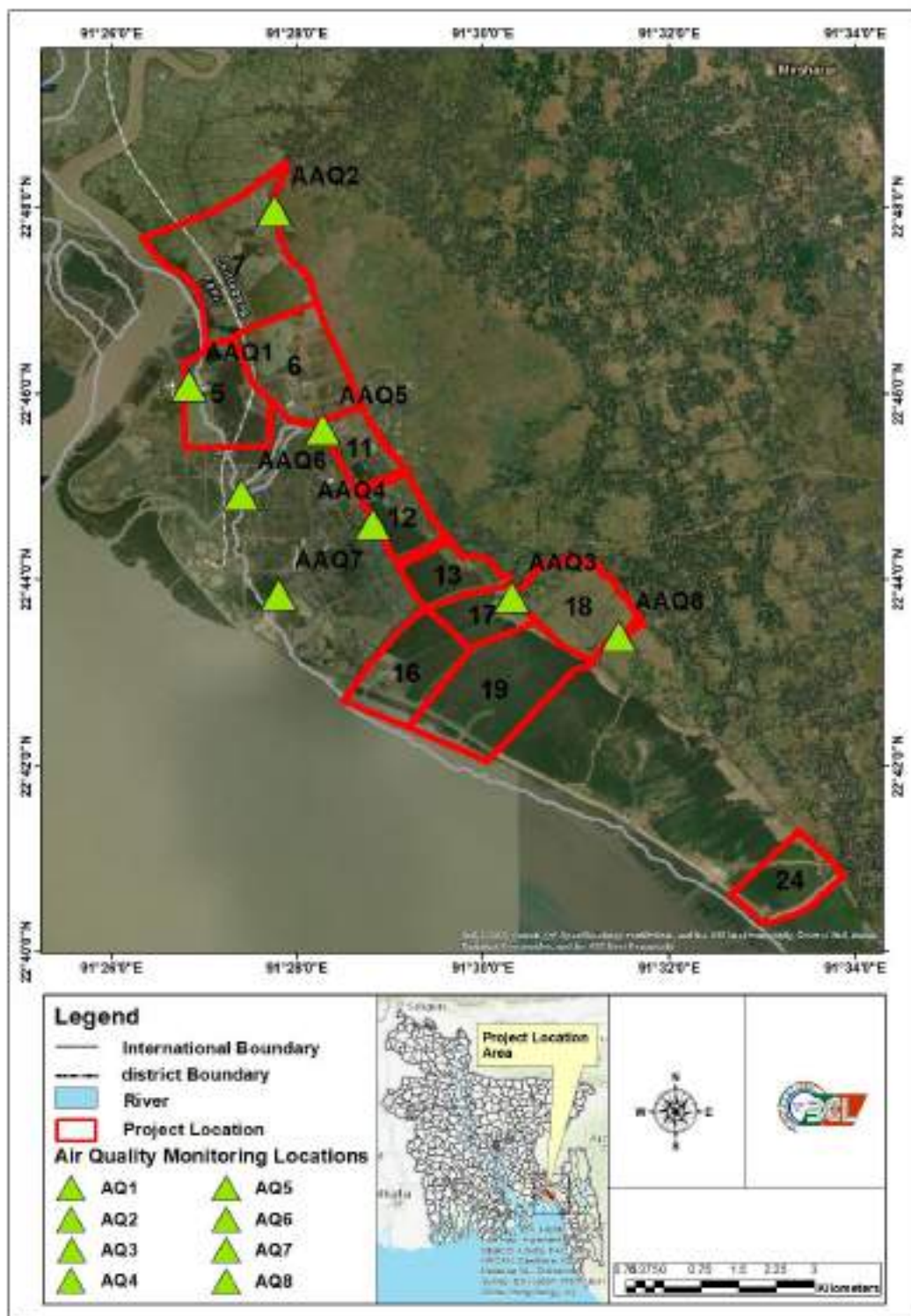


Figure 5: Seasonal Variation of Wind Rose in Sitakunda Station during the Years of 2015-2024
Units: m/s & Source: Sitakunda Meteorological Station, Bangladesh Meteorological Department (BMD), (2015-2024)

Ambient Air Quality Measurement During Summer Season



Map 1: Ambient Air Quality Measurements Location Map

Table 6: Ambient Air Quality Measurement Locations

SN.	Location Name	Station ID	Latitude	Longitude
1.	Adjacent to CP Mor	AQ1	22°43'46.55"N	91°30'21.17"E
2.	East side of the project location, Daborkhali Point	AQ2	22°44'29.00"N	91°29'36.00"E
3.	Ichakhali Sluice gate Bazar	AQ3	22°45'45.79"N	91°28'46.02"E
4.	Adjacent to the main road, Bodiullah Para Bazar	AQ4	22°44'25.81"N	91°31'7.90"E
5.	Charsarat Village	AQ5	22°45'2.00"N	91°30'18.00"E
6.	Charsarat Village	AQ6	22°46'39.47"N	91°29'50.97"E
7.	In front of Nippon and McDonald Steel Industries limited	AQ7	22°46'7.79"N	91°26'48.35"E
8.	Dakshin Magadia	AQ8	22°72'30.38"N	91°52'44.81"E

Source: Field Data collection by BCL Associates Limited, December 2023 and August 2025

Table 7: Summary of Ambient Air Quality Monitoring Results

Ambient Air Quality Measurement Results During Winter						
Station Code	PM _{2.5}	PM ₁₀	SO ₂	NO ₂	CO	O ₃
	µg/m ³	µg/m ³	µg/m ³	µg/m ³	ppm	µg/m ³
AQ1	7.93	17.50	274.47	10.26	0.80	8.79
AQ2	10.95	15.22	387.44	7.22	0.52	24.11
AQ3	10.47	13.07	273.75	18.36	0.72	24.11
AQ4	26.65	33.61	225.32	11.90	0.59	50.83
AQ5	18.37	30.27	90.54	8.75	0.50	15.15
AQ6	7.55	16.06	384.89	10.34	0.55	13.99
AQ7	20.61	32.75	268.74	2.48	0.82	37.34
AQ8	19.62	30.26	255.06	1.68	0.63	36.01
Duration (hours)	24	24	24	24	8	8
Weather	Sunny					
Ambient Air Quality Measurement Results During Monsoon						
AAQ1	9.2	16.5	41.3	22.36	0.43	14.72
AAQ2	9.9	19.2	30.5	15.97	0.29	9.97
AAQ3	8.97	23.8	39.3	19.78	0.29	26.92
AAQ4	9.09	20.5	33.5	27.66	0.42	27.3
AAQ5	10.6	22.1	29.8	17.35	0.18	27.36
AAQ6	8.76	19.2	28.6	22.34	0.42	25
AAQ7	7.33	18.7	42.8	24.28	0.24	37.8
AAQ8	9.42	23.8	28.9	17.04	0.25	29.47
Weather	Cloudy					
Bangladesh Standard ¹	65	150	80	80	5	100
WHO Standard ²	15	45	40	25	10	100

Source: Field Measurement and Laboratory Analysis by BCL Associates Limited

METHODOLOGY

4. The AQM-09 Air Quality Monitoring System machine was used to gather data on ambient air quality, encompassing Oxides of Nitrogen (NO_x), O₃ (Ozone), Carbon Monoxide (CO), Sulfur Dioxide (SO₂), as well as Particulate Matter (PM₁₀ and PM_{2.5}). Sampling and analysis of ambient air quality adhered to the guidelines set forth by the United States Environmental Protection Agency (USEPA). The monitoring device captures a reading every minute, automatically storing the data in its memory for subsequent retrieval. The assessment of ambient air quality was carried out by the recommendations of the United States Environmental Protection Agency (USEPA).

¹ Air Pollution (Control) Rules, 2022

² WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines

Table 8: Air Quality Monitoring System

Parameter	Machine	Methods of Testing	Sensors
PM _{2.5}	AQM-09	On-Site Recording	Light Scattering Technique
PM ₁₀	AQM-09	On-Site Recording	Light Scattering Technique
Nitrogen di oxide	AQM-09	On-Site Recording	High Sensitivity Electrochemical
Sulfur dioxide (SO ₂)	AQM-09	On-Site Recording	High Sensitivity Electrochemical
Carbon monoxide (CO)	AQM-09	On-Site Recording	High Sensitivity Electrochemical

5. Following national and international standards, Carbon Monoxide (CO) monitoring was conducted over an 8-hour period for comparison with the specified standard. Conversely, the standard duration for PM₁₀, PM_{2.5}, SO₂, and NO₂ was set at 24 hours. To align the data with the standard time frame, a conversion equation was applied. Numerous agencies, including the New York State Dept of Environmental Conservation, California Office of Environmental Health Hazards Assessment, USEPA, and Ontario Ministry of Environment, utilize a conversion process based on Pasqual's (1961) air mass dispersion tables. These tables define six air mass stability classes and corresponding meteorological conditions. Schroeder and Jugloff (2012) outlined a conversion approach using the simple power law to transform eight-hour readings into 24-hour/annual values. The stability classes are correlated with average wind speed, daytime solar radiation, and night-time cloud cover, with further refinement of these relationships developed by Pasquill.

Table 9: Meteorological Conditions Used to Define the Stability Classes

Stability Class	P	Definition
A	0.5	Very Unstable
B	0.5	Unstable
C	0.333	Slightly Unstable
D	0.2	Neutral
E	0.167	Slightly Stable
F	0.167	Stable

Source: Julie Schroeder and Denis Jugloff (2012), Interpretation of 24-hour sampling data: Development of 24-hour ambient air quality criteria and their use in Ontario, Human Toxicology & Air Standards Section, Standards Development Branch, Ontario Ministry of the Environment, Toronto, ON, Canada

Table 10: The average wind speed in all air quality survey locations

Surface Wind Speed	Day Time Incoming Solar Radiation	Nighttime Cloud Cover	Surface Wind Speed	Day Time Incoming Solar Radiation	Nighttime Cloud Cover
m/s	Strong	Moderate	Slight	>50%	<50%
<2	A	A-B	B	E	F
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D
m/s	Strong	Moderate	Slight	>50%	<50%

6. The average wind speed in all air quality survey locations is less than 2 m/s. Therefore, taking the simple average of these three values from **Table 9** and **Table 10**, the Project stability class was calculated as 0.39 (see below).

$$P = 0.5 + 0.5 + \frac{0.167}{3} = 0.389 \approx 0.39$$

7. This suggests a somewhat unstable air mass, resulting in considerable dilution of an Eight-hour sample when spread out over a 24-hour period. In order to provide 24-hour averages for SO₂, PM_{2.5}, and PM₁₀ parameters, the following power-law equation, as defined in Schroeder and Jugloff was applied:

$$C_{\text{long}} = C_{\text{short}} (t_{\text{short}}/t_{\text{long}})^P$$

Where,

C_{long} = Expected output in a specific time

C_{short} = Outcome during Monitoring Period

t_{short} = Specific time period during monitoring (in minutes)

t_{long} = Expected time period (in minutes)

p = Exponential factor where the value is 0.39

Photographs of the Ambient Air Quality Monitoring



AAQ1 (Adjacent to CP Mor)



AAQ2 (East side of the project location, Daborkhali Point)



AAQ3 (Ichakhali Sluice gate Bazar)



AAQ4 (Adjacent to the main road, Bodiullah Para Bazar)



AAQ5 (Charsarat Village)



AAQ6 (Charsarat Village)



AAQ7 (In front of Nippon and McDonald Steel Industries Limited, NSEZ)



AAQ8 (Baitur Rahman Panjegan Mosque, West Ichakhali, Jorarganj, Mirsharai, Chattogram)

Air Quality Test Methodology of Lab Results Sheet

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) Zone 5-7, 11-13, 16-19 & 24 Maldives, Changam.

Activities: Ambient Air Quality Monitoring

Sampling ID and Location: AQZ-1, Located at CP Mal Maldives, MD 204

Field Officer/Manager: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Monitoring/Sampling Date: 01.11.2023

Reporting Date: 12.01.2024

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentration (µg/m³)						CO (ppm)	CO ₂ (ppm)
			PM ₁₀	PM _{2.5}	SO ₂	NO ₂	O ₃	NO _x		
Ambient	01.11.2023 11:00:00 AM	04 55 55.00N 74 35 35.00E	7.00	11.00	215.47	10.00	4.70	1.00	100.00	
Background Standard			50	150	50	50	100	5	-	
WHO Standard			50	150	50	50	100	5	-	
Method			High Sensitivity Environmental							

Notes: Temperature at Sampling Location: 28.00°C
 "WHO Standard Air Quality Guidelines (AQG)" which are also being referred in the report sheet and WHO's Guidelines for Air Quality.
 PM₁₀: Particulate Matter of a diameter of 10 microns or less, PM_{2.5}: Particulate Matter of a diameter of 2.5 microns or less, NO_x: Nitrogen Dioxide, SO₂: Sulphur Dioxide, O₃: Ozone, CO: Carbon Monoxide, CO₂: Carbon Dioxide.

Micro-Meteorological Monitoring Results:

Parameter	At Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	km/h	Direction
Observation	28.00	68.00	1013.00	2.40	140.00 (SW)

Analysed By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Approved By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Stamp: BCL ASSOCIATES LIMITED

QR Code:

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) Zone 5-7, 11-13, 16-19 & 24 Maldives, Changam.

Activities: Ambient Air Quality Monitoring

Sampling ID and Location: AQZ-1, Located at CP Mal Maldives, MD 204

Field Officer/Manager: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Monitoring/Sampling Date: 01.11.2023

Reporting Date: 12.01.2024

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentration (µg/m³)						CO (ppm)	CO ₂ (ppm)
			PM ₁₀	PM _{2.5}	SO ₂	NO ₂	O ₃	NO _x		
Ambient	01.11.2023 11:00:00 AM	04 55 55.00N 74 35 35.00E	7.00	11.00	215.47	10.00	4.70	1.00	100.00	
Background Standard			50	150	50	50	100	5	-	
WHO Standard			50	150	50	50	100	5	-	
Method			High Sensitivity Environmental							

Notes: Temperature at Sampling Location: 28.00°C
 "WHO Standard Air Quality Guidelines (AQG)" which are also being referred in the report sheet and WHO's Guidelines for Air Quality.
 PM₁₀: Particulate Matter of a diameter of 10 microns or less, PM_{2.5}: Particulate Matter of a diameter of 2.5 microns or less, NO_x: Nitrogen Dioxide, SO₂: Sulphur Dioxide, O₃: Ozone, CO: Carbon Monoxide, CO₂: Carbon Dioxide.

Micro-Meteorological Monitoring Results:

Parameter	At Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	km/h	Direction
Observation	28.00	68.00	1013.00	2.40	140.00 (SW)

Analysed By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Approved By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

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BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) Zone 5-7, 11-13, 16-19 & 24 Maldives, Changam.

Activities: Ambient Air Quality Monitoring

Sampling ID and Location: AQZ-1, Located at CP Mal Maldives, MD 204

Field Officer/Manager: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Monitoring/Sampling Date: 01.11.2023

Reporting Date: 12.01.2024

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentration (µg/m³)						CO (ppm)	CO ₂ (ppm)
			PM ₁₀	PM _{2.5}	SO ₂	NO ₂	O ₃	NO _x		
Ambient	01.11.2023 11:00:00 AM	04 55 55.00N 74 35 35.00E	7.00	11.00	215.47	10.00	4.70	1.00	100.00	
Background Standard			50	150	50	50	100	5	-	
WHO Standard			50	150	50	50	100	5	-	
Method			High Sensitivity Environmental							

Notes: Temperature at Sampling Location: 28.00°C
 "WHO Standard Air Quality Guidelines (AQG)" which are also being referred in the report sheet and WHO's Guidelines for Air Quality.
 PM₁₀: Particulate Matter of a diameter of 10 microns or less, PM_{2.5}: Particulate Matter of a diameter of 2.5 microns or less, NO_x: Nitrogen Dioxide, SO₂: Sulphur Dioxide, O₃: Ozone, CO: Carbon Monoxide, CO₂: Carbon Dioxide.

Micro-Meteorological Monitoring Results:

Parameter	At Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	km/h	Direction
Observation	28.00	68.00	1013.00	2.40	140.00 (SW)

Analysed By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Approved By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Stamp: BCL ASSOCIATES LIMITED

QR Code:

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) Zone 5-7, 11-13, 16-19 & 24 Maldives, Changam.

Activities: Ambient Air Quality Monitoring

Sampling ID and Location: AQZ-1, Located at CP Mal Maldives, MD 204

Field Officer/Manager: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Monitoring/Sampling Date: 01.11.2023

Reporting Date: 12.01.2024

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentration (µg/m³)						CO (ppm)	CO ₂ (ppm)
			PM ₁₀	PM _{2.5}	SO ₂	NO ₂	O ₃	NO _x		
Ambient	01.11.2023 11:00:00 AM	04 55 55.00N 74 35 35.00E	7.00	11.00	215.47	10.00	4.70	1.00	100.00	
Background Standard			50	150	50	50	100	5	-	
WHO Standard			50	150	50	50	100	5	-	
Method			High Sensitivity Environmental							

Notes: Temperature at Sampling Location: 28.00°C
 "WHO Standard Air Quality Guidelines (AQG)" which are also being referred in the report sheet and WHO's Guidelines for Air Quality.
 PM₁₀: Particulate Matter of a diameter of 10 microns or less, PM_{2.5}: Particulate Matter of a diameter of 2.5 microns or less, NO_x: Nitrogen Dioxide, SO₂: Sulphur Dioxide, O₃: Ozone, CO: Carbon Monoxide, CO₂: Carbon Dioxide.

Micro-Meteorological Monitoring Results:

Parameter	At Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	km/h	Direction
Observation	28.00	68.00	1013.00	2.40	140.00 (SW)

Analysed By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Approved By: Mr. Mustafiz Rahman, Environmental, BCL, Associated Limited

Stamp: BCL ASSOCIATES LIMITED

QR Code:

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annex- 3: Detail Environmental Baseline Condition

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) along S-7, S-11, S-12 & S-13, Islamabad, Islamabad.

Activities: Ambient Air Quality Monitoring

Sampling Site and Location: AQM1, Islamabad Village

Field Officer/Manager: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Monitoring/Sampling Date: 11.12.2023

Reporting Date: 12.12.2023

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m³)						CO (ppm)	SO₂ (ppm)
			PM₁₀	PM₂.₅	NOₓ	NO₂	O₃	SO₂		
AQM1	11.12.2023 11:30:00 AM	33°45'45"N 73°12'15"E	100	50	40	10	10	10	10	10
Background Standard			50	25	20	5	5	5	5	5
WHO Standard			70	35	40	20	10	10	10	10
Methods:			1. SST Sampling Equipment High Sensitivity Measurement							

Notes: Temperature of ambient air (30°C), Humidity (65%), Wind Speed (1.5 m/s) and Wind Direction (SE) were recorded. The results of the monitoring are within the limits of the WHO Standard and the National Ambient Air Quality Standard (NAAQS) for Islamabad.

Other Meteorological Monitoring Results:

Parameter	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	m/s	Direction
Concentration	30.0	65.0	1013.0	1.5	SE

Analysed By: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Approved By: Dr. Hafiz Anwar, Director, Environmental and Environmental Engineering, BCL Associates Limited

Stamp: BCL Associates Limited, Environmental and Environmental Engineering, Islamabad

QR Code: [QR Code]

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) along S-7, S-11, S-12 & S-13, Islamabad, Islamabad.

Activities: Ambient Air Quality Monitoring

Sampling Site and Location: AQM2, Islamabad Village

Field Officer/Manager: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Monitoring/Sampling Date: 11.12.2023

Reporting Date: 12.12.2023

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m³)						CO (ppm)	SO₂ (ppm)
			PM₁₀	PM₂.₅	NOₓ	NO₂	O₃	SO₂		
AQM2	11.12.2023 11:30:00 AM	33°45'45"N 73°12'15"E	100	50	40	10	10	10	10	10
Background Standard			50	25	20	5	5	5	5	5
WHO Standard			70	35	40	20	10	10	10	10
Methods:			1. SST Sampling Equipment High Sensitivity Measurement							

Notes: Temperature of ambient air (30°C), Humidity (65%), Wind Speed (1.5 m/s) and Wind Direction (SE) were recorded. The results of the monitoring are within the limits of the WHO Standard and the National Ambient Air Quality Standard (NAAQS) for Islamabad.

Other Meteorological Monitoring Results:

Parameter	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	m/s	Direction
Concentration	30.0	65.0	1013.0	1.5	SE

Analysed By: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Approved By: Dr. Hafiz Anwar, Director, Environmental and Environmental Engineering, BCL Associates Limited

Stamp: BCL Associates Limited, Environmental and Environmental Engineering, Islamabad

QR Code: [QR Code]

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) along S-7, S-11, S-12 & S-13, Islamabad, Islamabad.

Activities: Ambient Air Quality Monitoring

Sampling Site and Location: AQM3, Islamabad Village

Field Officer/Manager: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Monitoring/Sampling Date: 11.12.2023

Reporting Date: 12.12.2023

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m³)						CO (ppm)	SO₂ (ppm)
			PM₁₀	PM₂.₅	NOₓ	NO₂	O₃	SO₂		
AQM3	11.12.2023 11:30:00 AM	33°45'45"N 73°12'15"E	100	50	40	10	10	10	10	10
Background Standard			50	25	20	5	5	5	5	5
WHO Standard			70	35	40	20	10	10	10	10
Methods:			1. SST Sampling Equipment High Sensitivity Measurement							

Notes: Temperature of ambient air (30°C), Humidity (65%), Wind Speed (1.5 m/s) and Wind Direction (SE) were recorded. The results of the monitoring are within the limits of the WHO Standard and the National Ambient Air Quality Standard (NAAQS) for Islamabad.

Other Meteorological Monitoring Results:

Parameter	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	m/s	Direction
Concentration	30.0	65.0	1013.0	1.5	SE

Analysed By: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Approved By: Dr. Hafiz Anwar, Director, Environmental and Environmental Engineering, BCL Associates Limited

Stamp: BCL Associates Limited, Environmental and Environmental Engineering, Islamabad

QR Code: [QR Code]

BCL ASSOCIATES LIMITED
Ambient Air Quality Monitoring Report

Project Name: Environmental Impact Assessment (EIA) of National Special Economic Zone (NSEZ) along S-7, S-11, S-12 & S-13, Islamabad, Islamabad.

Activities: Ambient Air Quality Monitoring

Sampling Site and Location: AQM4, Islamabad Village

Field Officer/Manager: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Monitoring/Sampling Date: 11.12.2023

Reporting Date: 12.12.2023

Description of Results:

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m³)						CO (ppm)	SO₂ (ppm)
			PM₁₀	PM₂.₅	NOₓ	NO₂	O₃	SO₂		
AQM4	11.12.2023 11:30:00 AM	33°45'45"N 73°12'15"E	100	50	40	10	10	10	10	10
Background Standard			50	25	20	5	5	5	5	5
WHO Standard			70	35	40	20	10	10	10	10
Methods:			1. SST Sampling Equipment High Sensitivity Measurement							

Notes: Temperature of ambient air (30°C), Humidity (65%), Wind Speed (1.5 m/s) and Wind Direction (SE) were recorded. The results of the monitoring are within the limits of the WHO Standard and the National Ambient Air Quality Standard (NAAQS) for Islamabad.

Other Meteorological Monitoring Results:

Parameter	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	°C	%	hPa	m/s	Direction
Concentration	30.0	65.0	1013.0	1.5	SE

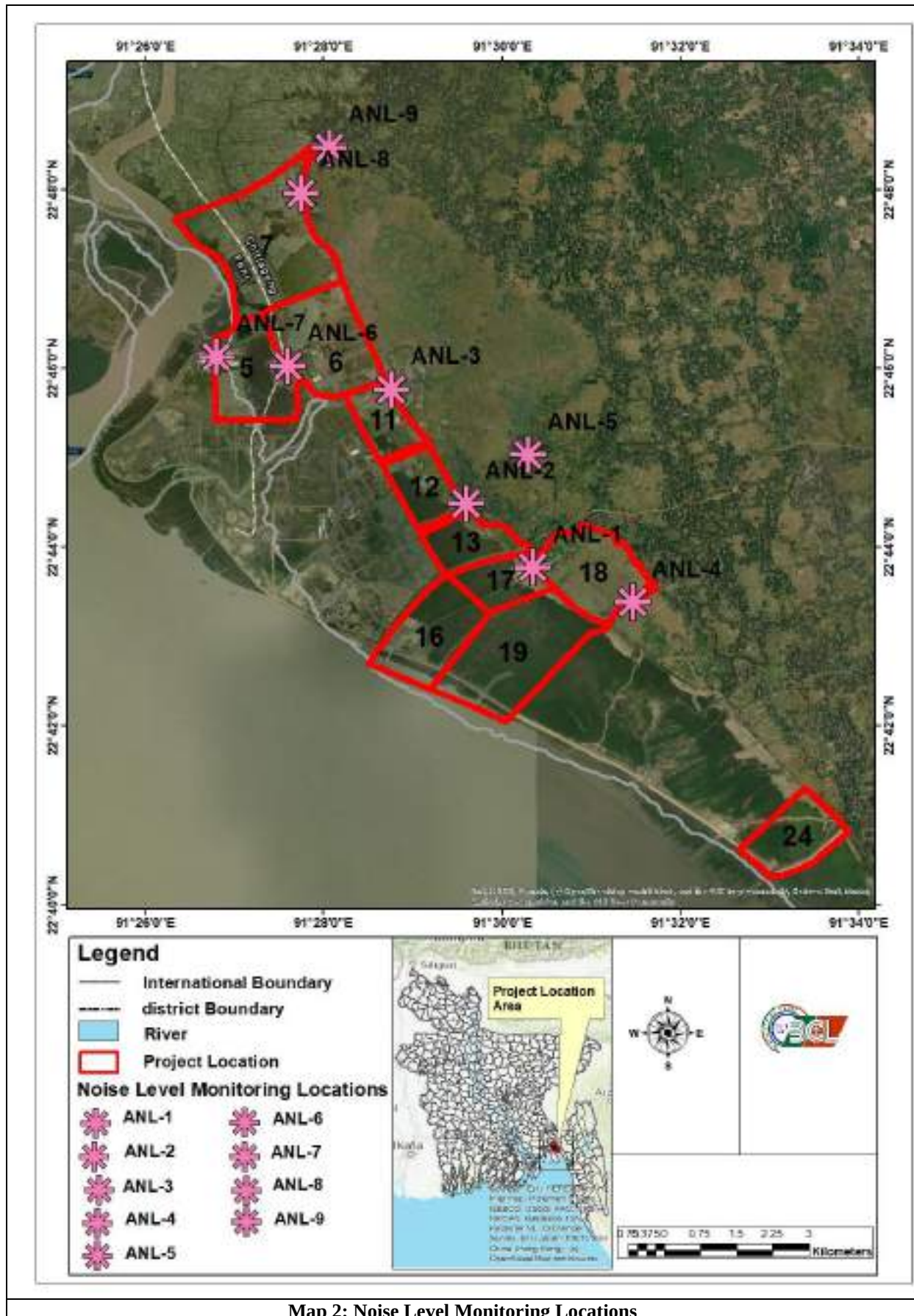
Analysed By: Mr. Mushtaq Rahman, Environmental, BCL Associates Limited

Approved By: Dr. Hafiz Anwar, Director, Environmental and Environmental Engineering, BCL Associates Limited

Stamp: BCL Associates Limited, Environmental and Environmental Engineering, Islamabad

QR Code: [QR Code]

Ambient Noise Level



Map 2: Noise Level Monitoring Locations

Table 11: Ambient Noise Level Monitoring Locations

SN	Code	Location	Geographic location	Location setting (DOE/IFC)
1.	ANL1	Adjacent to CP Mor, Ichakhali	22°43'46.55"N 91°30'21.17"E	Mixed Area/Commercial
2.	ANL2	East side of the project location, Daborkhali Point, Ichakhali	22°44'29.00"N 91°29'36.00"E	Mixed Area/Commercial
3.	ANL3	Ichakhali Sluice gate Bazar, Ichakhali	22°45'45.79"N 91°28'46.02"E	Commercial
4.	ANL4	Adjacent to the main road, Dakshin Maghadia	22°72'30.38"N 91°52'40.32"E	Silent/Institutional
5.	ANL5	In front of Abdul Kader Mia House, Charsarat	22°45'2.00"N 91°30'18.00"E	Residential
6.	ANL6	In front of BR Powergen	22°46'1.57"N 91°27'36.74"E	Industrial
7.	ANL7	In front of Nippon and McDonald Steel Industries limited	22°46'7.76"N 91°26'48.45"E	Industrial
8.	ANL8	Baitur Rahman Panjegana Mosque	22°47'57.69"N 91°27'45.01"E	Mixed Area
9.	ANL9	Tekerhat Bazar	22°48'28.16"N 91°28'4.10"E	Commercial

Source: Field Data collection by BCL Associates Limited, December, 2023 and August, 2025

Table 12: Ambient Noise Level Monitoring Result

Noise Level Measurement Result during Winter											
Sample Code	Noise level (dB(A)) ³						Bangladesh Standard (dB(A)) ⁴		IFC EHS Guideline (2007) ⁵		Area Setting
	Leq _{day}	L _{max}	L _{min}	Leq _{night}	L _{max}	L _{min}	Day	Night	Day	Night	
ANL1	52.7	68.2	35.1	37.9	55.6	32.5	60	50	70	70	Mixed Area/Commercial
ANL2	53.3	78.4	38.3	38.1	55.3	33.1	60	50	70	70	Mixed Area/Commercial
ANL3	67.4	84.2	38.6	44.3	57.0	33.8	70	60	70	70	Commercial
ANL4	62.4	81.5	39.2	42.5	54.8	32.3	50	40	55	45	Silent/Institutional
ANL5	38.5	61.5	33.1	34.9	51.3	32.6	55	45	55	45	Residential
ANL6	57.3	77.6	41.4	50.5	56.6	41.4	75	70	70	70	Industrial
ANL-7	60.5	78.0	30.5	50.3	57.1	41.7	75	70	70	70	Industrial
ANL-8	53.4	79.4	30.5	38.4	47.1	30.1	60	50	70	70	Mixed
ANL-9	54.0	73.7	30.4	42.8	54.8	30.7	70	60	70	70	Commercial

³ A-weighted decibel, abbreviated dB(A), is an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced, as the ear is less sensitive to low audio frequencies, especially below 1000 Hz, than to high audio frequencies.

⁴ Ministry of Environment, Forest, and Climate Change. (2006). Noise Pollution (Control) Rules, 2006 (S.R.O. No. 212-Law/2006). The People's Republic of Bangladesh.

⁵ Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

Noise Level Measurement Result during Monsoon											
ANL1	56.6	66.9	42.2	39.8	44.9	31	60	50	70	70	Mixed Area/Commercial
ANL2	53.1	71.9	44.8	41.9	60.9	31.1	60	50	70	70	Mixed Area/Commercial
ANL3	60.8	74	42.7	41.8	59.6	31	70	60	70	70	Commercial
ANL4	52.7	63.7	43.1	43.5	60.9	31	50	40	55	45	Silent/Institutional
ANL5	55.8	70.7	46.1	42.1	60.9	30.5	55	45	55	45	Residential
ANL6	59.8	76.1	46.6	42.3	56	31.3	75	70	70	70	Industrial
ANL-7	54.1	71.7	45.7	43.2	60.9	31.1	75	70	70	70	Industrial
ANL-8	52.3	63.5	38.7	38.6	60.9	31.4	60	50	70	70	Mixed
ANL-9	53	69.3	40.4	40.3	60.2	31	70	60	70	70	Commercial

Photographs of Noise Level Measurement



ANL1 (Adjacent to CP Mor, Ichakhali)



ANL2 (East side of the project location, Daborkhali Point, Ichakhali)



ANL3 (Ichakhali Sluice gate Bazar, Ichakhali)



ANL4 (Adjacent to the main road, Bodiullah Para Government Primary School, Maghadia)



ANL5 (In front of Abdul Kader Mia House, Charsarat)



ANL6 (In front of BR Powergen, NSEZ)



ANL7 (In front of Nippon and McDonald Steel Industries limited)

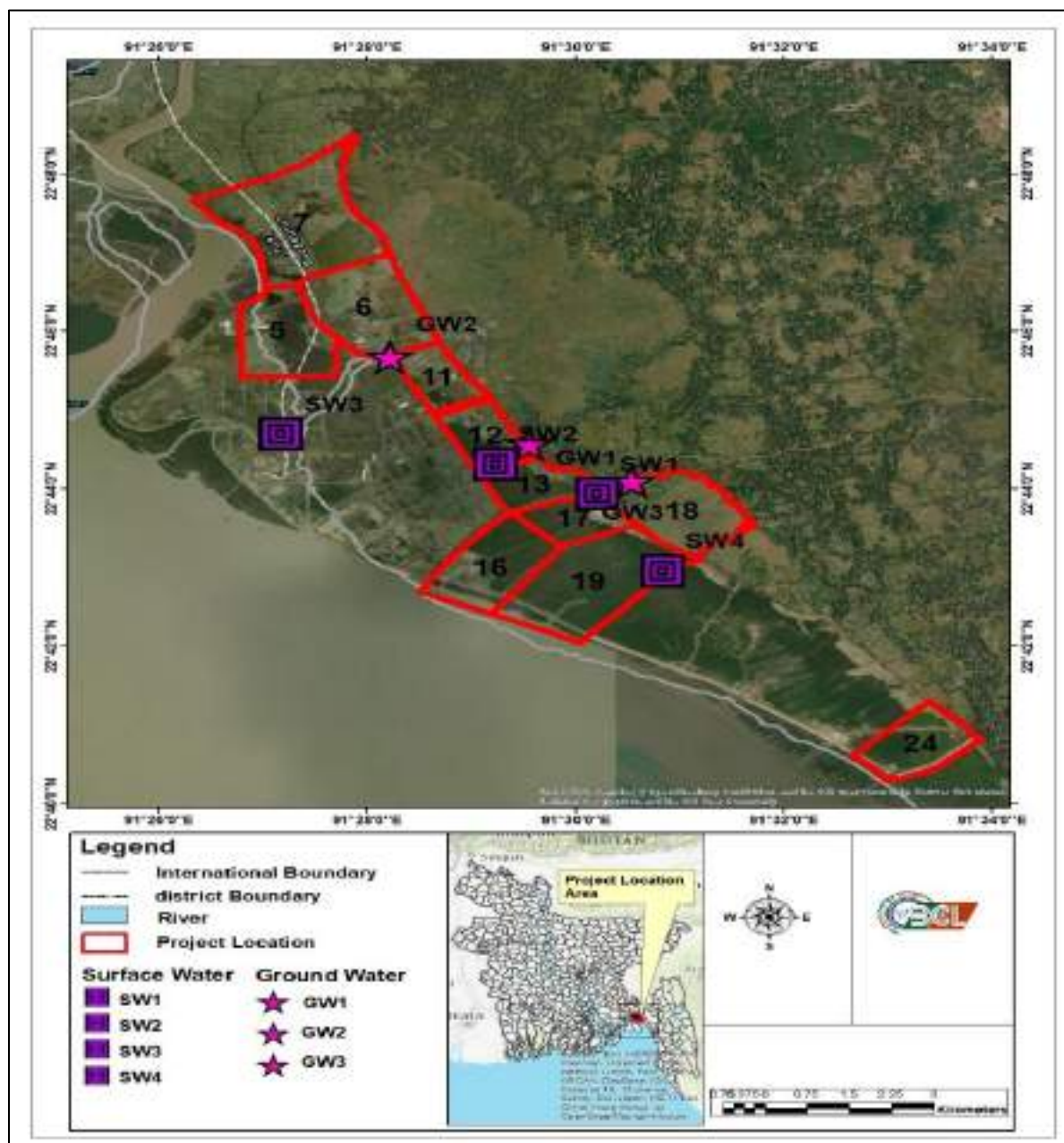


ANL8 (Baitur Rahman Panjegana Mosque)



ANL9 (Tekerhat Bazar)

Surface and Ground Water



Map 4: Surface water, ground water and sediment sample monitoring locations

Table 15: Surface water sampling locations

Sampling code	Sampling locations	GPS Coordinates	Sampling Date (Winter)	Sampling Date (Monsoon)
SW-01	Bamansundar Canal	22°43'36.06"N 91°29'14.67"E	14.12.2023	17.08.2025
SW-02	Daborkhali Canal	22°44'30.96"N 91°28'9.60"E	14.12.2023	17.08.2025
SW-03	Ichakhali Canal	22°44'41.63"N 91°27'11.03"E	14.12.2023	17.08.2025
SW-04	Shaherkhali Khal	22°41'13.6"N 91°31'23.8"E	14.12.2023	17.08.2025

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annex- 3: Detail Environmental Baseline Condition

Sl.	Sampling Location	Code	Geographical Location	Sampling Date	Type of Source
1.	Sandwip Channel	L-05	22°40'33.08"N 91°30'39.42"E	03.01.2024	Channel
2.	Sandwip Channel	L-07	22°41'42.93"N 91°28'45.49"E	03.01.2024	Channel
3.	Sandwip Channel	L-08	22°42'8.14"N 91°27'42.75"E	03.01.2024	Channel
4.	Sandwip Channel	L-09	22°42'51.65"N 91°26'30.74"E	03.01.2024	Channel

Source: Sample Collection by the Environment Team of BCL Associates Limited, December 2023

Table 16: Results of the surface water samples from sub-project area

Surface Water Quality Analysis Results in Winter							
Parameters	Unit	SW1	SW2	SW3	SW4	Bangladesh Standard ⁶	Test Method (APHA)
DO	mg/L	5.39	7.56	7.51	6.47	≥5	4500-O-G
TDS	mg/L	2168	1332	166	304	1000	2540.C
TSS	mg/L	84	34.0	6.0	5.0	-	2540.C
EC	μS/cm	3910	2750	327	540	-	2510.B
Turbidity	NTU	42.8	81.2	65.6	46.9	-	Turbidimeter
pH	-	7.32	8.02	7.09	7.08	6-9	4500-H ⁺ .B
Salinity	ppt	2.1	1.4	<0.1	0.2	-	-
COD	mg/L	5.64	1.88	2.82	3.76	50	5220.B
BOD	mg/L	2.32	<0.2	<0.2	0.58	≤30	5210.B
Mercury	mg/L	< 0.001	<0.001	<0.001	<0.001	-	3112.B
Lead	mg/L	< 0.001	< 0.001	<0.001	<0.001	0.1	3111.B
Cadmium	mg/L	< 0.001	< 0.001	<0.001	<0.001	-	3111.B
Oil and Grease	mg/L	<2.0	< 2.0	<2.0	<2.0	-	5520.B
Fecal Coliform	MPN/100ml	2.0	<1.8	2.0	<1.8 ⁷	2.0 indicates (absent) as per standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	2.0	2.0	2.0	<1.8	Same as FC	9221B-C
Surface Water Quality Analysis Results in Monsoon							
DO	mg/L	6.03	6.08	5.08	5.06	≥5	4500-O-G
TDS	mg/L	425	389	460	430	1000	2540.C
TSS	mg/L	12.5	17.8	19.6	21.2	-	2540.C
EC	μS/cm	328	286	382	346	-	2510.B
Turbidity	NTU	5.0	5.3	5.2	5.04	-	Turbidimeter
pH	-	7.49	7.36	8.5	7.65	6-9	4500-H ⁺ .B
Salinity	ppt	0.03	0.02	0.03	0.02	-	-
COD	mg/L	66.4	106	115	128	50	5220.B
BOD	mg/L	24.2	19.8	26.4	21.1	≤30	5210.B
Mercury	mg/L	0.003	0.004	0.005	0.006	-	3112.B
Lead	mg/L	0.04	0.06	0.05	0.07	0.1	3111.B
Cadmium	mg/L	0.3	0.5	0.4	0.6	-	3111.B
Oil and Grease	mg/L	6.23	5.18	5.07	5.3	-	5520.B

⁶ Bangladesh Environment Conservation Rules, 2023- Schedule 2 (Standards for Inland Surface Water, Water Usable for Fisheries).

⁷ As per MPN (most probable number) chart (APHA-22nd edition), MPN <1.8 indicates absence of test organism in the supplied sample.

Surface Water Quality Analysis Results in Winter							
Parameters	Unit	SW1	SW2	SW3	SW4	Bangladesh Standard ⁶	Test Method (APHA)
Fecal Coliform	MPN/100ml	22	27	31	27	2.0 indicates (absent) as per standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	11	14	17	13	Same as FC	9221B-C

Table 17: Results of Surface Water Sampling from Sandwip Channel

Parameters	Unit	Sandwip Channel (Coastal Surface Water)				Bangladesh Standard ⁸		Test Method (APHA)
		L-05	L-07	L-08	L-09	Inland	Coastal	
Temperature	°C	24.8	25.2	25.3	24.7	-	-	In-house
Total Suspended Solid (TSS)	mg/L	463	505	539	903	-	50	2540.D
Electrical Conductivity (EC)	µS/cm	27500	27400	27300	27400	-	-	2510.B
Turbidity	NTU	83.1	155	198	683	-	-	Turbidimeter
pH	-	7.90	7.95	7.98	8.00	6-9	6.5-8.5	4500-H ⁺ .B
Salinity	ppt	16.6	16.8	16.9	16.6	-		5220.B
Chemical Oxygen Demand (COD)	mg/L	1.95	2.92	1.88	2.82	50	5	4500-H ⁺ .B
Biological Oxygen Demand (BOD)	mg/L	< 0.2	<0.2	<0.2	<0.2	≤6	-	5210.B
Mercury (Hg)	mg/L	<0.001	<0.001	<0.001	<0.001	0.004	0.0001	3112.B
Lead (Pb)	mg/L	<0.01	<0.01	<0.01	<0.01	0.1	0.05	3111.B
Cadmium (Cd)	mg/L	<0.001	<0.001	<0.001	<0.001	-	0.005	3111.B
Zinc (Zn)	mg/L	<0.05	<0.05	<0.05	<0.05	-	-	3111.B
Chromium (Cr)	mg/L	<0.005	<0.005	<0.005	<0.005	0.05	0.05	3113.B
Total Coliform (TC)	MPN/100ml	<1.8*	<1.8*	<1.8*	<1.8*	≤5000	1000	9221B-C

Source: Laboratory Analysis in BCSIR, January 2024

⁸ Bangladesh Environment Conservation Rules, 2023- Schedule 2 (Standards for Inland Surface Water and Coastal Surface Water, Water Usable for Fisheries).

Note: < stands for Less Than

Surface Water Lab Result Sheet

Form No. QEW-02
Revision No. 02
Revision Date: 04 November, 2022
For office use, no signature required

ANALYSIS REPORT

AMC Ref No.: A-91001
Lab Sample ID: A-91001
Client Details: MCL Shalipal, Mero

Environmental and Social Consultancy Services
(Package No. EPC-16-00000-002A) of
Bangladesh Shalipal Mergers Acquis Development
Project, Bangladesh (PDBL 0770000)
BANGLADESH ECONOMIC ZONES AUTHORITY
BCL, Associates Ltd.
Project Office: Second Floor, 27th Floor, 1, Mohanpur C/O,
Dr. Chandra Mohanpur Road, Dhaka-1101
(02) 8000

Number of Sample: 1
Sample Description: Surface Water (Shalipal, Mero)

Test Commencement Date: 14/05/2022
Test Completion Date: 16/05/2022

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (ISIRI)
A-910	Surface Water (Shalipal, Mero)	TDS (Total dissolved solids)	1300 mg/L	2540.07
		TSS (Total Suspended Solids)	140 mg/L	2540.07
		Chemical Conductivity	2700 µS/cm	2540.07
		Hardness	410 mg/L	2540.07
		pH at 25°C	7.22	2540.07
		Salinity	1.1 g/L	2540.07
		DO (Dissolved Oxygen Demand)	1.10 mg/L	2540.07
		BOD (Biological Oxygen Demand)	1.10 mg/L	2540.07
		Alkalinity (mg/L)	1.10 mg/L	2540.07
		Lead (Pb)	1.10 mg/L	2540.07
		Cadmium (Cd)	1.10 mg/L	2540.07
		Cd and Cr (mg/L)	1.10 mg/L	2540.07

Page 1 of 1

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2. The sample should be kept in a cool and dry place until it is analyzed. Do not expose the sample to direct sunlight or extreme temperatures.
3. The sample should be kept in a cool and dry place until it is analyzed. Do not expose the sample to direct sunlight or extreme temperatures.

ANALYST: [Signature]
TESTER: [Signature]
CHECKER: [Signature]

Dr. Chandra Mohanpur Road, Dhaka-1101
Telephone: 02-8000, Fax: 02-8000, E-mail: info@bcl.com.bd, Website: www.bcl.com.bd

Form No. QEW-02
Revision No. 02
Revision Date: 04 November, 2022
For office use, no signature required

ANALYSIS REPORT

AMC Ref No.: A-91001
Lab Sample ID: A-91001
Client Details: MCL Shalipal, Mero

Environmental and Social Consultancy Services
(Package No. EPC-16-00000-002A) of
Bangladesh Shalipal Mergers Acquis Development
Project, Bangladesh (PDBL 0770000)
BANGLADESH ECONOMIC ZONES AUTHORITY
BCL, Associates Ltd.
Project Office: Second Floor, 27th Floor, 1, Mohanpur C/O,
Dr. Chandra Mohanpur Road, Dhaka-1101
(02) 8000

Number of Sample: 1
Sample Description: Surface Water (Shalipal, Mero)

Test Commencement Date: 14/05/2022
Test Completion Date: 16/05/2022

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (ISIRI)
A-910	Surface Water (Shalipal, Mero)	TDS (Total dissolved solids)	1300 mg/L	2540.07
		TSS (Total Suspended Solids)	140 mg/L	2540.07
		Chemical Conductivity	2700 µS/cm	2540.07
		Hardness	410 mg/L	2540.07
		pH at 25°C	7.22	2540.07
		Salinity	1.1 g/L	2540.07
		DO (Dissolved Oxygen Demand)	1.10 mg/L	2540.07
		BOD (Biological Oxygen Demand)	1.10 mg/L	2540.07
		Alkalinity (mg/L)	1.10 mg/L	2540.07
		Lead (Pb)	1.10 mg/L	2540.07
		Cadmium (Cd)	1.10 mg/L	2540.07
		Cd and Cr (mg/L)	1.10 mg/L	2540.07

Page 1 of 1

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3. The sample should be kept in a cool and dry place until it is analyzed. Do not expose the sample to direct sunlight or extreme temperatures.

ANALYST: [Signature]
TESTER: [Signature]
CHECKER: [Signature]

Dr. Chandra Mohanpur Road, Dhaka-1101
Telephone: 02-8000, Fax: 02-8000, E-mail: info@bcl.com.bd, Website: www.bcl.com.bd

Form No. QEW-02
Revision No. 02
Revision Date: 04 November, 2022
For office use, no signature required

ANALYSIS REPORT

AMC Ref No.: A-91001
Lab Sample ID: A-91001
Client Details: MCL Shalipal, Mero

Environmental and Social Consultancy Services
(Package No. EPC-16-00000-002A) of
Bangladesh Shalipal Mergers Acquis Development
Project, Bangladesh (PDBL 0770000)
BANGLADESH ECONOMIC ZONES AUTHORITY
BCL, Associates Ltd.
Project Office: Second Floor, 27th Floor, 1, Mohanpur C/O,
Dr. Chandra Mohanpur Road, Dhaka-1101
(02) 8000

Number of Sample: 1
Sample Description: Surface Water (Shalipal, Mero)

Test Commencement Date: 14/05/2022
Test Completion Date: 16/05/2022

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (ISIRI)
A-910	Surface Water (Shalipal, Mero)	TDS (Total dissolved solids)	1300 mg/L	2540.07
		TSS (Total Suspended Solids)	140 mg/L	2540.07
		Chemical Conductivity	2700 µS/cm	2540.07
		Hardness	410 mg/L	2540.07
		pH at 25°C	7.22	2540.07
		Salinity	1.1 g/L	2540.07
		DO (Dissolved Oxygen Demand)	1.10 mg/L	2540.07
		BOD (Biological Oxygen Demand)	1.10 mg/L	2540.07
		Alkalinity (mg/L)	1.10 mg/L	2540.07
		Lead (Pb)	1.10 mg/L	2540.07
		Cadmium (Cd)	1.10 mg/L	2540.07
		Cd and Cr (mg/L)	1.10 mg/L	2540.07

Page 1 of 1

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3. The sample should be kept in a cool and dry place until it is analyzed. Do not expose the sample to direct sunlight or extreme temperatures.

ANALYST: [Signature]
TESTER: [Signature]
CHECKER: [Signature]

Dr. Chandra Mohanpur Road, Dhaka-1101
Telephone: 02-8000, Fax: 02-8000, E-mail: info@bcl.com.bd, Website: www.bcl.com.bd

Form No. QEW-02
Revision No. 02
Revision Date: 04 November, 2022
For office use, no signature required

ANALYSIS REPORT

AMC Ref No.: A-91001
Lab Sample ID: A-91001
Client Details: MCL Shalipal, Mero

Environmental and Social Consultancy Services
(Package No. EPC-16-00000-002A) of
Bangladesh Shalipal Mergers Acquis Development
Project, Bangladesh (PDBL 0770000)
BANGLADESH ECONOMIC ZONES AUTHORITY
BCL, Associates Ltd.
Project Office: Second Floor, 27th Floor, 1, Mohanpur C/O,
Dr. Chandra Mohanpur Road, Dhaka-1101
(02) 8000

Number of Sample: 1
Sample Description: Surface Water (Shalipal, Mero)

Test Commencement Date: 14/05/2022
Test Completion Date: 16/05/2022

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (ISIRI)
A-910	Surface Water (Shalipal, Mero)	DO (Dissolved Oxygen)	1.10 mg/L	2540.07
A-911	Surface Water (Shalipal, Mero)	DO (Dissolved Oxygen)	1.10 mg/L	2540.07
A-912	Surface Water (Shalipal, Mero)	DO (Dissolved Oxygen)	1.10 mg/L	2540.07
A-913	Surface Water (Shalipal, Mero)	DO (Dissolved Oxygen)	1.10 mg/L	2540.07

Page 1 of 2

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3. The sample should be kept in a cool and dry place until it is analyzed. Do not expose the sample to direct sunlight or extreme temperatures.

ANALYST: [Signature]
TESTER: [Signature]
CHECKER: [Signature]

Dr. Chandra Mohanpur Road, Dhaka-1101
Telephone: 02-8000, Fax: 02-8000, E-mail: info@bcl.com.bd, Website: www.bcl.com.bd

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Form No. QP-01 (2015)
Water Analysis

Revision No. 11

Revision Date: 01 November, 2022
"we strive to, we improve"



Water Quality & Safety Report

BANGLADESH MINISTRY OF HEALTH AND FAMILIAR BANGSHI

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

Job Ref No. : 1510 of Analytical Service (AS)

ICRIS, 9481/2015

Lab Sample No. : 6-76-41

Client's Details : Dr. Md. Asim

Environmental and Social Consultancy Services
(Package No. PMC-04/00000-00/01) of
Bangladesh Water Supply Development
Project, Bangladesh PURC (FTR000)

BANGLADESH ELPOLIMIC JUPON AUTHORITY
ECJ, Assamara Ltd.

Project Office: Tazara/Tong (37) Road, 1100000 Dhaka,
The Union, ECJ Khushkhal Union, Dhaka-1205

Number of Sample : (05-05)

Sample Description : Surface Water other areas, within jurisdiction

Test Commenced Date : 06/01/2024

Test Completion Date : 22/01/2024

Lab No.	Description of Sample	Parameter	Result	Test Method (APHA)
A-26	Surface Water (A-26, Sampled/Checked)	Temperature	25.0°C	In-house
A-27	Surface Water (A-27, Sampled/Checked)	Temperature	25.0°C	In-house
A-28	Surface Water (A-28, Sampled/Checked)	Temperature	25.0°C	In-house
A-29	Surface Water (A-29, Sampled/Checked)	Temperature	25.0°C	In-house
A-30	From River Water (A-30)	Temperature	25.0°C	In-house
A-31	From River Water (A-31)	Temperature	25.0°C	In-house

Page 1 of 2

Notes:

- The sample reported here are based on the analytical results on the laboratory.
- Any sample that is reported as not to be analyzed, the test findings are not relevant to the laboratory.
- Any sample that is reported as not to be analyzed, the test findings are not relevant to the laboratory.

ANALYTICAL SERVICE UNIT
PO: Dhaka, Dhaka, Bangladesh. Phone: 01711-1111111
Telephone: 01711-1111111, 01711-1111111, 01711-1111111, 01711-1111111

Form No. (201/02)
Date: 05/05/2012



Division No. 12

By: Section Officer, 12th November, 2012
(see office order, no signature)



ಕರ್ನಾಟಕ ರಾಜ್ಯ ಸರ್ಕಾರ
KARNATAKA GOVT. OF MINISTERS AND DEPT. OF REVENUE

Particulars of supplied sample	Test Parameters	Result	ISIRI Standard (2001, 2001)	Test Method (APHA)
Surface Water (S-45), Standing Channel, S-40	Total Coliforms (c/100 ml unit)	< 1.00	Absent	521.94C
Surface Water (S-45), Standing Channel, S-45	Total Coliforms (c/100 ml unit)	< 1.00	Absent	521.94C
Surface Water (S-45), Standing Channel, S-40	Total Coliforms (c/100 ml unit)	< 1.00	Absent	521.94C
Surface Water (S-45), Standing Channel, S-40	Total Coliforms (c/100 ml unit)	< 1.00	Absent	521.94C
Spill from Water (S-45, S-40)	Total Coliforms (c/100 ml unit)	< 1.00	Absent	521.94C
Spill from Water (S-45, S-40)	Total Coliforms (c/100 ml unit)	< 1.00	Absent	521.94C

*As per ISIRI (most probable number) chart (c/100 ml) absent, MPN < 0.8 indicates absence of any organisms in the supplied sample. 47

(Signature)
12.01.04

Analyst

(Signature)
Supervisor

(Signature)
12.01.04

Inspector

1. To be submitted to the District Engineer, Bangalore.

2. To be submitted to the District Engineer, Bangalore.

3. To be submitted to the District Engineer, Bangalore.

Page 1 of 1

[illegible]

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annex- 3: Detail Environmental Baseline Condition

Form No. CDR-02
 Sheet No. 02
 Revision No. 02
 Revision Date: 04 November, 2022
 "See other side, no sign here"

राष्ट्रीय प्रदूषण नियंत्रण बोर्ड
NATIONAL BOARD OF POLLUTION CONTROL

राष्ट्रीय प्रदूषण नियंत्रण बोर्ड
NATIONAL BOARD OF POLLUTION CONTROL

Lab ID	Particulars of sampled sample	Parameters	Results	Test Method (IS/ISO)
A-17	Surface Water (1.0L, Sampling Channel)	TDS (Total Suspended Solids)	309 mg/L	2090.11
		Electrical Conductivity	27000 µS/cm	2090.11
		Turbidity	0.1 NTU	2090.11
		pH at 24.7°C	7.36	2090.11
		Salinity	0.0 g/g	2090.11
		DO (Dissolved Oxygen Demand)	1.00 mg/L	2090.11
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	2090.11
		Manganese (Mn)	Less than 0.05 mg/L	2090.11
		Lead (Pb)	Less than 0.04 mg/L	2090.11
		Cadmium (Cd)	Less than 0.001 mg/L	2090.11
		Zinc (Zn)	Less than 0.05 mg/L	2090.11
		Chromium (Cr)	Less than 0.05 mg/L	2090.11
A-18	Surface Water (1.0L, Sampling Channel)	TDS (Total Suspended Solids)	339 mg/L	2090.11
		Electrical Conductivity	27000 µS/cm	2090.11
		Turbidity	0.1 NTU	2090.11
		pH at 24.7°C	7.36	2090.11
		Salinity	0.0 g/g	2090.11
		DO (Dissolved Oxygen Demand)	1.00 mg/L	2090.11
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	2090.11
		Manganese (Mn)	Less than 0.05 mg/L	2090.11
		Lead (Pb)	Less than 0.04 mg/L	2090.11
		Cadmium (Cd)	Less than 0.001 mg/L	2090.11
		Zinc (Zn)	Less than 0.05 mg/L	2090.11
		Chromium (Cr)	Less than 0.05 mg/L	2090.11

Page 2 of 4

1. The results reported here are based only on the sampled samples in this laboratory.
 2. Any sample should not report test as to acceptable after the sample from the site of sampling if this test report.
 3. The laboratory shall not be responsible for the results of the sample if the sample is not reported in the laboratory.

Dr. Shashank K. Sharma Head, Environmental Laboratory, NBPCL
 Telephone: 011-26111111 Fax: 011-26111111 E-mail: nbpcl@nbpcl.gov.in Website: www.nbpcl.gov.in

Form No. CDR-02
 Sheet No. 02
 Revision No. 02
 Revision Date: 04 November, 2022
 "See other side, no sign here"

राष्ट्रीय प्रदूषण नियंत्रण बोर्ड
NATIONAL BOARD OF POLLUTION CONTROL

राष्ट्रीय प्रदूषण नियंत्रण बोर्ड
NATIONAL BOARD OF POLLUTION CONTROL

Lab ID	Particulars of sampled sample	Parameters	Results	Test Method (IS/ISO)
A-19	Surface Water (1.0L, Sampling Channel)	TDS (Total Suspended Solids)	303 mg/L	2090.11
		Electrical Conductivity	27000 µS/cm	2090.11
		Turbidity	0.1 NTU	2090.11
		pH at 24.7°C	7.36	2090.11
		Salinity	0.0 g/g	2090.11
		DO (Dissolved Oxygen Demand)	1.00 mg/L	2090.11
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	2090.11
		Manganese (Mn)	Less than 0.05 mg/L	2090.11
		Lead (Pb)	Less than 0.04 mg/L	2090.11
		Cadmium (Cd)	Less than 0.001 mg/L	2090.11
		Zinc (Zn)	Less than 0.05 mg/L	2090.11
		Chromium (Cr)	Less than 0.05 mg/L	2090.11
A-20	Tribal River Point (A-20)	TDS (Total Suspended Solids)	309 mg/L	2090.11
		Electrical Conductivity	27000 µS/cm	2090.11
		Turbidity	0.1 NTU	2090.11
		pH at 24.7°C	7.36	2090.11
		Salinity	0.0 g/g	2090.11
		DO (Dissolved Oxygen Demand)	1.00 mg/L	2090.11
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	2090.11
		Manganese (Mn)	Less than 0.05 mg/L	2090.11
		Lead (Pb)	Less than 0.04 mg/L	2090.11
		Cadmium (Cd)	Less than 0.001 mg/L	2090.11
		Zinc (Zn)	Less than 0.05 mg/L	2090.11
		Chromium (Cr)	Less than 0.05 mg/L	2090.11

Page 3 of 4

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Dr. Shashank K. Sharma Head, Environmental Laboratory, NBPCL
 Telephone: 011-26111111 Fax: 011-26111111 E-mail: nbpcl@nbpcl.gov.in Website: www.nbpcl.gov.in

Photograph of the Surface Water Sample Collection



SW1 (Bamansundar Canal)



SW2 (Daborkhali Canal)



SW3 (Ichakhali Canal)



SW4 (Shaherkhali Khal)



L-05 (Proposed dredging Location 05 at Sandwip Channel)



L-07 (Proposed dredging Location 07 at Sandwip Channel)



L-08 (Proposed dredging Location 08 at Sandwip Channel)



L-09 (Proposed dredging Location 09 at Sandwip Channel)

Table 18: Groundwater Sampling Locations

SN	Sampling Location	Code	Geographical Location	Sampling Date (Winter)	Sampling Date (Monsoon)
1.	Charsarat Village	GW1	22°44'34.01"N, 91°29'33.45"E	13.12.2023	17.08.2025
2.	BEZA Office	GW2	22°45'40.00"N, 91°28'13.00"E	13.12.2023	17.08.2025
3.	Near CP Mor	GW3	22°44'5.64"N, 91°30'32.35"E	13.12.2023	17.08.2025

Source: Sample Collection by the Environment Team of BCL Associates Limited

Table 19: Groundwater Quality Analytical Results

Ground Water Analysis Result in Winter (January 2024)						
Parameters	Unit	GW1	GW2	GW3	Bangladesh Standard ¹⁰	Test Method (APHA)
TDS	mg/L	374	332	2544	1000	2540.C
EC	μS/cm	590	587	5580	-	2510.B
Turbidity	NTU	1.1	0.83	90.8	5.0	Turbidimeters
pH		7.52	7.30	7.31	6.5-8.5	4500-H+. B
Salinity	ppt	0.3	0.3	2.4	-	
Total Hardness as CaCO ₃	mg/L	82.0	118	944	-	2340.C
Iron	mg/L	1.14	1.82	7.18	0.3-1.0	3111.B
Arsenic	mg/L	< 0.005	< 0.005	< 0.005	0.05	3114.C
Manganese	mg/L	< 0.05	< 0.05	0.38	0.4	3111.B
Odor	-	Agreeable	Agreeable	Agreeable	-	In-house
Fecal Coliform	MPN/100ml	<1.8	<1.8	<1.8	2.0 indicates (absent) as per BDS Standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	<1.8	<1.8	<1.8	2.0 indicates (absent) as per BDS Standard 1240:2021	9221B-C
Ground Water Analysis Result in Monsoon (August 2025)						
TDS	mg/L	320	284	327	1000	2540.C
EC	μS/cm	356	337	384	-	2510.B
Turbidity	NTU	4.2	4.6	4.1	5.0	Turbidimeters
pH		7.18	7.86	8.02	6.5-8.5	4500-H+. B
Salinity	ppt	0.004	0.002	0.003	-	
Total Hardness as CaCO ₃	mg/L	215	237	222	-	2340.C
Iron	mg/L	0.64	0.53	0.74	0.3-1.0	3111.B
Arsenic	mg/L	<0.002	0.008	0.006	0.05	3114.C
Manganese	mg/L	0.64	0.53	0.74	0.4	3111.B
Odor	-	1	2	1	-	In-house
Fecal Coliform	MPN/100ml	1	3	2	2.0 indicates (absent) as per BDS Standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	2	5	3	2.0 indicates (absent) as per BDS Standard 1240:2021	9221B-C

Photographs of Ground Water Sampling



Charsarat Village



BEZA Office



Near to CP Mor

Soil Map & Locations

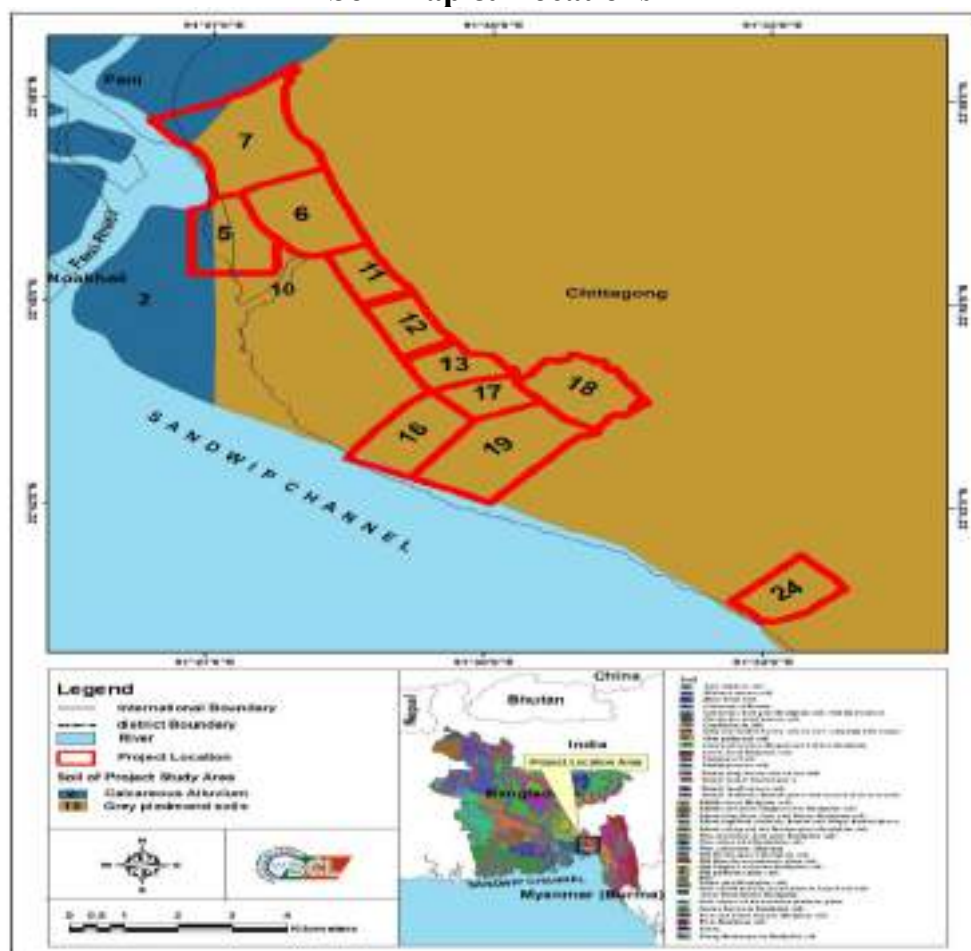


Table 20: Soil textural class of the samples collected from the Project areas

Sample Code	GPS Coordinates		Zone	Sand %	Silt %	Clay %	Textural Class
	Latitude	Longitude					
Soil-01	22° 44' 2.94" N	91° 30' 7.97" E	13	4.2	41.5	54.3	Silty Clay
Soil-02	22° 44' 25.15" N	91° 29' 32.57" E	12	6.4	41.4	52.0	Silty Clay
Soil-03	22° 45' 3.50" N	91° 29' 4.90" E	12	7.3	56.6	36.1	Silty Clay Loam

Source: Laboratory Analysis in Department of Soil, Water and Environment, Dhaka University, February, 2024

মৃত্তিকা, পানি ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়, ঢাকা ১০০০, বাংলাদেশ





**Department of Soil
Water and Environment**
University of Dhaka, Dhaka 1000, Bangladesh

February 20, 2023

Dr. Nahid Amin
E&S Consultant
Noorani Tower
1, Mohakhali C/A
Bir Uttam AK Khandaker Sarak
Dhaka 1212.

Package No: PMC-16 BSMSN-BEZA
Ref No: 49623/000-8 Dated: 04 January 2023

Dear Sir,
As per your request, the soil samples have been analyzed for soil texture and the results of the analyzed soil samples are given below;

Sample No.	% Sand	% Silt	% clay	Textural Class
Soil -1	4.2	41.5	54.3	Silty clay
Soil -2	6.4	41.4	52.0	Silty clay
Soil-3	7.3	56.6	36.1	Silty clay Loam

2A

Thanks and regards,



(Professor Dr. Md. Harunor Rashid Khan)
Chairman
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Soil Samples Laboratory Results Sheets

Table 21: Details of sediment sampling locations

SL.	Sampling Location	Code	Geographical Location	Sampling Date
1.	Sandwip Channel	L-05	22°40'33.08"N 91°30'39.42"E	03 January 2024
2.	Sandwip Channel	L-07	22°41'42.93"N 91°28'45.49"E	03 January 2024
3.	Sandwip Channel	L-08	22°42'8.14"N 91°27'42.75"E	03 January 2024
4.	Sandwip Channel	L-09	22°42'51.65"N 91°26'30.74"E	03 January 2024

Lab Sheet of Sediment Sample

Form No. (SST-32)
 Revision No. 01
 Revision Date: 04 November, 2023
 "For laboratory use only, do not alter"

ANALYSIS REPORT
 (To be filled by Analytical Service Unit, BCSIR-2001, 003)

Lab Sample ID: L-05
 Client's Details: Sandwip Channel

Project Name: Environmental and Social Feasibility Study
 (Package No. EME-00-00000-0000) of
 Bangladesh Coastal Development Project (PCDP)
 BANGLADESH ECONOMIC ZONES AUTHORITY
 BCL, Ashokkha Ltd.
 Project Site: Sonoma Cove CDP Phase I, Haldibadi C/A,
 B/L from AE, Haldibadi Bank, Haldia (D)

Project No: SST-32
 Sample Description: Sediment Sample from Sonoma Cove CDP Phase I
 Test Commencement Date: 04/01/2024
 Test Completion Date: 03/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-01	Sediment (L-05, Sandwip Channel)	Iron (Fe)	11.8 mg/kg	1011 B
		Copper (Cu)	0.8 mg/kg	1011 B
		Manganese (Mn)	1.0 mg/kg	1011 B
		Lead (Pb)	0.1 mg/kg	1011 B
		Cadmium (Cd)	0.01 mg/kg	1011 B
A-02	Sediment (L-07, Sandwip Channel)	Iron (Fe)	11.8 mg/kg	1011 B
		Copper (Cu)	0.8 mg/kg	1011 B
		Manganese (Mn)	1.0 mg/kg	1011 B
		Lead (Pb)	0.1 mg/kg	1011 B
		Cadmium (Cd)	0.01 mg/kg	1011 B

Page 1 of 2

Form No. (SST-32)
 Revision No. 01
 Revision Date: 04 November, 2023
 "For laboratory use only, do not alter"

ANALYSIS REPORT
 (To be filled by Analytical Service Unit, BCSIR-2001, 003)

Lab Sample ID: L-07
 Client's Details: Sandwip Channel

Project Name: Environmental and Social Feasibility Study
 (Package No. EME-00-00000-0000) of
 Bangladesh Coastal Development Project (PCDP)
 BANGLADESH ECONOMIC ZONES AUTHORITY
 BCL, Ashokkha Ltd.
 Project Site: Sonoma Cove CDP Phase I, Haldibadi C/A,
 B/L from AE, Haldibadi Bank, Haldia (D)

Project No: SST-32
 Sample Description: Sediment Sample from Sonoma Cove CDP Phase I
 Test Commencement Date: 04/01/2024
 Test Completion Date: 03/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-01	Sediment (L-07, Sandwip Channel)	Iron (Fe)	11.8 mg/kg	1011 B
		Copper (Cu)	0.8 mg/kg	1011 B
		Manganese (Mn)	1.0 mg/kg	1011 B
		Lead (Pb)	0.1 mg/kg	1011 B
		Cadmium (Cd)	0.01 mg/kg	1011 B
A-02	Sediment (L-08, Sandwip Channel)	Iron (Fe)	11.8 mg/kg	1011 B
		Copper (Cu)	0.8 mg/kg	1011 B
		Manganese (Mn)	1.0 mg/kg	1011 B
		Lead (Pb)	0.1 mg/kg	1011 B
		Cadmium (Cd)	0.01 mg/kg	1011 B
A-03	Sediment (L-09, Sandwip Channel)	Iron (Fe)	11.8 mg/kg	1011 B
		Copper (Cu)	0.8 mg/kg	1011 B
		Manganese (Mn)	1.0 mg/kg	1011 B
		Lead (Pb)	0.1 mg/kg	1011 B
		Cadmium (Cd)	0.01 mg/kg	1011 B

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Photograph of the Sediment Samples Collection



Proposed dredging Location 05 at Sandwip Channel (L-05)



Proposed dredging Location 07 at Sandwip Channel (L-07)

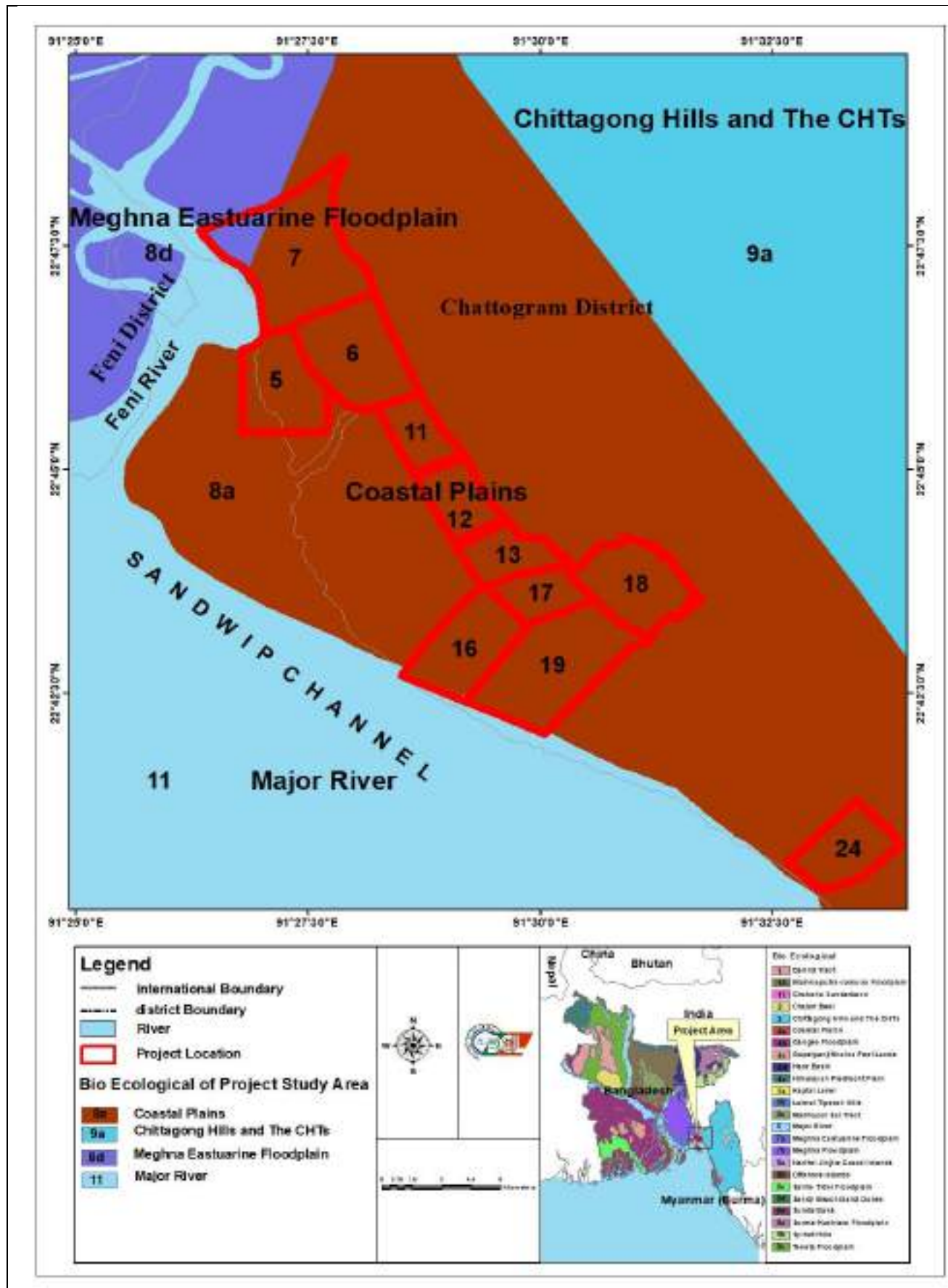


**Proposed dredging Location 08 at Sandwip Channel
(L-08)**



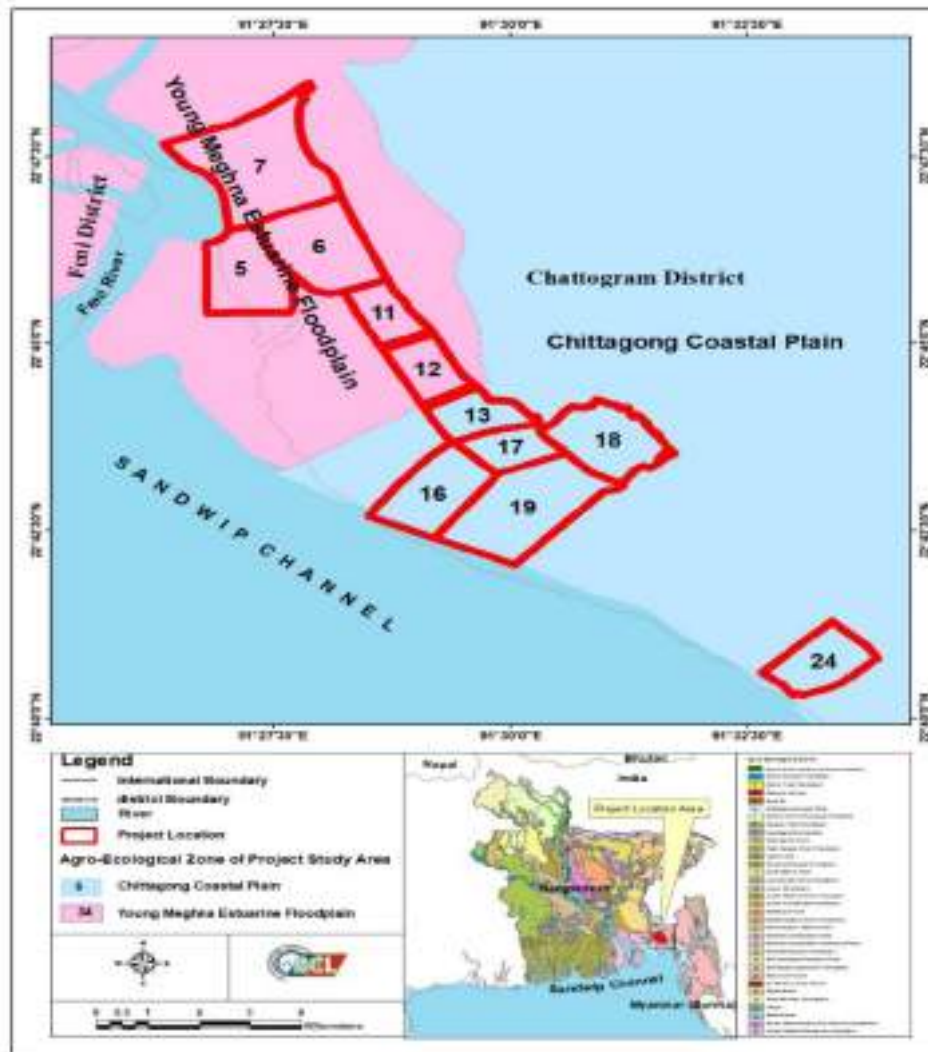
**Proposed dredging Location 09 at Sandwip Channel
(L-09)**

B. BASELINE ECOLOGICAL ENVIRONMENT



Agro-ecological zone

8. A map of the Agro-ecological zone is given in the below that represents the project area falls under zone 34 which is Young Meghna Estuarine Floodplain:



Map 9: Agro-ecological Map of Bangladesh.
Source: IUCN (2002)

Overall ecosystems of the study area can be divided in two categories: (1) Terrestrial Ecosystem and (2) Marine Ecosystem

B.1 TERRESTRIAL ECOLOGICAL ASSESSMENT

Plants Survey Methods

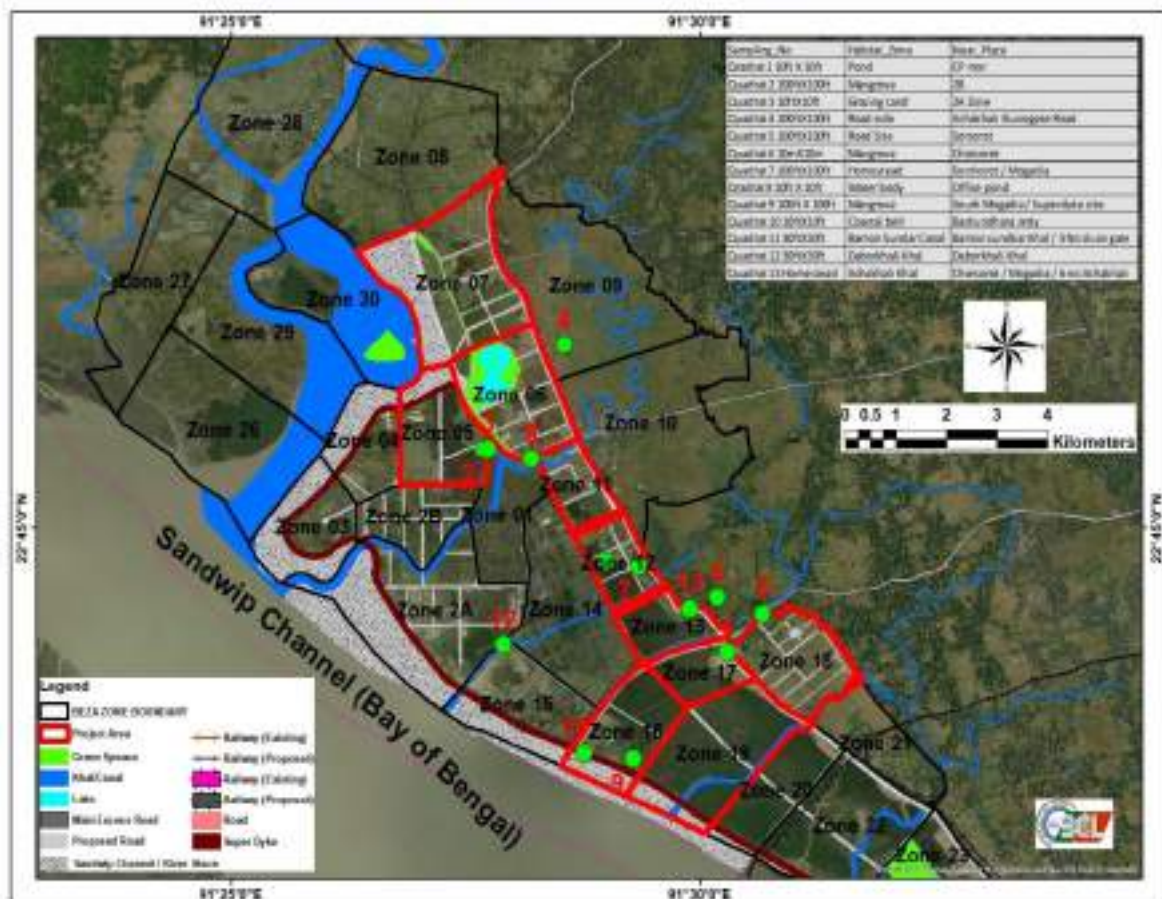
9. Terrestrial plants have been investigated using Random Meander method (Cropper, 1993) and also conducted study on habitat wise by using quadrat (100ftX100ft, 30ftX30ft, and 10ftX10ft) dated on 8-12 December, 2023, in this method the researcher explored plant data and information throughout the study through opportunistic basis. Different habitats (roadsides, homesteads, canals, ponds, mangrove, and cultivated lands) are investigated to find out the diversity of terrestrial plants. Red Data Book of Vascular Plants of Bangladesh. Yet not published from the Bangladesh National Herbarium. For gathering present conservation and distribution status, recorded plants are compared with the IUCN-Global status.

10. Local people have been interviewed during the investigation. A maximum of plant species has been identified at the field; however, for confusion in identification, close photographs of flowers, leaves, and stems and/or fertile specimens of leaves, stems, and roots were collected. A list of sampling no, Habitat, Location, Latitude, and Longitude as follows

Table 22: List of Sampling, Habitat, Location, Latitude, Longitude

S/N	Sampling no	Habitat	Locations	Latitude, E	Longitude, N
1	Quadrat 1 10ft X 10ft	Pond	CP mor	22° 43' 52"	91° 30' 17"
2	Quadrat 2 100ftX100ft	Mangrove	2B	22° 45'46"	91° 27' 41"
3	Quadrat 3 10ftX10ft	Grazing Land	2A zone	22° 45' 46"	91° 27' 44"
4	Quadrat 4 100ftX100ft	Roadside	Ichakhali Sluicgate Road	22° 46' 40"	91° 28' 35"
5	Quadrat 5 100ftX100ft	Road site	Charsarat	22° 44'10"	91° 30'40"
6	Quadrat 6 10mX10m	Mangrove	Charsarat	22° 44' 20"	91° 29' 90"
7	Quadrat 7 100ftX100ft	Homestead	Charsarat Maghadia	22° 44' 44"	91° 29' 02"
8	Quadrat 8 10ft X 10ft	Water body	Office pond	22° 45' 40"	91° 28' 12"
9	Quadrat 9 100ft X 100ft	Mangrove	South Maghadia Superdyke site	22° 42' 39"	91° 29' 15"
10	Quadrat 10 10ftX10ft	Coastal belt	Bashundhara Jetty	22° 42' 49"	91° 28' 45"
11	Quadrat 11 30ftX30ft	Bamon Sundar Canal	Bamon Sundar Khal, 3 No sluice gate	22° 44' 44"	91° 29' 02"
12	Quadrat 12 30ftX30ft	Daborkhali Khal	Daborkhali Khal	22° 43' 50"	91° 27' 55"
13	Quadrat 13 10ftX10ft	Ichakhali Khal	Charsarat Maghadia 6 no. Ichakhali	22.737364	91.496899

Source: During field survey, 2023



Map 10: Sampling Locations of Quadrat

11. By using quadrat habitat-wise plant sampling, taken and also number and qualitative status have been noted (Figure 12)



Photograph: Charsarat mangrove area

Plants species counting and Identification by using the quadrat method at Chorsoti area



Data collection on Chorsot Mangrove

Discussion with Kornafuli Gas Company staff

Species identification

Photograph: Data Collection Activities



Photograph: Fruit bearing plants (Banana) in the project area



Local fruit- Custard Apple at Zone 13

Local fruit-Papaw at Zone 13

Local fruit-Lemon at Zone 13

Photograph: Some fruit bearing trees in the project area

Table 23: List of Terrestrial Plants in the Project Area

S/N	Local Name	English name	Scientific name	Family	Relative abundance	Type	Use	IUCN-Global
1	Binna grass	Vetiver	<i>Chrysopogon zizanioides</i>	Poaceae	C	Herb	Cattle food	Unknown
2	Shimul	Red silk cotton	<i>Bombax ceiba</i>	Bombacaceae	R	Tree	Cotton	LC
3	Nol	Reed	<i>Phgmities karka</i>	Poaceae	C	Herb	Cow shade	Unknown
4	Khejur	Date palm	<i>Phoenix sylvestris</i>	Arecaceae	C	Shrub	Fruit	Unknown
5	Supari	Bettle Nut	<i>Areca catechu</i>	Arecaceae	C	Tree	Fruit	DD
6	Narikel	Coconut	<i>Cococs nucifera</i>	Arecaceae	C	Tree	Fruit	Unknown
7	Lichu	Litchi	<i>Litchi chinensis</i>	Sapidaceae	C	Tree	Fruit	Unknown
8	Aam	Mango	<i>Mangifera indica</i>	Anacardiaceae	C	Tree	Fruit	DD
9	Boroi	Jujubi	<i>Zizyphus mauritiana</i>	Rhamnaceae	C	Tree	Fruit	Unknown
10	Peyara	Guava	<i>Psidium quajava</i>	Myrtaceae	F	Herb	Fruit	LC
11	Kathal	Jackfruit Tree	<i>Artocarpus heterophyllus</i>	Moraceae	F	Tree	Fruit	Unknown
12	Kodbel	Wood apple	<i>Limonia acidissima</i>	Rutaceae	F	Tree	Fruit	Unknown
13	Sajna	Drumstick	<i>Moringa olefera</i>	Moringanaceae	F	Tree	Fruit	Unknown
14	Jalpai	Olive	<i>Elaeocarpus robustus</i>	Elaeocarpaceae	R	Herb	Fruit	Unknown
15	Jambura	Pomelo	<i>Citrus grandis</i>	Rutaceae	R	Shrub	Fruit	LC
16	Bel	Wood Apple	<i>Angle marmelos</i>	Rutaceae	R	Tree	Fruit	Unknown
17	Sarifa	Custard apple	<i>Annona reticulata</i>	Annonaceae	R	Tree	Fruit	LC
18	Ata	Bullock's Heart	<i>Annona squamosa</i>	Annonaceae	R	Tree	Fruit	LC
19	Kamranga	Star fruit	<i>Avarrhoa carambola</i>	Avarrhoaceae	R	Tree	Fruit	Unknown
20	Tal	Palm	<i>Borassus flabollifer</i>	Arecaceae	R	Tree	Fruit	Unknown
21	Lebu	Lemon	<i>Citrus aurantifolia</i>	Rutaceae	R	Tree	Fruit	Unknown
22	Chalta	Elephant Apple	<i>Dillenia indica</i>	Dilleniaceae	R	Tree	Fruit	LC
23	Bilati gub	Valvet apple	<i>Diospyros blancoi</i>	Ebenaceae	R	Tree	Fruit	Unknown
24	Kadbel	Wood-apple	<i>Feronia limonia</i>	Rutaceae	R	Tree	Fruit	Unknown
25	Safeda	Sapota	<i>Manilkara sapota</i>	Sapotaceae	R	Tree	Fruit	Unknown
26	Amloki	Indian gooseberry	<i>Phyllanthus emblica</i>	Phyllanthaceae	R	Tree	Fruit	Unknown
27	Dalim	Palm granate	<i>Punica granatum</i>	Punicaceae	R	Tree	Fruit	LC
28	Amra	Wild Mango	<i>Spondias pinata</i>	Anacardiaceae	R	Tree	Fruit	Unknown
29	Kola	Banana	<i>Musa paradisiaca</i>	Musaceae	VC	Shrub	Fruit	Unknown
30	None Jhau	Tamarix	<i>Tamarix dioica</i>	Tamaricaceae	C	Shrub	Fuel	Unknown
31	Dalkalmi	Pink morning glory	<i>Ipomea carnea</i>	Convulvulaceae	C	Shrub	Fuel	Unknown
32	Bajna	Cape yellow wood	<i>Xanthoxylum rhetsa</i>	Rutaceae	R	Shrub	Fuel	Unknown
33	Jiga	Indian ash tree	<i>Lannea coromandelica</i>	Anacardiaceae	VC	Shrub	Fuel	LC
34	Ghrita Kumari	Aloe vera	<i>Aloe vera</i>	Liliaceae	C	Herb	Medicinal	Unknown
35	Arahor	Gandule bean	<i>Cajanus cajan</i>	Fabaceae	C	Herb	Medicinal	NT
36	Kalkasundi	Kasunda, Baner	<i>Cassia sophera</i>	Fabaceae	C	Herb	Medicinal	Unknown

S/N	Local Name	English name	Scientific name	Family	Relative abundance	Type	Use	IUCN-Global
37	Jhonjhoni	Crotalaria	<i>Crotalaria saltiana</i>	Fabaceae	C	Herb	Medicinal	Unknown
38	Dhotura	Downy thorn apple	<i>Datura metel</i>	Solanaceae	C	Herb	Medicinal	Unknown
39	Dutura	Jimson weed or datura	<i>Datura stramonium</i>	Solanaceae	C	Herb	Medicinal	Unknown
40	Tulsi	Holy Basil	<i>Ocimum sanctum</i>	Lamiaceae	C	Herb	Medicinal	Unknown
41	Futki	Gooseberry	<i>Physalis minima</i>	Solanaceae	C	Herb	Medicinal	LC
42	Berela	flannel weed	<i>Sida cordifolia</i>	Malvaceae	C	Herb	Medicinal	Unknown
43	Tit begun	Eggplant	<i>Solanum nigrum</i>	Solanaceae	C	Herb	Medicinal	Unknown
44	Kantakiri	Yellow Berried Nightshade	<i>Solanum xanthocarpum</i>	Solanaceae	C	Herb	Medicinal	Unknown
45	Kauri	Toothache Plant	<i>Spilanthus acmela</i>	Poaceae	C	Herb	Medicinal	Unknown
46	Akondo	Sodom apple	<i>Calotropis gigantea</i>	Menispermaceae	C	Shrub	Medicinal	Unknown
47	Papaw	Carica papaw	<i>Carica papaya</i>	Caricaceae	C	Shrub	Medicinal	DD
48	Joggodumur	Fig	<i>Ficus racemosa</i>	Moraceae	C	Shrub	Medicinal	LC
49	Shetodron	Thumbai	<i>Leucas aspera</i>	Lamiaceae	C	Shrub	Medicinal	Unknown
50	Bherenda	Seed oil	<i>Ricinus communis</i>	Euphorbiaceae	C	Shrub	Medicinal	Unknown
51	Ghoraneem	China berry tree	<i>Melia azadarach</i>	Meliaceae	F	Tree	Medicinal	Unknown
52	Neem	Margosa tree	<i>Azadirachta indica</i>	Meliaceae	R	Tree	Medicinal	LC
53	Tetul	Tamarind	<i>Tamarindus indica</i>	Caesalpiniaceae	R	Tree	Medicinal	LC
54	Arjun	Arjuna Myrobalan	<i>Terminalia aurjuna</i>	Combretaceae	R	Tree	Medicinal	Unknown
56	Muktajhuri	Indian acalypha	<i>Acalypha indica</i>	Euphorbiaceae	VC	Herb	Medicinal	Unknown
57	Apang	Handicapped	<i>Achyrenthes aspera</i>	Amaranthaceae	VC	Herb	Medicinal	Unknown
58	Shialkanta	Mexican poppy	<i>Argemone mexicana</i>	Papaveraceae	VC	Herb	Medicinal	unknown
59	Brammisak	water hyssop	<i>Bacopa monnieri</i>	Plantaginaceae	VC	Herb	Medicinal	LC
60	Thankoni	Indian Pennywort	<i>Centella asiatica</i>	Apiaceae	VC	Herb	Medicinal	LC
61	Batua shak	Wild spinach	<i>Chenopodium album</i>	Chenopodiaceae	VC	Herb	Medicinal	Unknown
62	Bhat	Glorybower	<i>Clerodendrum viscosum</i>	Verbanaceae	VC	Herb	Medicinal	Unknown
63	Telakucha	Little Gourd	<i>Coccinia cordifolia</i>	Cucubitaceae	VC	Herb	Medicinal	Unknown
64	Kachu	Aram	<i>Colocasia esculenta</i>	Araceae	VC	Herb	Medicinal	LC
65	Khanchira	Bengal dayflower	<i>Commelia benghalensis</i>	Commelinaceae	VC	Herb	Medicinal	Unknown
66	Nanbhantur	Variegated laurel	<i>Croton bonplandinus</i>	Euphorbiaceae	VC	Herb	Medicinal	Unknown
67	Durbagrass	Devils grass	<i>Cynodon dactylon</i>	Poaceae	VC	Herb	Medicinal	Unknown
68	Dhekishak	Vegetable Fern	<i>Diplazium esculantum</i>	Athyriaceae	VC	Herb	Medicinal	Unknown
69	Kalokeshi	Bhringraj	<i>Eclipta alba</i>	Compositae	VC	Herb	Medicinal	LC
70	Helencha	Spinach	<i>Enhydra fluctuans</i>	Asteraceae	VC	Herb	Medicinal	LC
71	Assamlata	Christmas Bush	<i>Eupatorium odoratum</i>	Asteraceae	VC	Herb	Medicinal	Unknown
72	Dhudilata	Asthma plant	<i>Euphorbia hirta</i>	Euphorbiaceae	VC	Herb	Medicinal	Unknown
73	Gimashak	Slender carpet-weed	<i>Glinus oppositifolia</i>	Mulluginacea	VC	Herb	Medicinal	Unknown

S/N	Local Name	English name	Scientific name	Family	Relative abundance	Type	Use	IUCN-Global
74	Hatishur	Indian heliotrope	<i>Heliotropium indicum</i>	Boraginaceae	VC	Herb	Medicinal	Unknown
75	Lalbherenda	bellyache bush	<i>Jatropha gossipifolia</i>	Euphorbiaceae	VC	Herb	Medicinal	Unknown
76	Matmatia	Lemon bush	<i>Lippia geminata</i>	Verbenaceae	VC	Herb	Medicinal	Unknown
78	Shushnishak	4-leaf clover	<i>Marsilea quadrifolia</i>	Marsileaceae	VC	Herb	Medicinal	LC
79	Taralata	Climbing hemp weed	<i>Mikania scandens</i>	Asteraceae	VC	Herb	Medicinal	Unknown
80	Lajjabati	Sensitive plant	<i>Mimosa pudica</i>	Mimosoideae	VC	Herb	Medicinal	LC
81	Bishkatali	Water-pepper	<i>Persicaria hydropiper</i>	Polygonaceae	VC	Herb	Medicinal	LC
82	Bhoiamra	Chamber bitter	<i>Phyllanthus urinaria</i>	Euohorbiaceae	VC	Herb	Medicinal	Unknown
83	Bishkhatali	Pepperwort	<i>Polygonum orientale</i>	Polygonaceae	VC	Herb	Medicinal	Unknown
84	Mistridana	Sweet broom	<i>Scoparia dulcis</i>	Schrophulariaceae	VC	Herb	Medicinal	Unknown
85	Kumari lata	Prickly-ivy	<i>Smilax macrophylla</i>	Smilacaceae	VC	Herb	Medicinal	Unknown
86	Tridara	Coatbuttons	<i>Tridax procumbens</i>	Compositae	VC	Herb	Medicinal	Unknown
87	Nayantara	Pri winkle	<i>Vinca rosea</i>	Apocynaceae	VC	Herb	Medicinal	Unknown
88	Nishinda	Five leaved caste trees	<i>Vitex negundo</i>	Verbenaceae	VC	Herb	Medicinal	Unknown
89	Katamaira	Slender amaranth	<i>Amiranthus viridis</i>	Amaranthaceae	VC	Shrub	Medicinal	Unknown
90	Swarnalata	Lustrous	<i>Cuscuta reflexa</i>	Cuscutaceae	VC	Shrub	Medicinal	LC
91	Radhachura	Pea cock flower	<i>Caesalpinia pulcherrima</i>	Caesalpinaceae	C	Herb	Ornament	LC
92	Rangan	jungle geranium	<i>Ixora coccinea</i>	Rubiaceae	C	Herb	Ornament	Unknown
93	Mehendi	Henna	<i>Lawsonia inermis</i>	Lythraceae	C	Herb	Ornament	LC
94	Jaba	China rose	<i>Hibiscus rosa chinensis</i>	Poaceae	C	Shrub	Ornament	Unknown
95	Kulekhara	Swamp weed	<i>Hygrophila auriculata</i>	Acanthaceae	C	Shrub	Ornament	LC
96	Kanchon	Orchid tree	<i>Bauhinia purpurea</i>	Fabaceae	C	Tree	Ornament	LC
97	Jarul	Pride of India	<i>Lagerstroemia speciosa</i>	Lythraceae	C	Tree	Ornament	LC
98	Debdaru	Mast tree	<i>Polyalthia longifolia</i>	Annonaceae	C	Tree	Ornament	Unknown
99	Bansh	Bamboo	<i>Bambusa spp.</i>	Poaceae	C	Herb	Timber	Unknown
100	Akashmoni	Ear-pod Wattle	<i>Acacia auriculiformis</i>	Mimosaceae	C	Tree	Timber	LC
101	Babla	Black Babool	<i>Acacia nilotica</i>	Mimosaceae	C	Tree	Timber	LC
102	Shirish	Siris Tree	<i>Albizia lebbek</i>	Mimosaceae	C	Tree	Timber	LC
103	Chatim	Black board tree	<i>Alstonia scholaris</i>	Apocynaceae	C	Tree	Timber	LC
104	Sada Bayen	Indian mangrove	<i>Avicennia officinalis</i>	Avicennaceae	C	Tree	Timber	LC
105	Sonalu	Golden shower	<i>Cassia fistula</i>	Caesalpinioideae	C	Tree	Timber	LC
106	Jhau	Coastal sea-oak	<i>Casuarina equisetifolia</i>	Casuarinaceae	C	Tree	Timber	LC
107	Eucalyptus	Gum tree	<i>Eucalyptus camaldulensis</i>	Myrtaceae	C	Tree	Timber	NT
108	Pitali	False white teak	<i>Mallotus nudiflorus</i>	Euphorbiaceae	C	Tree	Timber	LC
109	Kadam	Burflower-Tree	<i>Neolamarckia cadamba</i>	Rubiaceae	C	Tree	Timber	Unknown
110	Raintree	Rain tree	<i>Samanea saman</i>	Mimosaceae	C	Tree	Timber	Unknown
111	Keora	Mangrove apple	<i>Sonneratia apetala</i>	Lythraceae	C	Tree	Timber	Unknown

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.

Annex- 3: Detail Environmental Baseline Condition

S/N	Local Name	English name	Scientific name	Family	Relative abundance	Type	Use	IUCN-Global
112	Mehogani	American mahogany,	<i>Swietenia mahagoni</i>	Meliaceae	C	Tree	Timber	NT
113	Jam	Black berry	<i>Syzygium cuminii</i>	Myrtaceae	C	Tree	Timber	Unknown
114	Katbadam	Almond	<i>Terminalia catappa</i>	Combretaceae	C	Tree	Timber	LC
115	Koroi	White siris	<i>Albizia procera</i>	Mimosaceae	R	Tree	Timber	LC
116	Barun	Three leaved capers	<i>Crataeva nurvala</i>	Capparaceae	R	Tree	Timber	Unknown
117	Krishnochura	Flamboyant	<i>Delonix regia</i>	Caesalpiniaceae	R	Tree	Timber	LC
118	Gab	River ebony	<i>Diospyros eregrine</i>	Ebeanaceae	R	Tree	Timber	Unknown
119	Mandar	Indian coral tree	<i>Erythrina indica</i>	Fabaceae	R	Tree	Timber	LC
120	Bot	Banayan tree	<i>Ficus bengalensis</i>	Moraceae	R	Tree	Timber	Unknown
121	Janglidumur	Opposite leaf fig	<i>Ficus hispida</i>	Moraceae	R	Tree	Timber	LC
122	Dumur	Cluster fig	<i>Ficus racemosa</i>	Moraceae	R	Tree	Timber	LC
123	Pakur	Sacred fig tree	<i>Ficus religiosa</i>	Moraceae	R	Tree	Timber	LC

(Data source: Field survey, VC=Very Common, C=Common, R=Rare, F=Few)

12. Some Important timber trees are *Acacia nilotica*, *Albizia lebbeck*, *Albizia procera*, *Ficus benghalensis*, *Ficus hispida*, *Ficus racemose*, *Ficus religiosa*, *Eucalyptus camaldulensis*, *Syzygium cumini*, *Neolamarckia cadamba*, *Swietenia mahagoni*, *Samanea saman* and *Acacia auriculiformis*.

13. Important Fruit bearing trees are *Elaeocarpus robustus*, *Psidium guajava*, *Musa paradisiaca*, *Citrus grandis*, *Mangifera indica*, *Spondias pinnata*, *Annona reticulata*, *Annona squamosa*, *Coccoloba nucifera*, *Areca catechu*, *Avicennia zanzibarica*, *Moringa oleifera*, *Phyllanthus emblica*, *Punica granatum*, *Angle marmelos*, *Citrus aurantifolia*, *Limonia acidissima*, *Litchi chinensis*, *Manilkara sapota*, *Phoenix sylvestris*, *Dillenia indica*, *Diospyros egeria*, *Diospyros blancoi*, *Artocarpus heterophyllus*, *Zizyphus mauritiana*, *Feronia limonia* and *Borassus flabellifer*.

14. Important Medicinal plants are *Achyrocline satureioides*, *Centella asiatica*, *Vinca rosea*, *Enhydra fluctuans*, *Eupatorium odoratum*, *Mikania scandens*, *Diplazium esculantum*, *Heliotropium indicum*, *Chenopodium album*, *Commelia benghalensis*, *Eclipta alba*, *Tridax procumbens*, *Coccinia cordifolia*, *Phyllanthus urinaria*, *Acalypha indica*, *Croton bonplandinus*, *Euphorbia hirta*, *Jatropha gossypifolia*, *Ocimum sanctum*, *Aloe vera*, *Marsilea quadrifolia*, *Mimosa pudica*, *Argemone mexicana*, *Bacopa monnieri*, *Cynodon dactylon*, *Spilanthes acmela*, *Persicaria hydropiper*, *Scoparia dulcis*, *Smilax macrophylla*, *Datura metel*, *Datura stramonium*, *Physalis minima*, *Solanum nigrum*, *Solanum xanthocarpum*, *Clerodendrum viscosum*, *Lippia gerrardii*, *Vitex negundo*, *Amiranthus viridis*, *Carica papaya*, *Cuscuta reflexa*, *Ricinus communis*, *Leucas aspera*, *Calotropis gigantea*, *Ficus racemosa*, *Tamarindus indica*, *Terminalia aurajuna*, *Melia azadirachta*, *Azadirachta indica*. No threatened species were identified from the project area. Relative abundance of the identified plants area Common=51, Very Common=36, Rare=31, and Few=05.

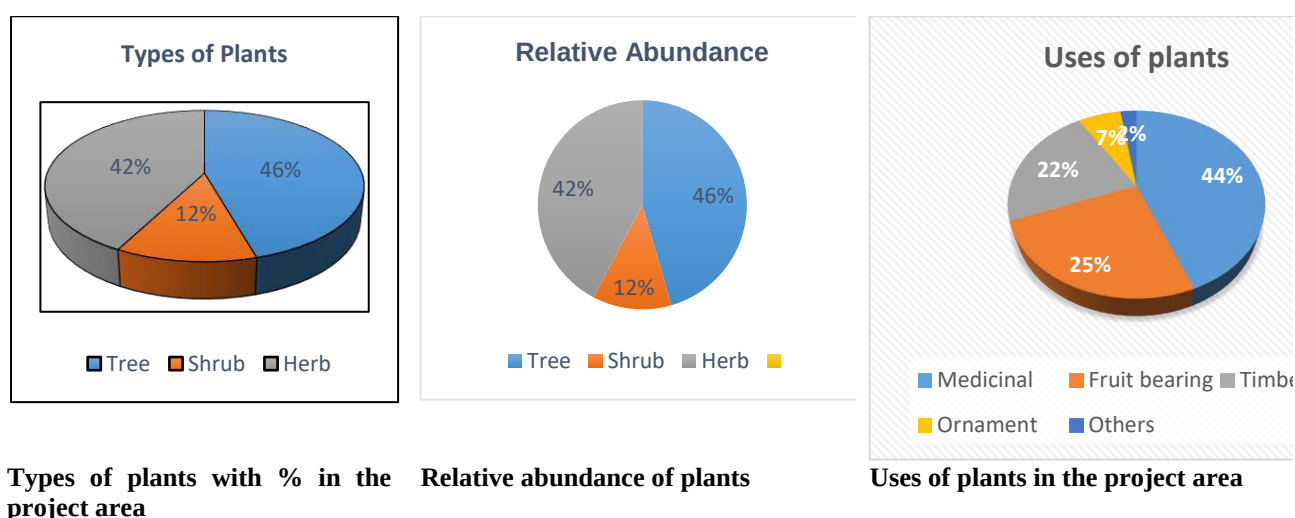


Figure 5: Types of plants, relative abundance and its use

Terrestrial fauna

In general, terrestrial fauna includes all wildlife under the classes Amphibia, Reptilia, Mammalia and Aves.

Survey Method

15. Terrestrial fauna, particularly Wildlife survey, has been done using the direct observation method and interviews with local people. Observations are done throughout the day, with emphasis on the morning (06:00 to 10:00 hr.) and evening (16:00 to 19:00 hr.) when wildlife is most active in nature. During field observation, we identified the presence of wildlife based on tracks, footprints, feeding signs, and animal/bird calls. Special habitats, like nesting and roosting habitats of birds, bats, etc., were also identified. Local people were interviewed during field observations for the determination of cryptic mammals and reptiles and seasonal variation of migratory wildlife. Several field guides were used for identification of wildlife; among them, 'Amphibians and Reptiles of Bangladesh' (Hasan et al. 2014; Whitaker et al. 2004), 'Birds of the Indian Sub-continent' (Grimmet et al. 2013) and 'A Field Guide to Indian Mammals' (Menon, V. 2003). 'Red List of Bangladesh Volume 2 – 4: Amphibians, Reptiles, Birds and Mammals' (IUCN Bangladesh, 2015) and

‘IUCN Red List of Threatened Species (Online Version 2021-3)’ (IUCN, 2021) are used for the determination of global threatened categories of wildlife. Wildlife (Conservation and Security) Act 2012 and CITES List 2021 are reviewed for the determination of protection status of wildlife in local and global contexts. Species richness has been measured using a widely used method:

Species richness = Total number of species/Total area surveyed.

Terrestrial wildlife

Amphibians

Table 24: List of Amphibians Identified in the project AOI with IUCN Status, distribution and habitat

Sl. No.	Local Name	English Name	Scientific Name	Family	Relative abundance	Status		
						IUCN-BD	IUCN-GL	WCSA
1	Kuno Bang	Asian Common Toad	<i>Duttaphrynus melanostictus</i>	Bufonidae	VC	LC	LC	Schedule - II
2	Katkati Bang	Skipper Frog	<i>Euphlyctis cyanophytis</i>	Dicroglossidae	VC	LC	LC	Schedule - II
3	Shobuj Bang	green pond frog,	<i>Euphlyctis hexadactylus</i>	Dicroglossidae	VC	LC	LC	Schedule-1
4	Kakrabhuk Bang	Crab-eating Frog	<i>Fejervarya cancrivora</i>	Dicroglossidae	C	LC	LC	Unknown
5	Syhadra Jhi-jhi Bang	Bombay Wart Frog	<i>Fejervarya syhadrensis</i>	Dicroglossidae	F	LC	LC	Schedule - II
6	Sona Bang	Indian Bullfrog	<i>Hoplobatrachus tigerinus</i>	Dicroglossidae	C	LC	LC	Schedule-1
7	pana bang	Green puddle frog	<i>Hylarana taylori</i>	Ranidae	C	LC	Unknown	Schedule 1
8	Venpu Bang	Painted Bull Frog	<i>Kaloula pulchra</i>	Microhylidae	F	NT	LC	Schedule - I
9	Dorakata Gecho Bang	Common Tree Frog	<i>Polypedates leucomystax</i>	Rhacophoridae	FC	LC	LC	Schedule - II
10	Chitra Gecho Bang	Indian tree frog	<i>Polypedates maculatus</i>	Rhacophoridae	C	LC	LC	Unknown -

Abbreviation: VC = Very Common, C = Common, F = Few, O = Occasional, CR = Critically Endangered, EN = Endangered, Vu = Vulnerable, LR = Lower Risk, DD = Data Deficient, M = Migratory, R = Resident, Bh = Bush, Op = Open place, Hh = Human habitation, Cl = Cultivated land, Tt = Tall tree, H = Hole, R = River, P = Pond, C = Canal, Dt = Ditch, We = Water edge, Ri = River

Reptiles

16. A total of 8 species of reptiles were recorded in the study. Whereas another study found 17 species of reptiles from Mirsharai Upazila in 2018, of which, 9 were lizards and 3 species of snakes. Out of these Girgiti, Chameleo (*Chamaeleo chamaeleon*), House Gecko (*Hemidactylus*)

Table 25: List of Reptiles Identified in the project AOI with IUCN Status, distribution and habitat

S/N	Local Name	English Name	Scientific Name	Sighting	IUCN Local status	IUCN Global status	Habitat
1	Tiktiki	Spotted House Lizard	<i>Hemidactylus brookii</i>	C	LR	LC	Bh, Op
2	Rokto-chosa	Common Garden Lizard	<i>Calotes versicolor</i>	VC	LR	Unknown	Bh, Op
3	Anjoni	Common Skink	<i>Mabuya carinata</i>	VC	LR	LC	Bh, Op

S/N	Local Name	English Name	Scientific Name	Sighting	IUCN Local status	IUCN Global status	Habitat
4	Dhora-shap	Cheekered Keel back Snake	<i>Xenochorphis piscator</i>	C	LR	Unknown	P, C, Dt
5	Dhora-shap	Stripped Keel back snake	<i>Amphiesma stolatum</i>	C	LR	LC	Bh, Op
6	Darash shap	Rat Snake	<i>Coluber mucosus</i>	C	LR	LC	Bh, Op
7	Girgiti	Grey Indian Monitor	<i>Varanus benghalensis</i>	C	LR	Unknown	Tt, Op
8	Kocchop	Striped Roof Turtle	<i>Kachuga dhongoka</i>	O	EN	CR	Ri

Abbreviation: VC = Very Common, C = Common, F = Few, O = Occasional, CR = Critically Endangered, EN = Endangered, Vu = Vulnerable, LR = Lower Risk, DD = Data Deficient, Bh = Bush, Op = Open place, Hh = Human habitation, Cl = Cultivated land, Tt = Tall tree, H = Hole, P = Pond, C = Canal, Dt = Ditch, Ri = River.

Mammals

17. As per the discussion with local people, deer and foxes are found in the planted mangrove forests (Charsarat mangrove) area, but none were spotted during the visit. However, Ramgarh forest does not fall within a 10 km radius area/AOI.

18. In total 10 species of mammals were recorded in the study area as well as confirmed with the consultation of community people (Table 12). However, another study found a total of 26 species of mammals from the Mirsharai Upazila in 2018. Of them, only the Fishing cat (*Prionailurus viverrinus*) is a Vulnerable species.

The greater short-nosed fruit bat (*Cynopterus sphinx*), or short-nosed Indian fruit bat, is a species of megabat in the family Pteropodidae. Bats are flying mammals of the order Chiroptera with their forelimbs adapted as wings, they are the only mammals capable of true and sustained flight. Bats are more agile in flight than most birds, flying with their very long spread-out digits covered with a thin membrane or patagium. A bat was seen in the zone-13, collecting juice from a date tree



Table 26: List of Mammals Found in the Project AOI with IUCN Status

S/N	Local Name	English Name	Scientific Name	Family	IUCN-Global
1	Metho-indur	Lesser bandicoot rat	<i>Bandicota bengalensis</i>	Muridae	LC
2	Badami Kathbirali	Irrawaddy squirrel	<i>Callosciurus pygerythrus</i>	Sciuridae	LC
3	Shial	Golden jackal	<i>Canis aureus</i>	Canidae	LC
4	Kola Badur	Greater short-nosed fruit bat	<i>Cynopterus sphinx</i>	Pteropodidae	LC
5	Bon Bilai	Jungle cat	<i>Felis chaus</i>	Felidae	NT
6	Moucha Bejji	Crab-eating mongoose	<i>Herpestes urva</i>	Herpestidae.	NT
7	Banor	Rhesus macaque	<i>Macaca mulatta</i>	Cercopithecidae	LC
8	Mesobiral	Fishing cat	<i>Prionailurus viverrinus</i>	Felidae	VU
9	Baro Badur	Indian flying fox	<i>Pteropus giganteus</i>	Pteropodidae	LC
10	Indur	Black rat	<i>Rattus</i>	Muridae	LC

Abbreviation: VC = Very Common, C = Common, F = Few, O = Occasional, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LC = Least Concern, LR = Lower Risk, DD = Data Deficient

19. Rat Snake (*Coluber mucosus*) and Checkered Keelback (*Xenochropis piscator*) were observed by the survey team during the field survey. The rest of the reptilian fauna were reported to be observed by locals during field consultations in the villages of AOI. Many of the fauna are listed here by consultation with the local people.



Chameleon (Girihiti) in the project area



Species identification technique by fishermen

Photograph: List of Reptiles Found in the Project AOI with IUCN Status

Terrestrial Avifauna

20. A total of 70 species of birds were identified from the terrestrial site of our current study (Figure 19 and Appendix 6). Whereas in another study recorded 109 species of birds in the Mirsharai Upazila (Anonymous 2018). Some species of birds such as House crow (*Corvus splendens*), Baya Weaver (*Ploceus philippinus*), Asian Pied Starling (*Sturnus contra*), Ruddy shelduck (*Tadorna ferruginea*), Dove (*Streptopelia suratensis*), House sparrow, Koyal/Kokil (*Eudynamys scolopaceus*), Machranga/Kingfisher (*Halcyn smyrensis*), Oriental Magpie Robin (*Copsychus saularis*), Blue Rock dove (*Columba livia*), Black Dhorongo/Finge (*Dicrurus macrocercus*), Common Tailor Bird (*Orthotomus sutorius*), Little Cormorent (*Phalacrocorax niger*), Palash fish Eagle, Common Myna (*Acridotheres tristis*), White breasted waterhen (*Amaurornis phoenicurus*), Indian Pond Heron (*Ardeola grayii*), Cattle egret (*Bubulcus ibis*), Little Egret (*Egretta garzetta*), Great Egret (*Casmerodius albus*), Pond Heron (*Ardeola grayii*) are found in the study area.



The great egret (*Ardea alba*)



Black drongo (*Dicrurus macrocercus*)



Common myna or Indian myna



Common Pigeon, Jalali Kobutor



jungle myna (*Acridotheres fuscus*)



House crow

Photograph: Commonly Found Avifauna in the Project Site

Table 27: Table: List of Avifauna Identified in the Study Area

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundance	IUCN GL	WCSA BD
1	Sturnidae	<i>Acridotheres fuscus</i>	Jungle Myna	Jhuti Shalik	VC	LC	Schedule – II
2	Sturnidae	<i>Acridotheres ginginianus</i>	Bank Myna	Gang Shalik	C	LC	Schedule – I
3	Sturnidae	<i>Acridotheres tristis</i>	Common Myna	Bhat Shalik	VC	LC	Schedule – II
4	Sylviidae	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler	Passerine bird	C	LC	Schedule – I
5	Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper	Pati Batan	C	LC	Schedule – II
6	Alcedinidae	<i>Alcedo atthis</i>	Common Kingfisher	Pati Machranga	C	LC	Schedule – II
7	Rallidae	<i>Amaurornis phoenicurus</i>	White-breasted Waterhen	Dahuk	C	LC	Schedule - II
8	Ciconidae	<i>Anas acuta</i>	Northern Pintail	Lenja Hans	C	LC	Unknown
9	Ciconidae	<i>Anastomus oscitans</i>	Asian Openbill	Sam Khol	FC	LC	Schedule – I
10	Motacillidae	<i>Anthus rufulus</i>	Paddy field Pipit	Dhani Tulika	F	LC	Schedule - II
11	Ardeidae	<i>Ardeola grayii</i>	Indian Pond Heron	Kani Bok	VC	LC	Schedule – I
12	Ardeidae	<i>Ardea alba</i>	Great Egret	Go Bok	VC	LC	Schedule – II
13	Cuculidae	<i>Cacomantis merulinus</i>	Plaintive Cuckoo	Korno Papia	FC	LC	Schedule - I
14	Picidae	<i>Celeus brachyurus</i>	Rufous Woodpecker	Khoira Kathkurali	FC	LC	Schedule – I
15	Cuculidae	<i>Centropus sinensis</i>	Greater Coucal	Kana Ko	C	LC	Schedule - I
16	Charadriidae	<i>Charadrius dubius</i>	Little Ringed Plover	-	FC	LC	Schedule – I
17	Charadriidae	<i>Charadrius mongolus</i>	Lesser Sand Plover	Chhoto Duljiria	FC	LC	Schedule – II
18	Laridae	<i>Chlidonias hybrida</i>	Whiskered Tern	Julphi Panchil	FC	LC	Schedule – I
19	Columbidae	<i>Columba livia</i>	Common Pigeon	Jalali Kobutor	VC	LC	Schedule – I
20	Muscicapidae	<i>Copsychus saularis</i>	Oriental Magpie Robin	Doel	C	LC	Schedule - II
21	Coraciidae	<i>Coracias benghalensis</i>	Indian Rollar	Bangla Nilkanto	FC	LC	Schedule – I
22	Corvidae	<i>Corvus leuallantii</i>	Jungle Crow	Dar Kak	FC	LC	Schedule - II
23	Corvidae	<i>Corvus splendens</i>	House Crow	Pati Kak	C	LC	Schedule – II
24	Cuculidae	<i>Cuculus micropterus</i>	Indian Cuckoo	Boukothakou Papia	C	LC	Schedule – II
25	Apodidae	<i>Cypsiurus balasensis</i>	Asian Palm Swift	Asio Talbatashi	VC	LC	Schedule – I
26	Corvidae	<i>Dendrocitta vagabunda</i>	Rufous Treepie	Harichacha	C	LC	Schedule – II

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annex- 3: Detail Environmental Baseline Condition

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundance	IUCN GL	WCSA BD
27	Dendrocygnidae	<i>Dendrocygna javanica</i>	Lesser Whistling Duck	Pati Sorali	C	LC	Schedule – I
28	Dicruridae	<i>Dicrurus macrocercus</i>	Black Drongo	Finge	VC	LC	Schedule – II
29	Picidae	<i>Dinopium benghalensis</i>	Black-rumped Flameback	Bangla Kaththokra	C	LC	Schedule - II
30	Ardeidae	<i>Egretta garzetta</i>	Little Egret	Chhoto Boga	C	LC	Schedule - II
31	Cuculidae	<i>Eudynamis scolopacea</i>	Western Koel	Asio Kokil	C	LC	Schedule - II
32	Falconidae	<i>Falco tinnunculus</i>	Common Kestrel	-	FC	LC	Schedule – II
33	Scolopacidae	<i>Gallinago</i>	Common Snipe	Pati Chega	FC	LC	Schedule – I
34	Scolopacidae	<i>Gallinago stenura</i>	Pin-tailed Snipe	Lenja Chega	C	LC	Schedule – I
35	Accipitridae	<i>Haliastur indus</i>	Brahminy Kite	Sonkho Chil	C	LC	Schedule - II
36	Cuculidae	<i>Hierococcyx varius</i>	Common Hawk Cuckoo	Pati Chokhgelo	FC	LC	Schedule – II
37	Ardeidae	<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	Lal Bogi	C	LC	Schedule – I
38	Strigidae	<i>Ketupa zeylonensis</i>	Brown Fish Owl	Hutum Pecha	F	LC	Schedule – I
39	Lanidae	<i>Lanius cristatus</i>	Brown Shrike	Khoira Latora	VC	LC	Schedule – II
40	Lanidae	<i>Lanius schach</i>	Long-tailed Shrike	Lenja Latora	C	LC	Schedule – II
41	Laridae	<i>Larus ridibundus</i>	Black-headed Gull	Kala Matha Jol Kobutor	F	LC	Schedule - II
42	Estrillidae	<i>Lonchura punctulata</i>	Scally-breasted Munia	Butibuk Munia	F	LC	Schedule – I
43	Anatidae	<i>Mareca strepera</i>	Gadwall	Gadwall	FC	LC	Schedule – I
44	Sylviidae	<i>Megalurus palustris</i>	Striated Grassbird	Dagi Ghas Pakhi	FC	LC	Schedule - II
45	Meropidae	<i>Merops orientalis</i>	Asian Green Bee-eater	Sobuj Suichora	FC	LC	Schedule - II
46	Ardeidae	<i>Mesophoyx intermedia</i>	Intermediate Egret	Majhla Boga	C	LC	Schedule – II
47	Accipitridae	<i>Milvus migrans</i>	Black Kite	Kalo Chil	C	LC	Schedule – II
48	Motacillidae	<i>Motacilla alba</i>	White Wagtail	Sada Khonjon	C	LC	Schedule - II
49	Motacillidae	<i>Motacilla maderaspatensis</i>	White-browed Wagtail	Dholabhru Khonjon	FC	LC	Schedule – I
50	Nectariniidae	<i>Nectarinia asiatica</i>	Purple Sunbird	Beguni Moutushi	FC	LC	Schedule – I
51	Nectariniidae	<i>Nectarinia zeylonica</i>	Purple-rumped Sunbird	Beguni Komor Moutushi	FC	LC	Schedule – I
52	Ardeidae	<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	Nishi Bok	FC	LC	Schedule – I

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annex- 3: Detail Environmental Baseline Condition

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundance	IUCN GL	WCSA BD
53	Oriolidae	<i>Oriolus xanthornus</i>	Black-hooded Oriole	Holde Pakhi	C	LC	Schedule – II
54	Sylviidae	<i>Orthotomus sutorius</i>	Common Tailorbird	Tuntuni	VC	LC	Schedule – II
55	Paridae	<i>Parus major</i>	Great Tit	Boro Tit	C	LC	Schedule – I
56	Passeridae	<i>Passer domesticus</i>	House Sparrow	Ghor Chorui	VC	LC	Schedule - II
57	Phalacrocoracidae	<i>Phalacrocorax niger</i>	Little Cormorant	Pati Pankouri	VC	LC	Schedule – I
58	Passeridae	<i>Ploceus philippinus</i>	Baya Weaver	Deshi Babui	FC	LC	Schedule – I
59	Psittacidae	<i>Psittacula krameri</i>	Rose-ringed Parakeet	Sabuj Tia	F	LC	Schedule – II
60	Pycnonotidae	<i>Pycnonotus cafer</i>	Red-vented Bulbul	Laltala Bulbul	VC	LC	Schedule - II
61	Pycnonotidae	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	Sipahi Bulbul	FC	LC	Schedule – I
62	Laridae	<i>Sterna albifrons</i>	Little Tern	Choto Panchil	FC	LC	Schedule – I
63	Laridae	<i>Sterna aurantia</i>	River Tern	Nadia Panchil	R	NT	Schedule – I
64	Columbidae	<i>Streptopelia decaocto</i>	Eurasian Collared Dove	Eurasio Kanthi Ghugu	C	LC	Schedule – I
65	Sturnidae	<i>Sturnus contra</i>	Asian Pied Starling	Go Shalik	VC	LC	Schedule – II
66	Podicipedidae	<i>Tachybaptus ruficollis</i>	Little Grebe	Chhoto Duburi	FC	LC	Schedule – I
67	Anatidae	<i>Tadorna ferruginea</i>	Ruddy shelduck	Khoira Chokachoki	C	LC	Unknown
68	Timalidae	<i>Turdoides earlei</i>	Striated Babbler	Dagi Chhatare	FC	LC	Schedule – I
69	Charadriidae	<i>Vanellus cinereus</i>	Grey-headed Lapwing	Metematha Titi	F	LC	Schedule – II
70	Charadriidae	<i>Vanellus indicus</i>	Red-wattled Lapwing	Hot Titi	FC	LC	Schedule – I

B.2 AQUATIC ECOSYSTEMS

21. Aquatic habitat in the project area. A total of 23 species of aquatic plants were recorded (Table 27)

Table 28: List of Aquatic Plants in the Project Area

Sl. No	Local Name	Common Name	Scientific Name	Family	IUCN-Global status
1	Mushak Dana	Musk Mallow	<i>Abelmoschus moschatus</i>	Malvaceae	Unknown
2	Malanchai	Alligator Weed	<i>Alternanthera philoxeroides</i>	Amaranthaceae	Unknown
3	Brahmisak	Water Hyssop	<i>Bacopa monnieri</i>	Plantaginaceae	LC
4	Phutki	Balloon Vine	<i>Cardiospermum halicacabum</i>	Sapindaceae	Unknown
5	Kochu	Arum	<i>Colocasia esculenta</i>	Araceae	LC
6	Kanaidoga	Day Flower	<i>Commelina appendiculata</i>	Commelinaceae	Unknown
7	Kachuripana	Water Hyacinth	<i>Eichhornia crassipes</i>	Pontederiaceae	Unknown
8	Helencha	Water cress	<i>Enhydra fluctuans</i>	Asteraceae	Unknown
9	Hatishur	Indian Heliotrope	<i>Heliotropium indicum</i>	Boraginaceae	Unknown
10	Kalmishak	Water spinach	<i>Ipomea aquatica</i>	Convolvulaceae	Unknown
11	Kolmishak	Swamp Morning Glory	<i>Ipomoea aquatica</i>	Convolvulaceae	LC
12	Dholkolmi	Pink Morning Glory	<i>Ipomoea carnea</i>	Convolvulaceae	Unknown
13	Arail	Southern Cutgrass	<i>Leersia hexandra</i>	Poaceae	LC
14	Khudipana	Duckweed	<i>Lemna minor</i>	Araceae	LC
15	Matmatia	Bushy Lippia	<i>Lippia geminata</i>	Verbenaceae	Unknown
16	Keshordam	Water Primrose	<i>Ludwigia adscendens</i>	Onagraceae	LC
17	Sushnishak	Water Clover	<i>Marsilea quadrifolia</i>	Marsileaceae	LC
18	Chadmala	Banana Lily	<i>Nymphoides aquatica</i>	Menyanthaceae	LC
19	Amroolshak	Creeping Wood sorrel	<i>Oxalis corniculata</i>	Oxalidaceae	Unknown
20	Futki	Native Goose berry	<i>Physalis minima</i>	Solanaceae	Unknown
21	Topapana	Water Cabbage	<i>Pistia stratiotes</i>	Araceae	LC
22	Pani Biskhatali	Water Pepper	<i>Poligonum lanatum</i>	Poligonaceae	Unknown
23	Bishkatali	Water Pepper	<i>Polygonum hydropiper</i>	Polygonaceae	LC

FRESH WATER FISHES

22. A total of 59 species of freshwater and brackish water fishes were identified within the impact site. Fisheries resources of the study area are rich and diversified. Fish habitats of the study area are creeks, Khal, rivers, aquaculture ponds, and natural ponds. Water in these bodies varies from fresh to brackish. Both natural and aquaculture fisheries exist in the study area. The khals that drain into the Sandwip Channel have moderate species diversity. Species diversity is higher in the estuarine mouth compared to that of its upstream direction.

23. Fish survey to be based on direct observation and interview with local people, especially fishers. A pictorial data collection format used for the identification of fish at the field by the local people. IUCN Red List of Threatened Species (Online Version 2020-1) (IUCN, 2020) will also be reviewed for the determination of globally threatened categories of fish.

24. Consultation was carried out with the fishermen in the study area to gain knowledge about the fish species in canals, Khals, Beels, ponds, etc. 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/Taposhi, Lorka, Senuwa, Loitta, Nylostika, Mud crabs, Holona, mrigal, silver carp, gras carp, karpoo, barbs (putis), Chitol, Folai, catfish (Tengra, Singi, Magur, Boal, Pungus), Snakehead (Shol, Taki), bele etc. In total, 59 species of fish were identified that are in **Table 28** and also cross-checked with EIA report on Mirsharai (2015)

Table 29: List of Fresh Water and Brackish Water Fish Species Found in the Project Impact Area

Sl.No.	Local Name	English name	Scientific Name	IUCN-Local	IUCN Global
1	Kajuli	Catfish	<i>Ailia coilia</i>	NT	Unknown
2	Mola Carplet	Mola carplet	<i>Amblypharyngodon mola mola</i>	LC	LC
3	Koi	Climbing perch	<i>Anabas testudineus</i>	LC	LC
4	Teen Chokha	Blue panchax	<i>Aplocheilichthys panchax</i>	LC	LC
5	Dalli Chewa	Minute Mudskipper	<i>Apocryptes bato</i>	LC	LC
6	Queen Loach	Bengal loach	<i>Botia Dario</i>	EN	LC
7	Catla	Bengal Carp	<i>Catla</i>	LC	LC
8	Nama Chanda	Elongate glassy perchlet	<i>Chanda nama*</i>	LC	LC
9	Gajar	Bullseye snakehead	<i>Channa marulius**</i>	EN	LC
10	Telo Taki	Ceylon snakehead	<i>Channa orientalis</i>	LC	VU
11	Taki	spotted snakehead	<i>Channa punctata</i>	LC	LC
12	Shol	Striped snakehead	<i>Channa striata</i>	LC	LC
13	Chhep chela	Chela	<i>Chela cachius</i>	VU	LC
14	Mrigal	mrigal carp	<i>Cirrhinus cirrhosus</i>	NT	VU
15	Magur	Walking catfish	<i>Clarias batrachus</i>	LC	LC
16	Ghaura	Guarchacha	<i>Clupisoma garua</i>	EN	LC
17	Khailsha	Labyrinth Fish	<i>Colisa fasciata</i>	LC	LC
18	Kachki	Ganges river sprat	<i>Corica soborna</i>	LC	LC
19	Kukur Jeeb	Bengal tonguesole	<i>Cynoglossus</i>	LC	LC
20	Common carp	Common carp	<i>Cyprinus carpio</i>	VU	VU
21	Nipati	Moustached danio	<i>Danio dangila</i>	VU	LC
22	Darka	Flying barb	<i>Esomus danricus</i>	LC	LC
23	Bacha	Schilbid catfish	<i>Eutropiichthys vacha</i>	LC	LC
24	Bailla	Bareye Goby	<i>Glossogobius giuris</i>	LC	LC
25	Chapila	Indian river shad	<i>Gudusia chapra</i>	VU	LC
26	Shingee	Fossil cat	<i>Heteropneustes fossilis</i>	LC	LC
27	Decre Poa	Koitor poa	<i>Johnius coitor</i>	LC	LC
28	Koitor	Coitor croaker	<i>Johnius coitor</i>	LC	LC
29	Bata	Batafish/Minor carp	<i>Labeo bata</i>	LC	LC
30	Baus	orange fin labeo	<i>Labeo calbasu</i>	LC	LC
31	Gonia	Kuria labeo	<i>Labeo gonius</i>	NT	LC
32	Rui	Multipurpose carp	<i>Labeo rohita</i>	LC	LC
33	Tara Baim	Lesser spiny eel	<i>Macrognathus aculeatus</i>	NT	LC
34	Kuchia	Eel fish	<i>Monopterusuchia</i>	VU	LC
35	Nuna-tengra	Long whiskers catfish	<i>Mystus gulio</i>	NT	LC
36	Tengara Mystus	Tengara	<i>Mystus tengara**</i>	LC	LC
37	Tengra	Striped dwarf catfish	<i>Mystus vittatus</i>	LC	LC
38	Bheda	Gangetic leaf fish	<i>Nandus</i>	NT	LC
39	Indian Potasi/ Bashpata	Emerald shiner	<i>Neotropius atherinoides</i>	LC	LC
40	Foli	Bronze featherback	<i>Notopterus notopterus</i>	VU	LC
41	Boali Pabda	Butter catfish	<i>Ompok bimaculatus</i>	EN	NT
42	Pabda	Pabdah catfish	<i>Ompok pabda</i>	EN	NT
43	Pangas	Mild-flavored white-fleshed fish	<i>Pangasius pangasius</i>	EN	LC
44	Tapasi	paradise threadfin	<i>Polynemus paradiseus</i>	NT	LC
45	Chewa	bony fishes	<i>Pseudapocryptes elongatus</i>	LC	LC
46	Pool Barb	The pool barb	<i>Puntius sophore</i>	LC	LC
47	Teri Punti	One spot barb	<i>Puntius terio</i>	LC	LC
48	Tit punti	Ticto barb	<i>Puntius ticto</i>	VU	LC
49	Darkina	Rasbora	<i>Rasbora rasbora</i>	NT	LC
50	Chela	large razorbelly minnow	<i>Salmostoma bacaila</i>	LC	LC
51	Phasa	Gangetic hairfin anchovy	<i>Setipinna phasa</i>	LC	LC
52	Teli Phasa	Scaly hairfin anchovy	<i>Setipinna taty</i>	LC	LC
53	Dhain	Silond catfish	<i>Silonia silondia</i>	LC	LC
54	Bhangat	Long-whiskered catfish	<i>Sperata aor</i>	VU	LC

Sl.No.	Local Name	English name	Scientific Name	IUCN-Local	IUCN Global
55	Baila	Knight Goby	<i>Stigmatogobius sadanundio</i>	LC	Unknown
56	Sada Chewa	Burrowing goby	<i>Trypauchen vagina</i>	LC	LC
57	Boal	Helicopter fish	<i>Wallago attu</i>	VU	VU
58	Boa	Great white sheatfish	<i>Wallago attu</i>	VU	VU
59	Kankila	Freshwater garfish	<i>Xenentodon cancila</i>	LC	LC

Source: Field survey and local consultations, 2023

. * Abbreviation: VC = Very Common, C = Common, F = Few, O = Occasional, CR = Critically Endangered, EN = Endangered, Vu = Vulnerable, LR = Lower Risk, DD = Data Deficient, M = Migratory, R = Resident, Bh = Bush, Op = Open place, Hh = Human habitation, Cl = Cultivated land, Tt = Tall tree, H = Hole, R = River, P = Pond, C = Canal, Dt = Ditch, We = Water edge, Ri = River

Fish Market Survey

25. For fish species identification and investigation visited some fish markets, like Abu Torab Bazar, Jolodas para, Sarker para, Itchakhali Bazar, Bamon Sundar Dorgar Hat, and so on. Fishermen fishing at the Ichakhali, Shaherkhali, and Bamon Sundar Khal, and fish farms. Photographs of fish are given below.



Pabda, Gaura fish



Poa, and Chingri



Tilapia fish and Chingri



Discussion with fishermen, fishing at Ichakhali Khal



Tilapia, Pabda, Gaura fishes



Tengra, Bata fishes



Chingri, Gaura



Chingri



Bagda chingri, Baila, Tengra, poti, shorpoti, etc.



Chiringi



Chapila



Sorting out of fishes by fishermen

26. Fish species also identified through pictorial view with fishers in the fishing communities.



Pictorial of freshwater fish for identification by fishermen.



Learners are very interested in identifying the fish species (Pictorial Photographs of fish)

Fish species identification through pictorial view

Fish identification through pictorial view with fishermen at Jaladas para



Marine fish species Identification at Baro Kumira fish landing centre through pictorial view with fishing community.





Photograph: Photograph from Abu Torab Bazar, Boro Kumira ghat and Bamon sundar Dorgarhat bazar. Species area Poa, Koral, Loitta, sada chingri

Consultation with Forest Officer

Mr. Abdul Gaffor Mollah is a Forest Beat Officer short meeting conducted with him. He said that 23,200 acres of forest land handed over to BEZA for this project through DC. He also said that once Deer, monkey, and jackal/fox were in the project area due to development activities, scarcity of food and shelters, did not observed in the NSEZ area. In the Forest beat office area, nursery or seedling production is ongoing and afforestation is also ongoing in the different locations of the project.



Livestock and Poultry

27. Livestock and poultry, being an essential sector of the integrated farming system, play an important role in the economy of the study area (Figure 6). 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 reduces poverty by generating employment and income.

28. During the visit, the site observed three types of domestic animals grazing the surrounding project area, mainly buffalo, cow, and sheep in the three locations distinctly. The owners of the livestock population are facing problems in respect to the availability of fodder and feeds during the months from March to December due to a shortage of grazing fields. Not only are development activities ongoing, but also infrastructure development.



Buffalo grazing in the project area



Take rest in the water because of high temperature



Sheep grazing area

Photograph: Common Livestock Found in the Project Area

29. During the visit site was observed three types of domestic animals were observed grazing surrounding the Project area mainly buffalo, cow, and sheep in the three locations, distinctly. The owners of the livestock population are facing problems in respect of the availability of fodder and feeds during the month from March to December due to a shortage of grazing fields.



Photograph: Aquaculture in the core zone of NSEZ

B. 3 MARINE ECOLOGICAL ASSESSMENT

Introduction

30. Hydrologically ‘Estuary’ is the most productive and variable place in which fresh water from upstream source mixes with the salt water from oceanic sources (Alexander et al 1935; Devasy and Gopinathan, 1970; Spencer, 1956). In general, life in the sea, estuary, and river can be divided into three groups: plankton, nekton and benthos. The main components of phytoplankton are diatoms and dinoflagellates. Phytoplankton are the primary base of the food web, hence supporting the productivity of upper trophic level consumers, including zooplankton, fish, and shrimp. Zooplankton refers to all the aquatic fauna, macroscopic or microscopic, with such a limited swimming ability that they are forced to float passively with the movement of water. Benthos is the community that lives on/in the bottom deposits of water. Benthic macroinvertebrates are important food web members of estuarine ecosystem, particularly in areas with high detritus matter. They are essential food sources for fish, shrimp and other aquatic consumers. The macrobenthos plays remarkable contribution in the mineralization, promoting and mixing of sediments and flux of oxygen into sediments, cycling of organic amount in matter (Bilgrami, 1985). Environmental changes in a river are reflected in the benthic organisms as the suspended solids/matters ultimately sinks to the bottom to decompose and thus cause a change in the benthic organisms. Direct effects of sediment extraction can include an initial reduction in species diversity, abundance, and biomass (Sutton and Boyd 2009). Benthic fauna can be categorized according to their size as macrofauna ($>0.5\text{ }\mu\text{m}$), meiofauna ($62\text{ }\mu\text{m}-0.5\mu\text{m}$) and microfauna ($<62\text{ }\mu\text{m}$). Their composition is determined by the nature of water flowing over them, and thus, they generally indicate the water quality. Benthic organisms are also influenced by the associated sediment texture, which may limit the distribution of certain organisms with the sediment (Davis, 1961). So High species diversity values reflect on the stability of the environment and the fluctuation of parameters is the limiting factor for the distribution of benthos (Samidurai et al., 2012). Therefore, a comprehensive assessment of pelagic (Phyto and zooplankton) and benthic organisms can provide an important baseline, indicate the ecosystem health, and guide in predicting the impact of human interventions.

31. When compared to the resources needed, the percentage of terrestrial and marine protected areas worldwide is 15.4% and 7.8%, respectively. Furthermore, biodiversity is found outside of these regions, where human risks pose a threat. Since most urban species are on the verge of extinction owing to habitat loss and unchecked development, wildlife is far safer in rural regions than in urban ones. These days, the coasts are crucial for supporting a variety of animal species, particularly avifauna. Owing to its strategic location at the meeting point of two very rich biogeographical realms—the Indo-Himalayan and Indo-China sub-regions—in the eastern region, this small South Asian nation has a large wealth of biodiversity (Khan 2018, IUCN BD 2015). Until now, 57 species of amphibians, 167 reptiles, 690 birds, and 127 species of mammals have been recorded from Bangladesh, which indicates the rich vertebrate wildlife diversity of this country (Shome et al. 2021). Among the wildlife species, many wildlife groups live in coastal areas. In all types of habitats, ecological resources mean the abiotic and biotic components of an ecosystem, which are important for maintaining the ecological system. Ecological resources play an important role in an area for ecological, environmental, and cultural sectors.

Objectives

- This baseline survey of current flora and fauna aimed to achieve the following specific objectives:
- Compiling an inventory of the existing flora and fauna, including plankton and benthos composition in the project zone
- Identifying endangered species of both plants and animals
- Types of ecosystems and wildlife habitats within the area
- Identifying potential threats to wild plants, animals, critical habitats, and ecosystems arising from project activities

Study Area

32. The Precinct F (Project area and Housing Facilities) and Precinct B are important areas of NSEZ; thus, development and land filling are a priority work for the NSEZ. To develop the land project activities under the NSEZ, include land filling using dredged materials from the Sandwip channel. It is estimated that about 16,000,000 cum dredging volume will be required to fill 1200 acres existing land.

Justification of the Ecological Sampling Site Selection

33. Project authority, BEZA, is planning to dredge from the Sandwip channel and surrounding areas in order to land development of part of Precinct F (Project area and Housing Facilities) and Precinct B of NSEZ. Before implementing the plan, consultants marked 12 locations at the Sandwip channel for marine ecological assessment based on criteria such as review of secondary report, site observation and visualization, assessment, overlay, distance from dredging location to landfilling and creation of geospatial data through using Google Earth Pro. Sampling a coastal river channel for dredging might be considered for several reasons:
34. Coastal river channels are often crucial for navigation, supporting the transportation of goods and fostering economic activities. Dredging can be essential to maintain or improve the navigability of these channels, ensuring the efficient movement of vessels.
35. Coastal rivers are susceptible to sedimentation, leading to reduced channel capacity and increased flood risk. Sampling and dredging can help manage sedimentation, maintain the channel's capacity to handle water flow and mitigate the risk of flooding in downstream areas.
36. Being part of important infrastructure, such as ports and harbors, regular dredging can be necessary to prevent the accumulation of sediments that could impede the functioning of these facilities.
37. In some cases, selective dredging in coastal river channels may be undertaken for ecological restoration purposes. This could involve removing excess sediment to enhance habitat diversity, promote the growth of vegetation, and support the recovery of aquatic ecosystems.
38. Coastal rivers are often a source of sand, which is a valuable resource for construction and other industries. Sustainable sand mining practices involve careful sampling and dredging to manage the extraction of sand while minimizing environmental impacts.
39. Among these 12 locations, 4 locations (Site No- 5, 7, 8, 9) were selected for ecological sampling (Figure-7) these sampling sites are selected based on the following specific criteria:
40. There is no ecologically sensitive area or biological hotspot in or around the EZ-2 or the proposed additional area,
41. No estuarine mouth present, because species diversity is higher in the estuarine mouth compared to that of its upstream direction. It is obvious because organism prefer estuarine habitat,
42. This part of the Bay of Bengal has high turbidity of water and soft bottom strata that is not suitable for growth of seaweed (Environmental Impact Assessment Report (EIA-NSEZ-2_addendum_24092020; Marinho-Soriano et al. 2009; Ullah et al. 2023), which may avoid impact on seaweed growth,
43. Site 8-10 are predicted Hilsa breeding ground, also the ecologically sensitive habitat, should avoid these sites for dredging.
44. The Sandwip Channel in the Bay of Bengal, including some sampling points (e.g., 5-10) proposed in our study, has been identified by some researchers as a breeding ground for Hilsa fish (Islam et al., 1987; Hossain et al., 2014). These sites require special attention while conducting dredging. Therefore, station the sampling sites were selected as representative, covering both upstream and downstream of the channel. Very few species of birds were found in the project site (ESMF, 2020 and NSEZ EIA and SIA, 2019) that may have less impact on sea birds,
45. No sensitive aquatic species like dolphins are reported within 10 km radius of the EZ site (Aziz 2019),
46. Deep sea dredging can impact the marine ecosystem by disturbing the benthos (dwelling on sea floor) especially to sessile organisms attached to sea floor/other physical structures (ESIA-NSEZ-2019, Christiansen et al. 2020, Helmons et al. 2022), therefore avoiding deep sea areas for dredging and at the downstream (site no 1, 2, and 3) are far away from the project locations, will not be viable for dredging activities,
47. The downstream sea ecosystems span vast expanse of the ocean floor, significantly contribute to extensive biogeochemical cycles and offer crucial ecosystem services such as carbon sequestration, nutrient recycling, waste accumulation, fisheries, and marine habitat. Therefore, these sites avoided for ecological sampling.
48. Therefore, 5, 7, 8, 9 locations were selected to collect the primary data for baseline and analysis.

Methodology of Study of Plankton and Benthos

50. Abundance and diversity of the major phytoplankton, zooplankton, and benthic macroinvertebrates were assessed to understand the existing pelagic and benthic fauna with a view to finding locations/areas less likely to be affected by dredging. Samples were collected along the Sandwip Channel within the targeted impact zone of the proposed dumping site of dredged material. Benthic and pelagic biological communities have been reported to gradually change along the longitudinal gradient of river/estuary (Muylaert et al., 2009; Piscart et al., 2005). Therefore, a total of 4 representative sites were selected for this study to cover the coastal ecosystem areas. St 1 to St4 belong to the true coastal ecosystem and can be expected to have similar ecosystem characteristics to St5. From each selected site, samples were collected at duplicate points from the edge of the subtidal zone, which were around 10-20 m from the shoreline.

Phytoplankton

51. Monofilament nylon plankton net of 25 µm mesh size was used for this survey. For qualitative study, net hauls were made at 0.5 m below the surface and 5-10 m from the subtidal line. For quantitative analysis, phytoplankton were collected by the plankton net by passing 500 liters of water through it and finally concentrated to 50 ml. Immediately after collection, phytoplankton were preserved using 2-3% acid free formalin and 2% lugol's Iodine in plastic plankton bottles. The samples were stored in dark inside icebox to prevent photolytic breakdown and transported to laboratory. At the laboratory, analyses involved transfer of 1 mL sub-sample from each of the samples to the Sedgewick Rafter counter and counting of cells within 10-20 squares of the cells, chosen randomly under a compound binocular microscope equipped with camera (OMAX, Italy). Identification of phytoplankton were conducted in accordance with Prescott (1964), Bellinger (2015) and other published literatures. The phytoplankton were identified up to the genus level. The cell counts were used to calculate the cell density using the Stirling (1985) formula where the plankton density is estimated by-

$$N = \frac{A \times C \times 1000}{V \times F \times L}$$

Where,

N = No. of phytoplankton cells or units per liter of original river water.

A = Total No. of phytoplankton counted.

C = Volume of final concentrate of the samples in ml.

V = Volume of a field in cubic mm.

F = No. of fields counted.

L = Volume of original sample water in liters.

Zooplankton

52. Monofilament nylon plankton net of 150 µm mesh size was used for this survey. For qualitative study, net hauls were made at 0.5 below the surface similarly like phytoplankton. For quantitative analysis, zooplankton was collected by the plankton net by passing 500 L of water through it and finally concentrated to 50 ml. The zooplankton samples were stored in plastic bottles and preserved with 3- 5% buffered formalin. An aliquot of sub-sample was observed on a Sedgewick-Rafter counting cell under a compound binocular microscope equipped with camera (OMAX, Italy). The cell counts were used to calculate the cell density using the Stirling (1985) formula where the zooplankton density was estimated by:

$$N = \frac{A \times C \times 1000}{V \times F \times L}$$

Where,

N = No. of zooplankton cells (L-1).

A = Total No. of zooplankton counted.

C = Volume of final concentrate of the samples (mL);

V = Volume of a field (mm³).

F = No. of fields counted.

L = Volume of water sample collected (L).

53. The zooplankton will be identified up to the genus level and enumerated with reference to APHA (1992) and Bellinger (1992). The number of zooplankton was recorded and expressed numerically per liter of river water. Qualitative studies were undertaken in accordance with Slotwinski et al. (2014), and Abou Zaid et al. (2014), Nahid et al. (2023), Davis (1955) and other relevant documents. The identification was verified with the specimen at the University of Dhaka.



Photograph: Collection of Plankton (Left) and Benthic Macroinvertebrates (Right).

Benthos

54. Benthos samples were collected by Ekman dredge at about 1m depth (shallow region) at each site. At each sampling site duplicate samples were collected and pulled before analysis. The samples were sieved onto a 500 μ m mesh size steel screen. The sediment and other debris will be screened out and macroinvertebrates has stored in a plastic bag with 10% acid-free formalin solution. The sample bags have been transferred to the laboratory in a thermally isolated container cooled with ice packs. The samples were sieved further under clean water using a 230 μ m mesh screen. The sieving has been performed very carefully in order to avoid any damage to the fragile organisms and to ensure that all animals present in the sample were collected. At the laboratory, the unsorted material was placed on a tray for an initial general sorting for larger organisms with the help of a magnifying lens. Fine sorting has been performed under a stereo microscope. During this phase, a small quantity of the sample was spread onto a Petri dish/glass slide and carefully examined to identify the organisms. Organisms were identified according to the main lowest possible taxonomic groups, usually Bivalves, gastropods, crustaceans, insects, etc. or lower. The identification has been verified with the specimen at the University of Dhaka. Data was reported as the number of individuals of each taxon in an area.



Ekman Dredger



Sieves

55. There are several unique invertebrates like Marine Flatworms (Polycladida), snails, bivalve shells, crabs, etc. may be available at the site, in addition to fish resources. These were identified in the laboratory of the Zoology and Fisheries Department, Dhaka University.



Marine Flatworms (Polycladida)



Marine Flatworms (Polycladida)



Photograph: Photographs of Marine Flatworms

Methodology of Marine Fish Diversity Study

Selection of Fishers

56. A total of 45 professional fishers, 30 from the Bay of Bengal and 15 from the Muhuri Reservoir, were selected along the sampling points using the snowball sampling technique (Goodman, 1961) for the questionnaire survey. The survey aimed to identify the species found at these sampling points. The first potential professional fishers from each survey point were identified with the help of local people adjacent to the surveyed areas.

Fish Identification Techniques

57. To identify the fish species commonly found in the sampling points, we were compiled data on the common species caught by fishers in the Bay of Bengal and the Muhuri reservoir of Bangladesh from existing literature (Akter et al., 2017; Froese and Pauly, 2023; Habib and Islam, 2020; Yeasmin et al., 2017). Subsequently, a fish photo album was created (Faruque and Matsuda, 2021), including the local names, as well as the common and scientific names of the fishes (Figure 8). At each survey point, fishers were asked to identify the fish caught in their fishing nets using the fish photo albums.



Photograph: Fish Photo Album.

58. For the onboard identification of marine species at the surveyed points, we observed the landed catch of fishers (5 locations from the marine Habitat) during their fishing activities. The landed species were identified using taxonomic keys proposed by Quddus and Shafi (1983), Rahman (2005), Shafi and Quddus (1982), and Talwar and Jhingran (1991). All scientific names of the documented species were validated using Fish Base (Froese and Pauly, 2019). Finally, the list of species found in the studied areas was compiled using both the data obtained during personal interviews with fishers and direct onboard identification.



Photograph: Observation of the Landed Catch of Fish

59. One-third of the fishers initially selected from each surveyed point were chosen for Focus Group Discussion using purposive sampling to get the in-depth knowledge on the fish species and their availability in the studied areas (Cresswell and Plano Clark, 2011). Those selections possess a minimum of ten years of fishing experience in the surveyed areas. A total of three FGD with fishermen were conducted. Participants were asked to rank identified species based on catch frequencies in their nets on a scale of 1 to 4 (1= rare, 2 = less abundant, 3 = abundant, 4 = most abundant). The final reports included the species compositions, availability, and the Red List status of the identified species. This analysis included seven categories within the IUCN Red List. This analysis included seven categories within the IUCN Red List: not evaluated (NE), data deficient (DD), least concerned (LC), near threatened (NT), vulnerable (VU), endangered (EN), and critically endangered (CR). No form of national or regional IUCN assessment was available for most of the identified fish species (IUCN, 2015). Therefore, we used the global assessment categories (IUCN, 2024) where national IUCN Red List categories were unavailable.



Photograph: Questionnaire Survey and Focus Group Discussion with Fishers along the surveyed Points

Observations and Results

Phytoplankton

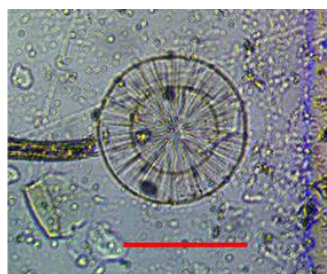
60. In this study, the team encountered 24 phytoplankton genera belonging to Chlorophyta (green algae), cyanobacteria (blue-green algae), and Bacillariophyta (diatoms). The average density of phytoplankton was 951.6 ± 538.0 cell/L. Two genera of diatoms, *Coscinodiscus* sp. and *Cyclotella* sp. were in all the sampling stations. Among these phyla, diatom was the most dominant group, where *Coscinodiscus* sp., *Odontella* sp. and *Melosira* sp. were most dominant on the other hand, the Dinoflagellate, *Ceratium* sp. were found at nearly all sites and were abundant. Phytoplankton belonging to Chlorophyta were only recorded in the riverine side. The phytoplankton density varied from 279-1659 cells L⁻¹, with the highest count observed in the Sandwip channel. The riverine sites demonstrated very low density. The phytoplankton density at all sites were very low compared to other reports from surrounding or nearby estuaries (Mehedi Iqbal et al., 2017; Hossain et al., 2017; Haque et al., 2015), but higher than that of the Sandwip coast reported by Sharif et al (2017). The species composition of the phytoplankton community in these sites is nearly like other studies, with only a notable difference in the low abundance of cyanobacteria and a very high proportion of diatoms. The low abundance is likely in winter and high lithogenically turbid areas. All the sampling sites in this study were highly turbid with a Secchi disc depth of <25 cm. The overarching dominance of diatoms could be due to high concentration of SiO₃²⁻ because of upstream dredging or sediment flow, or a combination of both (Timmermans et al., 2004). The near absence of cyanobacteria like *Spirogyra* or *Anabaena* could be due to low PO₄³⁻ and low light penetration in that area (Zhou et al., 2008). all sites recorded low productivity

Table 30: Abundance of Phytoplankton Genus at Various Sites in the Sandwip Channel

Phylum	Genus	St 5	St 7	St 8	St 9
Bacillariophyta	Bacillaria	37	0	0	0
	Chateceros	55	146	19	0
	Coscinodiscus	236	400	128	291
	Cyclotella	37	73	55	19
	Cylindrotheca	73	0	0	0
	Ditylum	37	146	37	0
	Enromoneis	55	0	0	0
	Flagillaria	0	0	19	37
	Gyrosigma	0	0	0	19
	Hyalodiscus	37	0	0	0
	Melosira	0	55	345	291

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annex- 3: Detail Environmental Baseline Condition

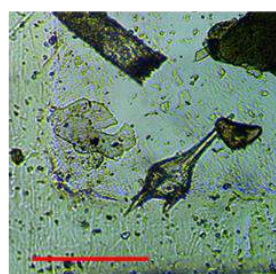
Phylum	Genus	St 5	St 7	St 8	St 9
	Nitzschia	55	55	37	0
	Odontella	182	182	91	273
	Pleurosigma	0	0	19	0
	Rhizosolenia	0	0	19	0
	skeletonema	19	73	37	37
	Surirella	19	0	0	0
	Thalassionema	37	91	182	73
	Thalassiosira	0	37	19	0
	Triceratium	37	37	37	19
Chlorophyta	Pediastrum	0	0	0	0
Cyanobacteria	Anabaena	19	0	0	0
Dinoflagellata	Ceratium	73	345	182	128
	Peridinium	0	19	0	0
Total		1008	1659	1226	1187



Hyalodiscus sp.



Anabaena sp.



Ceratium sp.



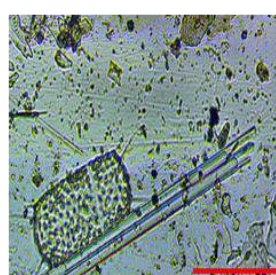
Chaetoceros sp.



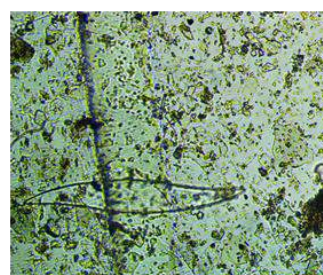
Ditylum sp.



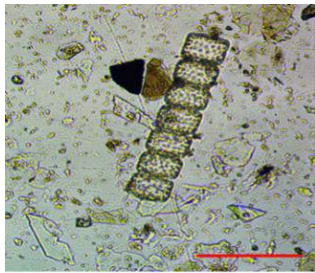
Entomoneis sp.



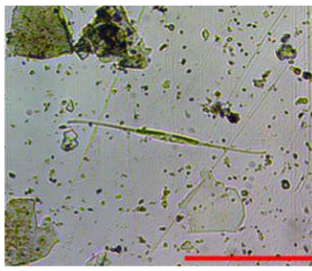
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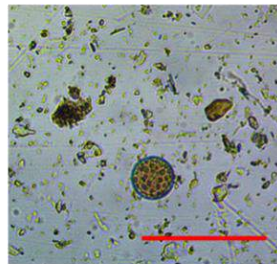
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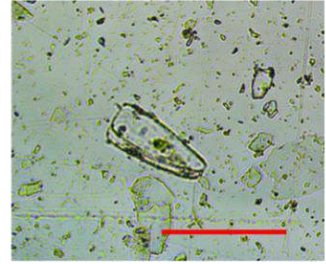
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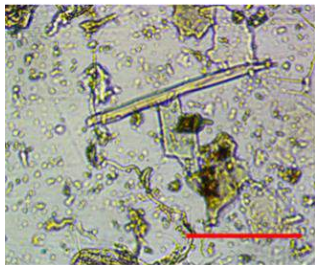
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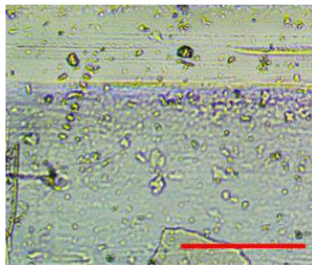
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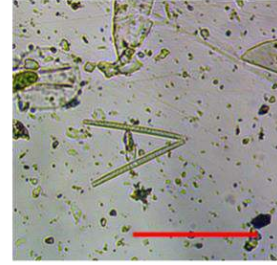
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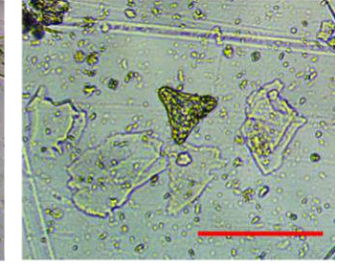
Rhizosolenia sp.



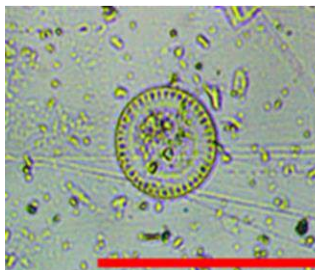
Skeletonema sp.



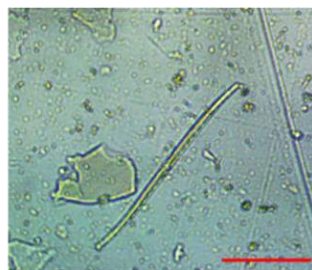
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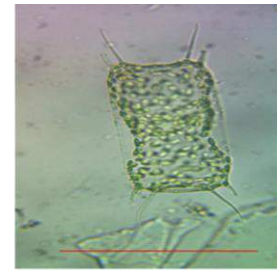
Triceratium sp.



Cyclotella sp.



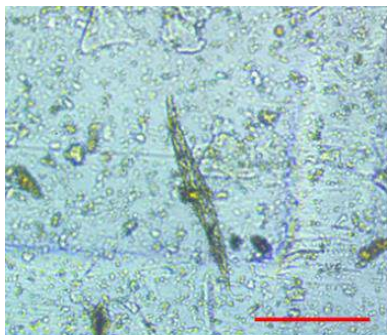
Nitzschia sp.



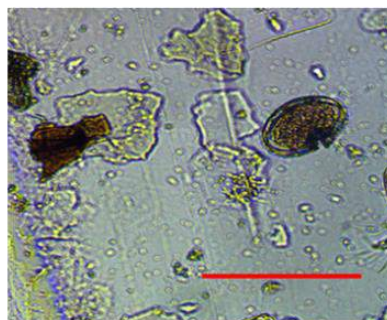
Odontella sp.



pediastrum sp.



Pediastrum sp.



Peridinium sp.

Photograph: Representative Phytoplankton Genera Identified from Sandwip Channel Survey

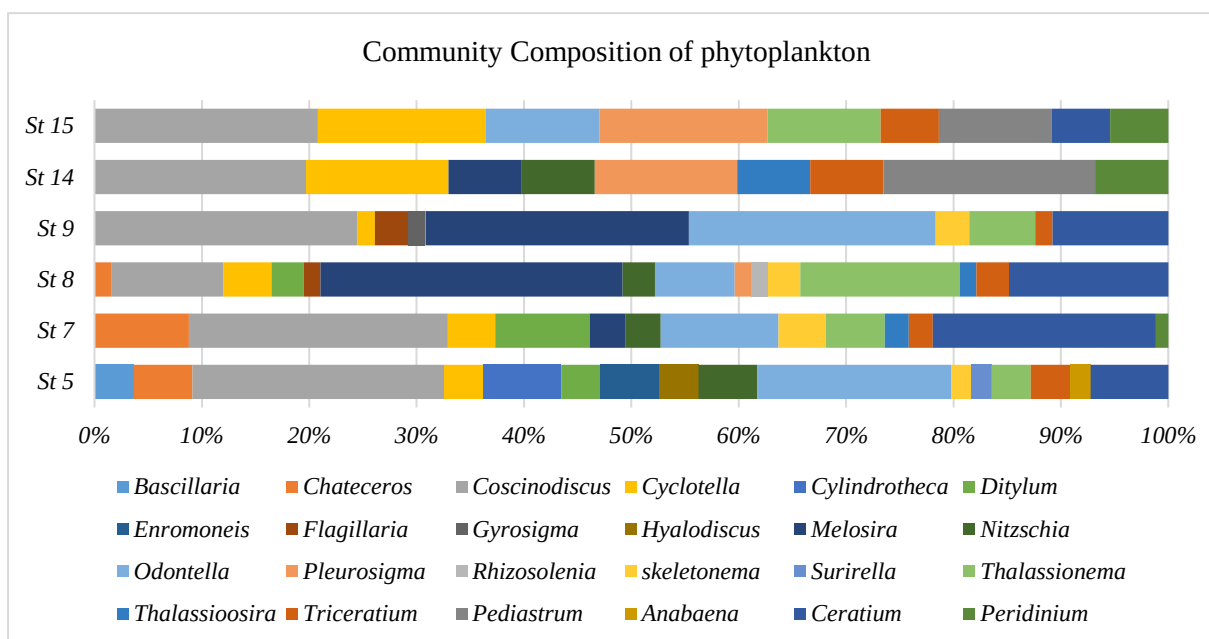


Figure 6: Community Composition of Phytoplankton Genus in the Sandwip Channel

Zooplankton

61. The study team encountered 15 zooplankton genera and their 3 larval stages. The average density of zooplankton was 278.6 ± 187.2 cell/L. Expectedly, copepods followed by the Cladocera were the two most dominant groups as it is common in similar regions. All sites in the Sandwip channel side had similar species composition, The zooplankton density almost followed the spatial pattern of phytoplankton. Even at the riverine side, we did not find any rotifer species, which could be due to the high salinity of all sites (>15 ppt). The notable finding in this study is that the density of small-sized zooplankton was very low. It could be due to low productivity as suggested by phytoplankton, or due to unfavorable condition created by high suspended particulate matter (SPM) resulting from dredging or other activities. An increase in suspended matter concentrations may affect foraging efficiency of zooplankton (Phua et al., 2004). Another consequence is the possibility that zooplankton will ingest inorganic particles associated with phytoplankton, reducing the nutritional value of the algal food affecting their weight, body size, and feeding behavior (Burford and O'Donohue 2006).

Table 31: Abundance of Zooplankton Genus at Various Locations in the Sandwip Channel

Group	Sub group	Genus	St 5	St 7	St 8
Cladocera	Daphnidae	Dafnia	0	0	8
	Moidae	Moina	0	8	8
Copepoda	Calanoida	Candacia	0	8	4
		Bosmina	0	0	12
		Calanoid nauphius	148	84	100
		Paracalanus	0	8	0
	Copepoda	Copepod nauphlii	0	72	0
		Cyclop larvae	4	0	0
	Cyclopoida	Acartia	4	0	8
		Cyclops	0	8	52
		Eucyclops	12	0	0
		Macrocyclus	4	8	4
		Mesocyclops	24	20	24
		Microcyclops	0	4	4

Group	Sub grup	Genus	St 5	St 7	St 8
		Paracyclops	0	0	4
		Thermocyclops	0	4	0
Oligotrichea	Ostracoda	Favella	0	0	0
Protozoa	Choreotrichida	Tintinopsis	140	232	180
Total			336	456	408

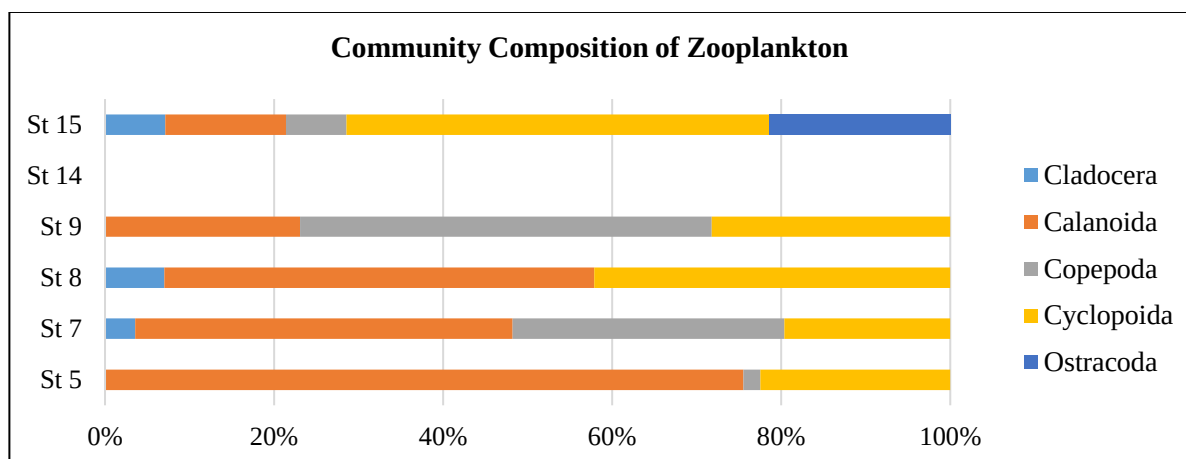
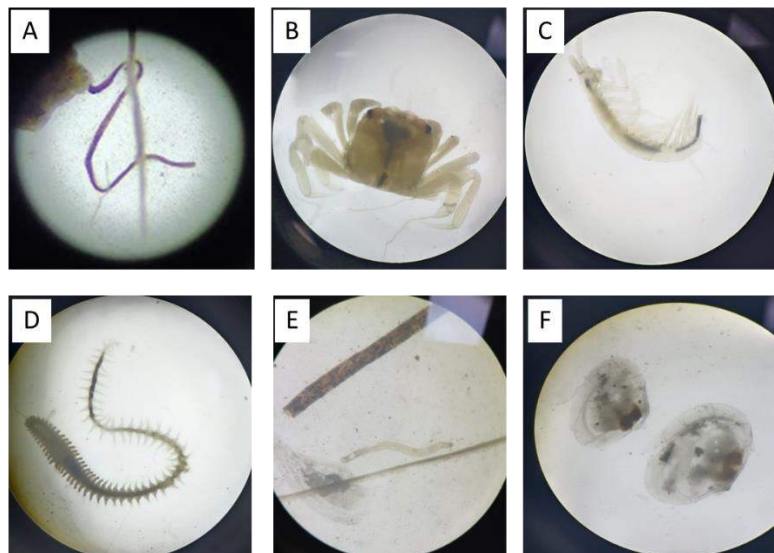


Figure 7: Community Composition of Zooplankton Genus at Various Sites

Benthos

62. A total of 19 taxa (families) of soft-bottom macrobenthos were recorded of which 14 families were identified over the six sampling sites. The mean abundance (individual/m²) was 707.8±210.2. St 9 had the lowest density of macrobenthos, followed by St14. The other sites demonstrated similar density but were >1.5 times higher abundance than that of St 9 and 14. The macrobenthos abundance at all sites were dominated by the polychaetas followed by crustacean which is typical of any estuary or coastal ecosystem of similar region (Matin et al., 2018; Hossain et al., 2018). Among the recorded samples, there were no keystone species or endemic species. Furthermore, the community composition and families reported were nearly similar in the other study conducted in the Muhuri reservoir (Matin et al., 2018). The diversity index also suggests that the species composition was similar to previous reports (Table 3). However, it is important to note that the overall density or abundance of benthic organisms in these study sites was 2-10-fold lower than previous studies of other estuaries/coasts in Bangladesh (Noman et al., 2019; Ullah et al., 2020; Matin et al., 2018; Hossain et al., 2013; Khan et al., 2007). Such variations are likely due to changing environmental parameters and various anthropogenic activities such as dredging. Several dredging machines were found to be deployed in the sampling sites during sample collection for this study. Several studies have reported that dredging or sand mining can alter the benthos community composition (Newell et al. 2002; Sutton and Boyd 2009). However, macrofauna communities are primarily determined by the substrate type, but hydrodynamically mediated food availability also plays a major role in their distribution, structure, and diversity (Gutperlet et al., 2015). While all previous studies only reported benthos from the intertidal zone, this study collected samples from the edge of the subtidal zone, which is the target zone of typical dredging operations. Therefore, the contribution of dredging to such a decrease in microbenthic abundance is inconclusive as there were no comparable study reports that detailed the species/genus level composition.



Photograph: Some Representative Benthic Macroinvertebrates Identified During the Study.

A) Polychaeta sp., B) Ocypode sp., C) Gammaridae sp. D) Nereidae sp., E) Unidentified Polychaeta, and F) Unidentified Bivalve

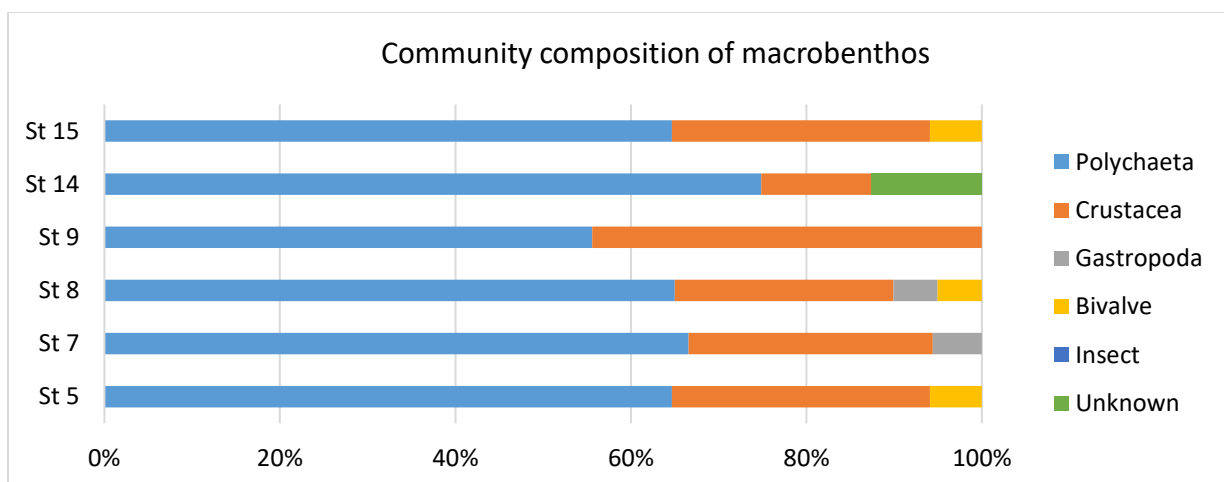


Figure 8: Community Composition of Benthic Macroinvertebrates Collected from Subtidal Zone of the Sandwip channel

Table 32: Abundance of Benthic Macroinvertebrates Collected from the Subtidal Zone of the Sandwip Channel

Class	Family	Abundance (individual/m ²)			
		St 5	St 7	St 8	St 9
Polychaeta	Capitellidae	178	134	45	89
	Syllidae	45	45	45	0
	Lumbrinereidae	0	0	89	45
	Nereidae	178	134	223	45
	Goniadidae	45	0	0	45
	Cossuridae	0	0	134	0
	Glyceridae	45	223	45	0
Crustacea	Mysidae	134	134	89	45
	Gammaridae	89	45	45	134
	Portunidae	0	45	89	0
	Ocypode	0	0	0	0
Gastropoda	Gastropoda sp.	0	45	45	0
Bivalve	Bivalve	45	0	45	0
Insect	Insecta	0	0	0	0

Class	Family	Abundance (individual/m ²)			
		St 5	St 7	St 8	St 9
	Unidentified	45	0	45	0
Total		804	805	939	403
Shannon-Wiener index		2.01	1.89	2.3	1.67

Overall Assessment on plankton and benthos

63. The impact of dredging activity mainly relates to the physical removal of substratum and associated organisms from the river/seabed along the path of the dredge head, and additionally, subsequent deposition of materials to nearby areas by dispersal. Various studies suggested potential environmental impacts on phytoplankton productivity as a result of sand mining (Nairn et al., 2004; Bhattacharya et al., 2019) and dredging, which could ultimately impact the zooplankton and benthos. Sand mining was reported to have deteriorated due to the turbidity process and reducing the light penetration into the river. Sand mining can change PP through influences such as erosion, siltation, and dynamic heat transfer process through the invariable link between the active channel and the floodplain. All the PP changes deteriorate the aquatic ecosystem in the channel (Derni et al., 2003).

64. On the other hand, there are contrasting findings also, which reported no or insignificant impact (Adekunbi et al., 2018). The intensity of any change could be very minor to considerable, depending on the degree of dredging and its size. Marine organisms conform to the principles of ecological succession, hence possess the intrinsic capacity of recovery after dredging. Literature suggests that a recovery of 6-8 months of many estuarine mud communities. On the other hand, communities in sand and gravel can take more than 2-3 years. However, opposite results were also recorded. There is evidence that communities found in hydrodynamically active sandy habitats will recover more quickly following physical disturbance than those found in less energetic, muddy environments (Derni et al. 2003). Therefore, the dredging duration could be a key here to ensure the environmental recovery.

65. Overall, phyto and zooplankton abundance and composition suggest that St 5-9 is low productive and has similar pelagic ecosystem structure. There were not seaweeds found in the study location as the sediment surface was not suitable, but also because of high water turbidity. Typically, the soft bottom sediments are characterized by annelids either as a dominant group or an important contributor to the macrobenthic fauna. However, the benthos community suggested that there was already some modification of the bottom, as there was a low abundance of soft-bodied annelids. Together, the pelagic and benthic faunal composition suggests that St 5-9 are seemingly similar ecosystems and are more productive. All these sites did not have any plankton or benthos declared as ecologically critical. Marine organisms conform to the principles of ecological succession, hence possess the intrinsic capacity of recovery after dredging. Greater biodiversity typically means a higher number of opportunistic organisms. At the beginning of recovery, opportunistic organisms colonize first and gradually other organisms' re-settle. Therefore, St 5-8 in the Sandwip channel could be less significantly affected by dredging activities. The connectivity of these sites to upper estuarine flow and lower marine tidal influence are likely to contribute to the reestablishment of communities.

66. To reduce any potential environmental damage associated with dredging at the above-mentioned sites (St5-8), there should be a continuous Biological and Physical Monitoring Program (BPMP). The BPMP could include benthic communities and their trophic relationships to fishes, marine mammals, and wildlife (operational monitoring), sediment sampling and analysis, wave monitoring and modeling, bathymetric and substrate surveys, and shoreline monitoring and modeling as suggested by Nairn et al. (2004).

Marine Fish Diversity and Abundance

67. A total of 95 species of marine fish were recorded from the marine habitat adjacent to the proposed Area.

Table-33: List of Marine Fish Species Recorded from the Marine Habitat

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
1	<i>Polynemus paradiseus</i>	Paradise Threadfin	Topsi/Rilsha	Abundant	LC
2	<i>Parastrumateus niger</i>	Black Pomfret	Hail Chanda, Kala Chanda	Less abundant	LC

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
3	<i>Eleutheronema tetradactylum</i>	Fourfinger Threadfin	Thailla	Less abundant	EN
4	<i>Pomadasys hasta</i>	Silver Grunt	Sada Datina/Gangoria	Less abundant	LC
5	<i>Selar boops</i>	Oxeye Scad	Chukha Surma	Less abundant	LC
6	<i>Pomadasys argenteus</i>	Silver Grunt	Datina/ Kalo Poa	Rare	LC
7	<i>Megalaspis cordyla</i>	Torpedo Scad	Kauwa Mouri, Kauwa, Lohamorri, Kawa Surma	Rare	LC
8	<i>Psettodes erumei</i>	Indian Halibut	(Samudra Serbot	Abundant	DD
9	<i>Chirocentrus dorab</i>	Dorab Wolf-Herring	Karati Chela/ Chela	Abundant	LC
10	<i>Johnius belangerii</i>	Belanger's Croaker	Lalpoa, Rupali	Rare	LC
11	<i>Tenualosa ilisha</i>	Hilsa Shad	Ilish	Most abundant	LC/LC
12	<i>Ilisha filigera</i>	Coromandel Ilisha	Chamila/ Boro Choukka	Less abundant	DD/LC
13	<i>Sardinella frimbata</i>	Fringescale Sardinella	Kochuna/ Khaira	Less abundant	LC
14	<i>Otolithes ruber</i>	Tigertooth Croaker	Poa	Most abundant	LC
15	<i>Sardinella melanura</i>	Blacktip Sardinella	Chapila/Takhia, Chandana	Rare	LC
16	<i>Conger cinereus</i>	Longfin African Conger	Kailla/ Kamila	Rare	LC
17	<i>Dendrophysa russelii</i>	Goatee Croaker	Dhari Poa/ Poa	Rare	LC
18	<i>Panna microdon</i>	Panna Croaker	Chotta Lambu	Rare	LC
19	<i>Cynoglossus</i>	Bengal Tongue Sole	Kukur Jeeb/ Churboti	Most abundant	LC
20	<i>Drepane longimana</i>	Concertina Fish	Pan Mach	Less abundant	LC
21	<i>Protonibea diacanthus</i>	Blackspotted Croaker	Kala Poa	Rare	NT
22	<i>Setipinna taty</i>	Scaly Hairfin Anchovy	Phaisa	Most abundant	LC/LC
23	<i>Thryssa mystax</i>	Moustached Thryssa	Phasa, Phaisa	Most abundant	LC
24	<i>Coilia dussumieri</i>	Goldspotted Grenadier Anchovy	Olua	Most abundant	LC/LC
25	<i>Ephippus orbis</i>	Orbfish	Hatir Kan	Rare	LC
26	<i>Gerres filamentosus</i>	Whipfin Silver-Biddy	Dom Mach	Less abundant	LC
27	<i>Pentaprion longimanus</i>	Longfin Mojarra	Jagri	Less abundant	LC
28	<i>Harpadon nehereus</i>	Bombay-Duck	Loittya Machh	Most abundant	NT
29	<i>Therapon jarbua</i>	Jarbua Terapon	Gangori/ Barguni	Most abundant	LC
30	<i>Lobotes surinamensis</i>	Tripletail	Samudra Koi/ Gang Koi	Most abundant	LC
31	<i>Sillaginopsis panijus</i>	Flathead Sillago	Hundura	Abundant	NE/LC
32	<i>Pampus argenteus</i>	Silver Pomfret	Foli Chanda	Less abundant	VU
33	<i>Pampus chinensis</i>	Chinese Silver Pomfret	Rup Chanda	Less abundant	NE
34	<i>Saurida tumbil</i>	Greater Lizardfish	Tiktiki Machh, Achila, Koniari	Rare	LC
35	<i>Lepturacanthus savala</i>	Savalai Hairtail	Churi Macch	Less abundant	DD
36	<i>Planiliza subviridis</i>	Greenback Mullet	Bata/ Sonali Bata	Most abundant	LC
37	<i>Mugil cephalus</i>	Flathead Grey Mullet	Khorul Bata	Less abundant	LC/LC
38	<i>Platycephalus indicus</i>	Bartail Flathead	Murbaila	Most abundant	DD/LC
39	<i>Leptomelanosoma indicum</i>	Indian Threadfin	Thaila/ Lakkha	Rare	NE
40	<i>Megalops atlanticus</i>	Tarpon	Lady Fish/ Sundori Koral	Rare	VU

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
41	<i>Megalops cyprinoides</i>	Indo-Pacific Tarpon	Nanchil Koral	Rare	DD
42	<i>Gymnothorax tile</i>	Indian Mud Moray	Kuiccha	Most abundant	LC
43	<i>Pisodonophis cancrivorus</i>	Longfin Snake-Eel	Idura	Most abundant	LC/LC
44	<i>Escualosa thoracata</i>	White Sardine	Moila	Rare	LC
45	<i>Gonialosa manmina</i>	Ganges River Gizzard Shad	Goni Chapila	Less abundant	LC/LC
46	<i>Hilsa kelee</i>	Kelee Shad	Chokkha Ilish	Abundant	LC/LC
47	<i>Coilia neglecta</i>	Neglected Grenadier Anchovy	Chobi Olua	Most abundant	LC
48	<i>Coilia reynaldi</i>	Reynald's Grenadier Anchovy	Olua	Most abundant	LC
49	<i>Stolephorus commersonii</i>	Commerson's Anchovy	Chepta Mola	Most abundant	LC
50	<i>Thryssa hamiltonii</i>	Hamilton's Thryssa	Ram Fesa	Abundant	LC
51	<i>Ilisha megaloptera</i>	Bigeye Ilish	Boro Chokha Ilish	Less abundant	LC
52	<i>Raconda russeliana</i>	Raconda	Modhu Paia	Most abundant	LC
53	<i>Mystus gulio</i>	Long Whisker Catfish	Nuna Tengra	Abundant	LC/NT
54	<i>Pangasius</i>	Pangas Catfish	Bangla Pangus	Abundant	LC/EN
55	<i>Arius gagora</i>	Gagora Catfish	Kata Mach/ Gora Mach	Abundant	NT
56	<i>Arius</i>	Threadfin Sea Catfish	Chiccha Poa	Most abundant	LC
57	<i>Allenbatrachus reticulatus</i>	Toadfish	Bang Mach	Rare	NE
58	<i>Haliutaea stellata</i>	Minipizza Batfish	Pizza Mach	Rare	LC
59	<i>Strongylura leiura</i>	Banded Needlefish	Dora Kakila	Less abundant	LC
60	<i>Rhynchorhamphus georgii</i>	Long Billed Half Beak	Ekthuitta	Less abundant	LC
61	<i>Trachyrhamphus bicoarctatus</i>	Double-Ended Pipefish	Dumukha Kumirer Heel	Most abundant	LC
62	<i>Grammoplites scaber</i>	Rough Flathead	Mur Bailla	Less abundant	NE
63	<i>Lates calcarifer</i>	Seabass	Koral	Most abundant	LC
64	<i>Epinephelus coioides</i>	Orange Spotted Grouper	Guti Boal	Less abundant	LC
65	<i>Priacanthus macracanthus</i>	Red Bigeye	Boro Akhi Lal Mach	Less abundant	LC
66	<i>Lactarius</i>	False Travel	Cungamukhi Mach	Rare	LC
67	<i>Alectis indica</i>	Indian Threadfish	Pekhm Mouri	Less abundant	LC
68	<i>Parastromateus niger</i>	Black Pomfret	Hail Canda	Less abundant	LC
69	<i>Ulua mentalis</i>	Longrakered Trevally	Olua Mouri	Less abundant	LC
70	<i>Pomadasys andamanensis</i>	Andaman Grunt	Gangori/ Dora Mach	Less abundant	DD
71	<i>Otolithoides pama</i>	Pama Croaker	Payra Poa	Most abundant	DD/LC
72	<i>Daysciaena albida</i>	Bengal Corvina	Jati Poa	Most abundant	LC
73	<i>Drepane punctata</i>	Spotted Sickfish	Goti Pan Mach	Less abundant	LC
74	<i>Apocryptes bato</i>	Gobies	Ful Ciring	Most abundant	LC/LC
75	<i>Awaous guamensis</i>	Gobies	Choto Chela/Veda	Less abundant	LC/LC
76	<i>Odontamblyopus rubicundus</i>	Gobies	Cheua	Most abundant	LC/LC

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
77	<i>Trypauchen vagina</i>	Gobies	Sada Cheua	Most abundant	LC/LC
78	<i>Planiliza parsia</i>	Goldspot Mullet	Faissa Bata	Most abundant	LC
79	<i>Osteomugil cunnesius</i>	Longarm Mullet	Jati Bata	Less abundant	NE
80	<i>Paramugil parmatas</i>	Broad-Mouthed Mullet	Bash Pata Bata	Less abundant	LC
81	<i>Pseudorhombus elevatus</i>	Deep Flounder	Fali Sherboti	Abundant	LC
82	<i>Paraplagusia bilineata</i>	Doblelined Tonguesole	Duirekha Kukur Jib	Most abundant	LC/LC
83	<i>Carcharhinus limbatus</i>	Blacktip Shark	Kala Hangor	Rare	VU
84	<i>Carcharhinus melanopterus</i>	Blacktip Reef Shark	Ilissha Boli Hangor	Rare	VU
85	<i>Scoliodon laticaudus</i>	Spadnose Shark	Thutte Hangor, Churi Hangor	Abundant	NT
86	<i>Chiloscyllium punctatum</i>	Grey Carpet Shark	Bilai Hangor	Rare	NT
87	<i>Rhina ancylostoma</i>	Brownmouth Guitarfish	Bang Hangor/ Titamari Hangor	Abundant	CR
88	<i>Gymnura poecilura</i>	Long Tailed Butterfly Ray	Podoni	Less abundant	VU
89	<i>Himantura undulata</i>	Honeycomb Whipray	Bagha Haus	Rare	EN
90	<i>Pateobatis bleekeri</i>	Bleeker's Whipray	Hauspata	Less abundant	EN
91	<i>Himantura imbricata</i>	Drawf Whipray	Hauspata	Abundant	VU
92	<i>Maculabatis gerrardi</i>	Whitespotted Whipray	Hauspata	Abundant	EN
93	<i>Maculabatis pastinacoides</i>	Round Whipray	Hauspata	Rare	EN
94	<i>Maculabatis rundalli</i>	Arabian Banded Whipray	Rammi Shapla	Less abundant	LC
95	<i>Aetobatus flagellum</i>	Longhead Eagle Ray	Chil Haus	Rare	EN

68. For marine species identification, our result showed that the majority of the species identified belonged to the Perciformes order, comprising almost one-third (35.79%, n=34) of the total identified species. This was followed by species from the Clupeiformes order (17.89%, n=17), and Myliobatiformes order (8.42%, n=8). From the availability graph, the less abundant species comprised the majority of the total species (31 among 95). After that, the 27 most abundant species were found during this study. On the other hand, IUCN Least Concern (LC) species were most prominent (68.4%) in this study area.

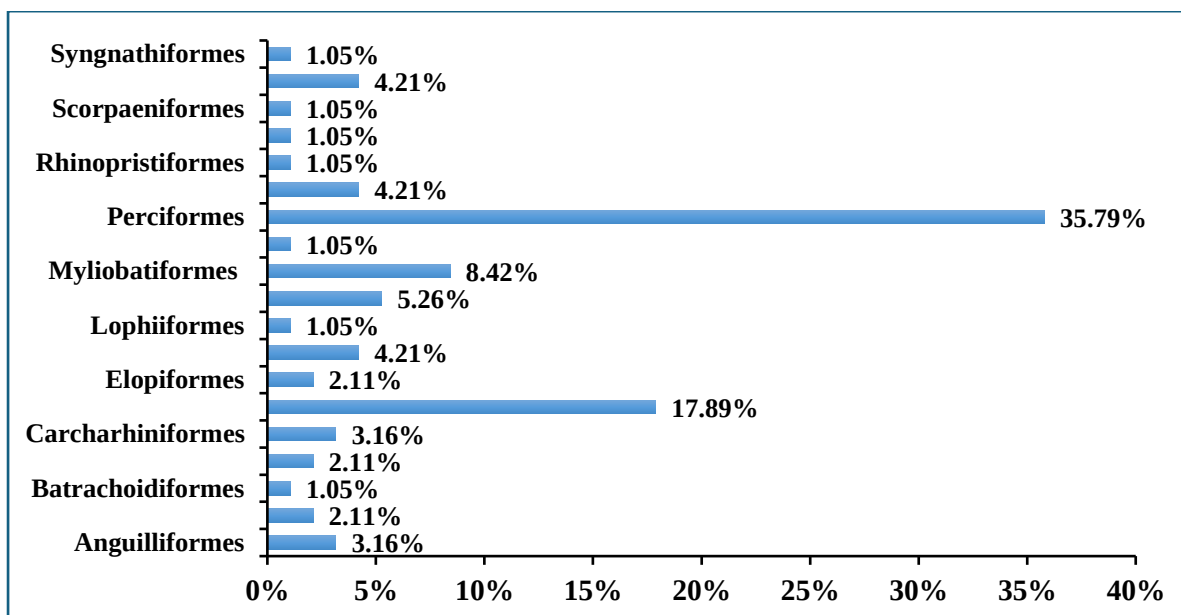


Figure 9: Composition of Identified Marine Fish Species Based on their Taxonomic Order.

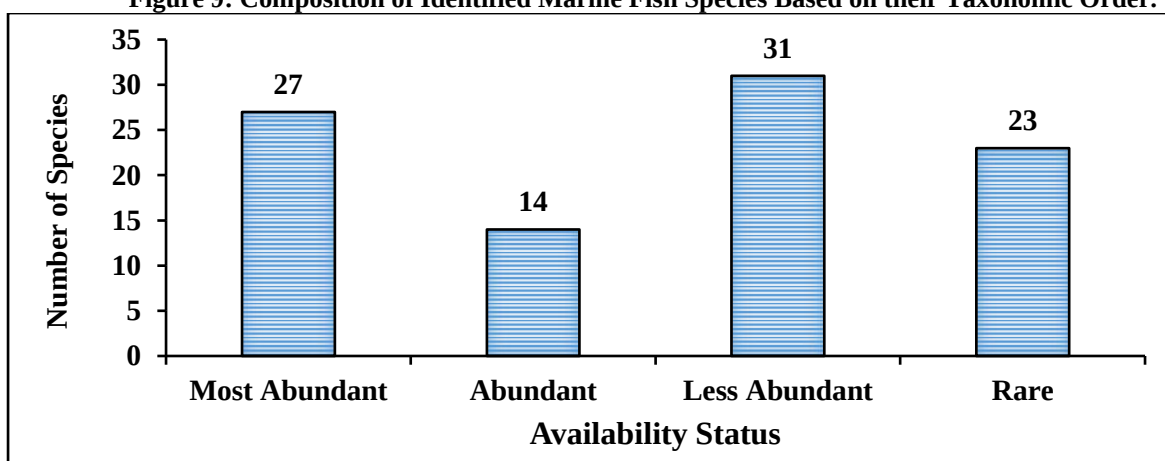


Figure 10: Marine Fish Species Composition According to Availability

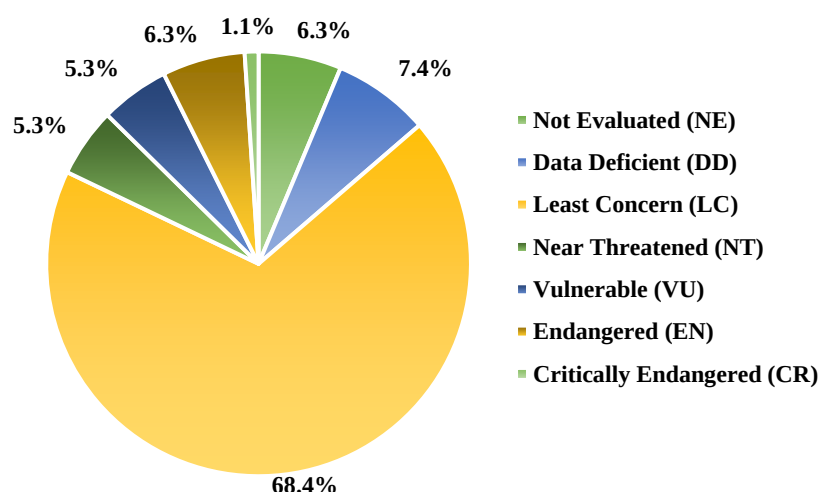


Figure 11: Fish Species Composition According to IUCN Global Red-List Categories.

69. For species identification in the Muhuri Reservoir, the Perciformes order contained the vast majority (31.37%) of the identified species. Along with that, the second-most species identified order was Siluriformes, and then Clupeiformes 1). In the Muhuri Reservoir, the majority of the available species were abundant species because 18 species (from 51 species) were included in this order 2). The IUCN global red list indicated that the major portion of the identified species were in the least Concern (LC) category. Nearly four-fifths part of the total species were included in this segment 3).

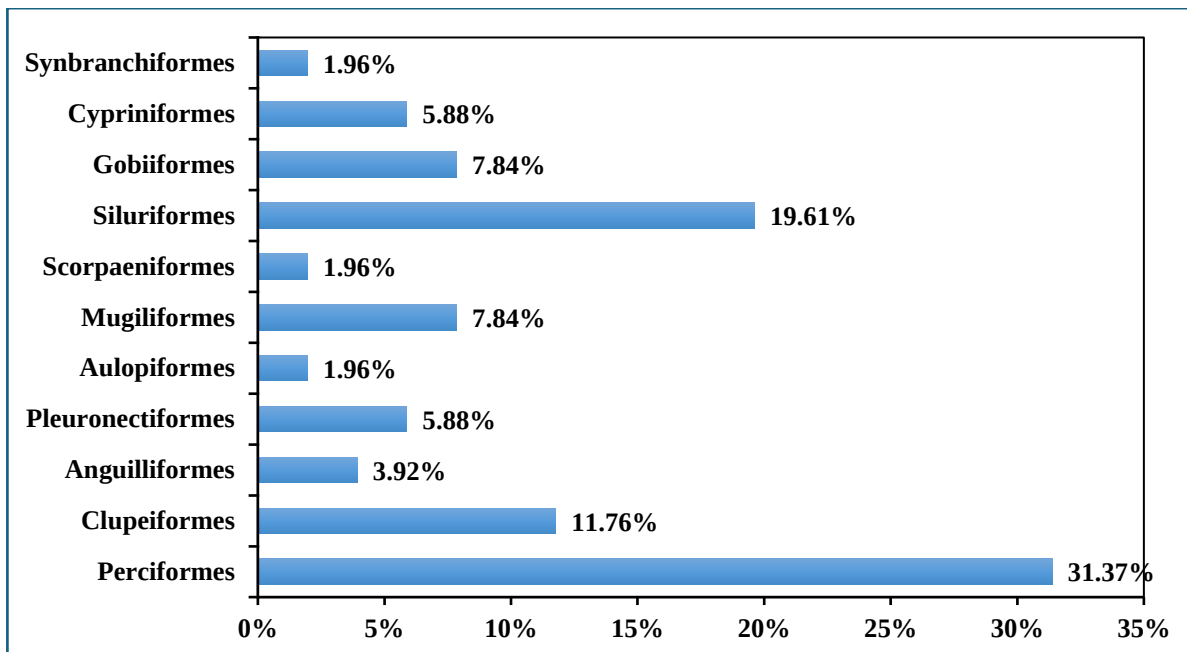


Figure 12: Composition of Fish in the Muhuri Reservoir Based on Taxonomic Order.

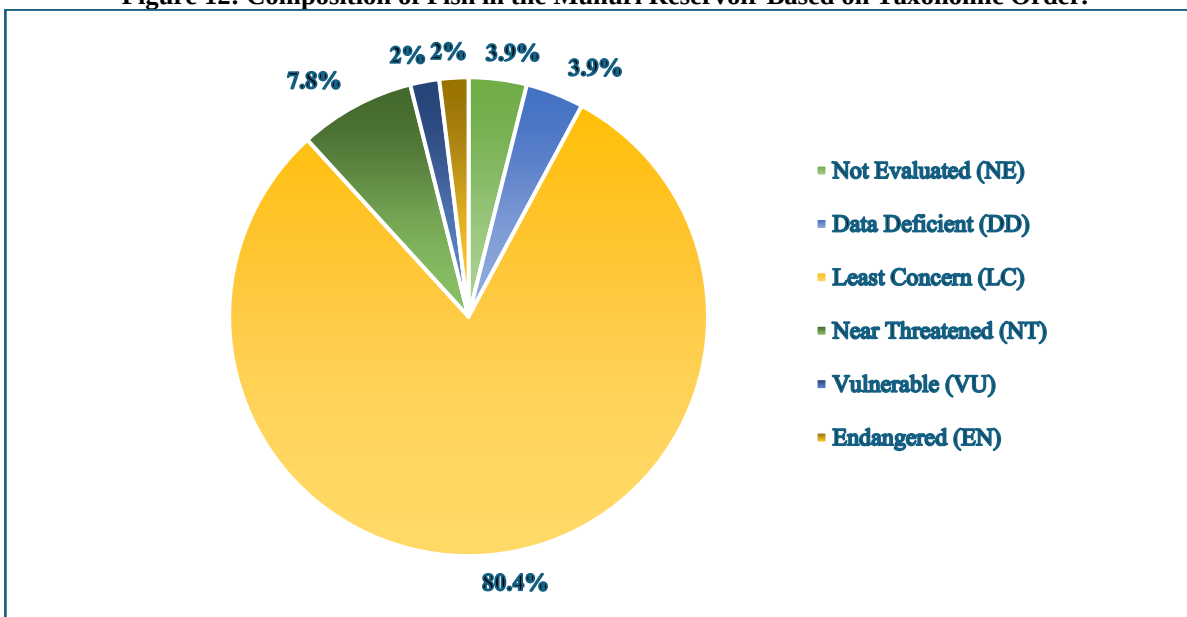


Figure 13: Fish Species Composition According to IUCN Global Red-List Categories.

Impact Assessment for Fisheries

70. The Sandwip Channel in the Bay of Bengal, including some sampling points (e.g., 10-5) proposed in our study, has been assumed by researchers as a breeding ground for Hilsa fish (Islam et al., 1987; Hossain et al., 2014). However, understanding the seasonal breeding behavior of Hilsa fish is crucial. Generally, Hilsa breed throughout the year, but the majority spawn during the main peak season (i.e., September to November) (Das et al., 2022). Therefore, dredging activities should be scheduled during periods when the fish are less likely to be present in the vicinity for breeding, aligning with their migration and breeding seasons. Additionally, maintaining a water depth of 10 meters is crucial for the migration and breeding of Hilsa fish (Ahsan et al., 2014). Dredging the shallow zones near the shore not only ensures the required water depth but also facilitates optimal conditions for Hilsa fish to breed and migrate successfully in that location.

71. In addition, no protected areas, such as fish sanctuaries or marine reserves, were identified at either the riverine or marine sampling points. Consequently, the proposed Exclusive Economic Zone is expected to have minimal impacts on fisheries diversity due to the absence of established protected zones in these areas.

Observation and Major Findings of Wildlife

- Faunal Diversity
- Fauna in Coastal Ecosystem

72. The coastal ecosystem of the study area plays a significant role as an important habitat for wildlife and biodiversity. The coast and the open water associated with the coast is an important habitat for sea turtles like olive ridley (*Lepidochelys olivacea*), Dolphins (*Platanista gangetica*, *Orcaella brevirostris*). Sea snakes are also an important snake species in this habitat.

73. The coast and associated water body of the coast is important for Migratory birds are occupied a special position in this type of habitat due to their higher number of abundances during the winter season. Larger flocks of bird species were observed during the winter season in the study area. Wild duck and migratory duck species (eg, shelduck, gadwall, pochard, teal etc.), waders (plover, sandpiper, gull, tern, shank, snipe etc.) wagtail, cormorants, heron, egret, bittern, kingfisher, was observed from the study area.

Fauna of Mangrove Forest

74. Mangrove forest plays an important role as a habitat of different types of bird like kingfisher, heron, egret, bittern, wagtail, ibis, etc. Besides minivet, tits, sparrows are other important birds of this habitat. This habitat provides support for the livelihood for different types of reptilian species. An individual of spotted deer also observed from here. Different species of Bat, Rat, and small carnivores also used this habitat.

Fauna of River Side Habitat

75. Riverside habitat, especially mudflat, provides support for different groups of bird species, like plover, waders, sandpiper, gulls, heron, bittern, egret, etc.

76. Faunal Diversity and Species Composition

77. During the survey period, 82 species of wildlife were observed in the study area. Among them, four were mammals and 78 were bird species. The 78 species of birds were under 15 orders and 30 families, and the four species of mammals were under three orders and three families. Under the order Passeriformes the highest number of bird species (22 species) was observed, which is followed by the order Charadriiformes (22 species). The highest number of bird population (n=576) was observed, followed by Anseriformes (n=247). Among the 30 families, the highest number of bird species was under the order Scolopacidae (n=380). A total of nine migratory duck species were observed in the study area.

78. Among the four observed sites, S-8 has the lowest with 37 species, and S-5 has the lowest abundance with 196 individuals. Simpson's Index (Ds) is a measure of diversity that considers both the number of species and their abundance. All sites show high values close to 1, indicating a high level of diversity and evenness in the communities. The Shannon-Weiner Index (H) measures the uncertainty or entropy in the species distribution. S-8 has the lowest at 3.396. Evenness (E) represents how evenly abundance is distributed among different species. S-5 has the highest evenness (0.9142), suggesting a relatively even distribution of individuals among species.

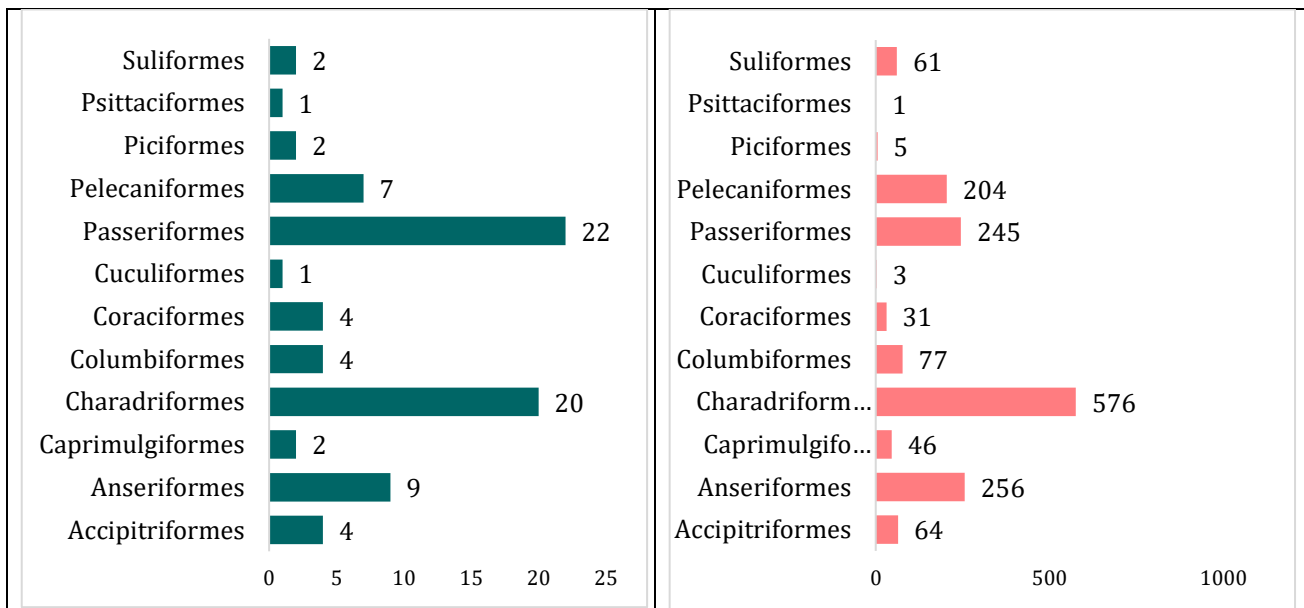


Figure 14: Order Wise Species (A) Richness and (B) Abundance in the Study Area.

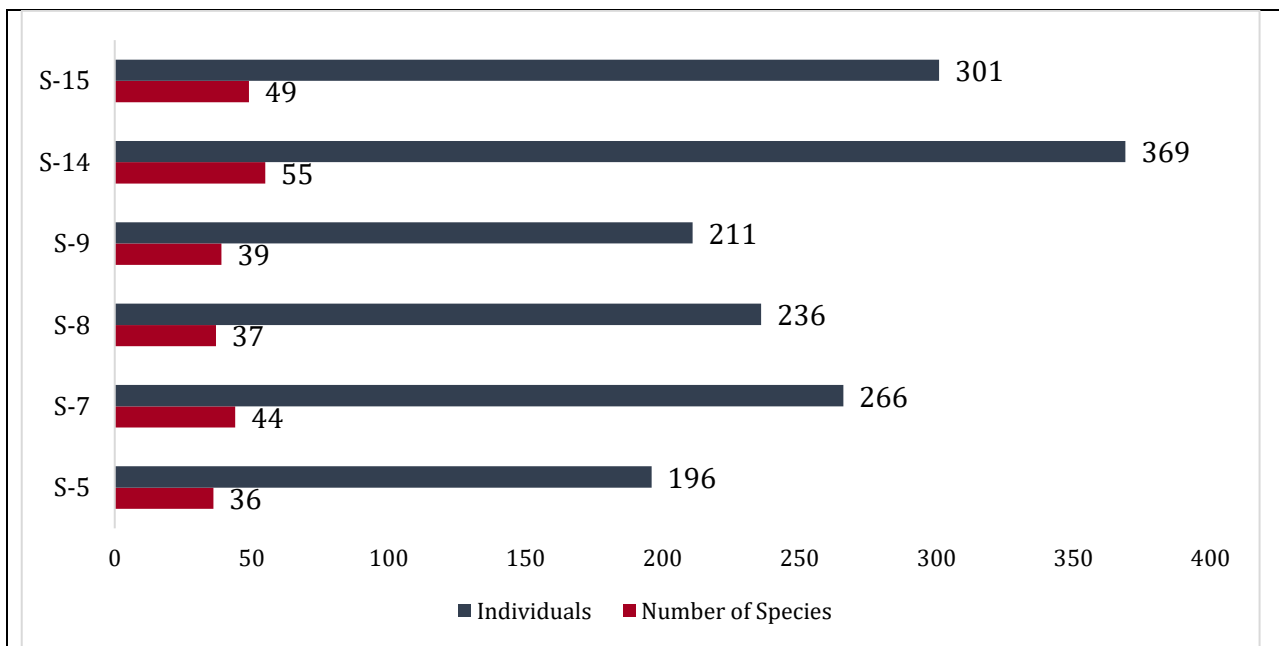


Figure 15: Site Wise Species Richness and Abundance.



Limosa



Tadorna



Halcyon pileata



Pandion haliaetus



Tadorna ferruginea



Mareca penelope



Larus brunnicephalus



Recurvirostra avosetta



Chlidonias hybrida



Axis

Photograph: Photos of some important wildlife from study area.

[Note- Species richness (S), Abundance (A), Simpson's Index (Ds), Shannon-Weiner Index (H), Evenness (E)]

Table 34: Species Richness, Abundance and Diversity Indices in Different Study Site

Site	S	A	Ds	H	E
S-5	36	196	0.9653	3.494	0.9142
S-7	44	266	0.966	3.605	0.8359
S-8	37	236	0.9556	3.396	0.8069
S-9	39	211	0.9628	3.516	0.8628

Note- Species richness (S), Abundance (A), Simpson's Index (Ds), Shannon-Weiner Index (H), Evenness (E)]

79. Among the observed 82 fauna, *Larus brunnicephalus* was the most abundant bird species (n=106, 6.7%). The ten most abundant species constituted 41.27% of total individuals, whereas the 40 least abundant species held only 10.1%. This signifies a highly uneven distribution of species in the community, which is explained in the rank abundance plot 6). The wetland specialist bird species ranked highest in the rank abundance curve (*Larus brunnicephalus*, *Mareca strepera*, *Mareca Penelope*, *Charadrius alexandrinus*). The y-axis shows the relative abundance, and the x-axis ranks the species in order of their abundance from the highest to the lowest.

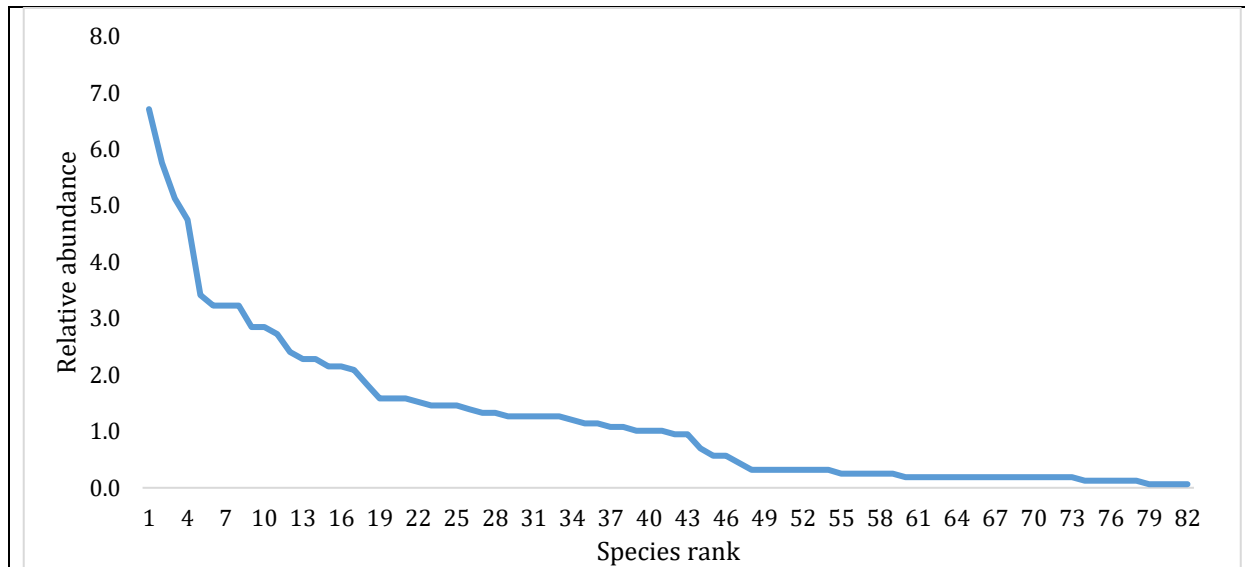


Figure 16: Rank Abundance Plot for Species Recorded from the Study Site.

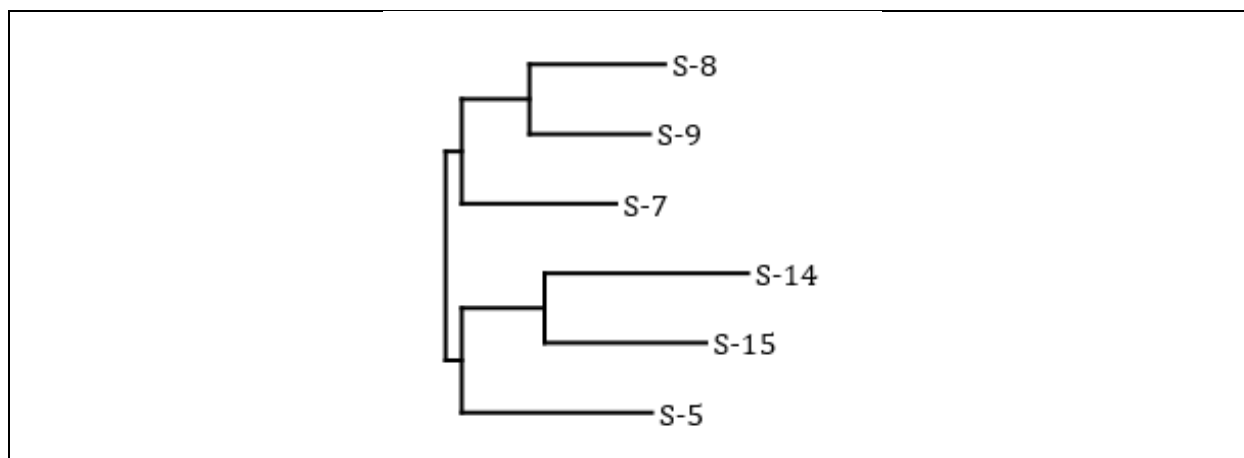


Figure 17: Similarity Profile Test Among Different Study Site Using Bray-Curti's Index.

80. In total 82 species of wildlife were recorded; of them 78 species were birds, and the remaining 4 species were mammals. Among the observed bird species 38 species (52%) were migratory and the rest were resident. Totally, two species were nationally vulnerable (*Clanga*, *Threskiornis melanocephalus*) two species was near threatened (*Limosa*, *Numenius arquata*) according to IUCN Bangladesh 2015. Among the observed wildlife relative abundance shows that 31 species (37.80%) was very common 7 (8.53%) species common, 3 (3.65%) species uncommon and 41 species (50%) was few.

81. The mammalians, representing Cetartiodactyla and Chiroptera orders, include the Spotted Deer, Indian Flying Fox, Lesser Bandicoot Rat, and House Mouse, showcasing a mix of terrestrial and arboreal species with varying degrees of abundance.

Designated Protected Area and Important Biodiversity Area around the Study Site

82. Ecologically Critical Area (ECA) is an environmental protection zone, defined by the Government of Bangladesh under the Bangladesh Environment Conservation Act, 1995, where the ecosystem is threatened with reaching a critical state. According to the Wildlife (Conservation and Security) Act, 2012, protected areas and environmentally controlled areas of Bangladesh are declared as national park, wildlife sanctuary, botanic

garden, eco-park, safari park, kunjoban etc. Besides them, Ecologically Critical Area (ECA) of Bangladesh are notified under the Bangladesh Environmental Conservation Act, 1995.

83. No sensitive aquatic species like dolphins, are also reported within a 10 km radius of the EZ site. (Ref. Addendum EIA report on PSDSP of BEZA). There are some areas near the project site of the study area. The team observed deteriorated environments for spotted deer within coastal mangroves in the project location. Critical habitat for spotted deer was identified by Anonymous (2018), which is located far from the project location, in the southern part. Among the locations indicated in only Muhuri Dam is near to the project location, while the forested or hilly habitats of Mirsharai Upazila is far away from the channel. Thus, no impact on terrestrial animals could occur in those locations.

Table 35: Status of Protected Area and Other Important Habitats near the Study Site

Name of the Area	Type	Impact	Distance
Patenga Beach	IBA (A1, A4i)	No effect	40 Km (From point 1)
Baraiyadhala National Park	National Park	No effect	10 Km (From point 3)
Mohamaya Lake		No effect	30 Km (From point 5)
Khoiyachara Waterfalls		No effect	35 Km (From point 5)
Napittachara Waterfalls		No effect	35 Km (From point 5)
Critical habitat for Spotted deer	Anonymous (2018)	No effect	18 Km (From point 14)

84. Baroiyadhala National Park: IUCN Category II national park and nature reserve in Bangladesh. The park is located at Sitakunda Upazila, Chattogram District, in the eastern part of the Dhaka-Chattogram Highway. It provides important wildlife corridors for the disappearing flora and fauna of Bangladesh. Khoiyachora Waterfall is located inside the Baroiyadhala National Park. The park was officially declared as a national park by the government of Bangladesh on 6 April 2010. It covers an area of 2933.61 hectares. Fauna of this park includes mainland serow, barking deer, marbled cat, Assamese macaque, Chinese pangolin, kalij pheasant, and various other animals.

85. Ramgarh Sitakunda Reserved Forest: The latitude of Ramgarh Sitakunda Reserved Forest is 22.70528, and the longitude is 91.64972 with the GPS coordinates of 22° 42' 19.00" N and 91° 38' 58.99" E. Ramgarh Sitakunda Reserve Forest is the largest forest in Bangladesh, covering an area of 72 square kilometers. It is located in the Chattogram Division of Bangladesh, near the city of Chattogram. The forest is home to 25 species of mammals, 123 species of birds, eight species of reptiles, and 25 species of trees. The forest is also home to the Baroiadhala National Forest and the Hazarikhil Wildlife Sanctuary.



Waterfall in Mirsharai



Mirsharai-fall-3-Ecotourism at Sitakunda and Mirsharai in BD



Baridhara National Park under Sitakunda Upazila



Ramgarh Sitakunda Reserved Forest

Photograph: Status of Protected Area and Other Important Habitats Near the Study Site

Conservation of Protected and significant areas

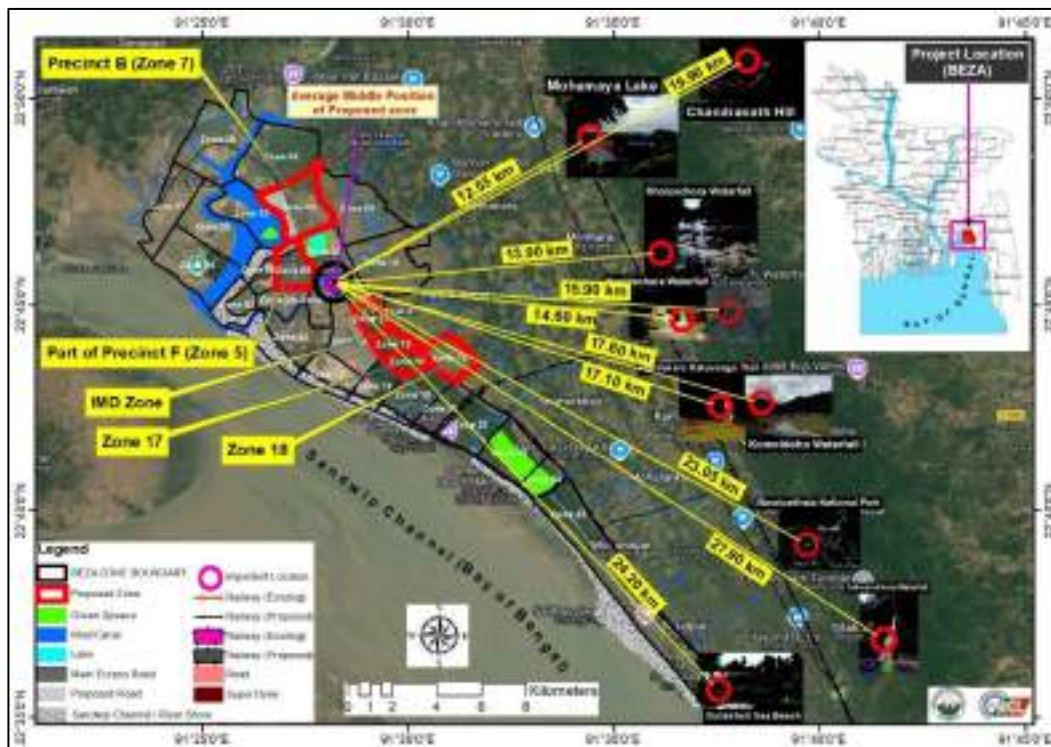
86. To explore the project area to find protected and ecologically significant areas, and Consultant also consulted with forest people and other concerned stakeholders. Protected and significant areas previously declared by the Government of Bangladesh were not found within the project area. Identification of critical and significant areas is in the table below.

Table 36: Identification of Critical and Significance Areas

Parameters	Name of the Critical/ Significance area	Location
National Park	No	No
Wildlife sanctuary	No	No
Community conserved area	No	No
Ecologically critical area	No	No
Fish sanctuary	No	No
Staging ground (assembling ground)	No	No
Flyway area	No	No
Biodiversity hotspots area	No	No
Mega biodiversity area	No	No
Animal corridor area	No	No

Ecologically Sensitive Areas

87. Ecological sensitive sites which are very important for the flora and fauna (Wildlife). Following map shows the locations of ecological sensitive sites with distance. The sensitive ecological sites from the Precinct F (Project area and Housing Facilities) and Precinct B are as follows:



Map 11: The Ecologically Sensitive Sites with Distance from the Project Area

88. Mohamaya Lake: Mohamaya Lake is the second largest artificial lake in Bangladesh, located at Mirsharai in Chattogram. Its area is about 11 square kilometers. Mahamaya Lake consists of an 11 sq km artificial lake built at the foot of a hill two kilometers east of Thakurdighi Bazar in Durgapur Union No. 6 of Mirsharai Upazila.

89. Khoiyachora Waterfall: It is one of the largest waterfalls in Mirsharai, Chattogram. This tourist attractive place Khayachara waterfall, is located at a distance of 4.2 km from Baratakia Bazar where tourists are always fascinated by the nine steps and aesthetic beauty of Khayachara waterfall. It is very difficult to ignore

the unique greenery of the village, the winding path, and the unique appeal of Khayachara in the hills, so nature lovers have termed Khayachara Jharna as the queen of springs in Bangladesh.

90. Napittachora Waterfall: Mirsharai's Napittachara spring in Chattogram is easily a very beautiful spring. The interesting thing is that there are three waterfalls in a very short distance. The three springs are Kupikatakum, Mithachari and Bandarkum. And the path to the waterfalls is probably called Napittachara.

91. Horinmara Hatuvanga Trail: The easiest and most beautiful trail in the Mirsharai area is the Horinmara Trail. It is called the Harinmara Trail because deer used to be hunted in the spring.

92. Komoldoho Waterfall at Sitakundo, Chattagram. The Komoldoho Jhorna Trail is a fairly unfamiliar trail. This amazing trail has a large lotus waterfall. Upstream of the big Kamaladaha fountain, there are again 4-5 large and medium fountains. Upstream, there are fountains on both the left and right sides. In the meanwhile, on the far left, the path becomes divided into two. There are several fountains on both sides, one of which is a huge 3-step fountain (height 120-140 feet). Upstream of the big lotus fountain is very dangerous in the rainy season. So it is better to go at the end of the rainy season.

93. Chandranath Hill: It is the highest peak of the Chattogram western hill range. The Chattogram Western Hill Range is the eastern part of the Himalayas separated from the rest of the range. This hill goes south and south-east of the Himalayas. Sitakunda Eco Park is built on the foothills of this hill.

94. Guliakhali Sea Beach: The Guliakhali sea beach is one of the lesser-known beaches of Bangladesh. It is also known as Muradpur beach to the local people. It is located 5 kilometres away from Sitakunda bazar. The beach is full of greenery, which makes it special. The sea beach situated at Sitakunda in Chattagram Division.

95. Sohosrodhara Waterfall: The Sahosrodhara Waterfall is located in the Sitakunda Ecopark of the evergreen forest in the traditional Chandranath Reserve Forest Block of Sitakunda Upazila of Chattogram District. The eco-park is 35 km from the Chattogram city. To the north is the east side of the Dhaka-Chattagram highway and railway. The water in this spring is much less during the rest of the year except the rainy season. If you go in the rainy season, you will see the fountain full of water and you will be able to fully enjoy the beauty of the fountain.

96. Suptadhara Waterfall: There is another waterfall very close to this waterfall, which is known as Suptadhara Waterfall.

97. Horinmara Hatuvanga Trail: The easiest and most beautiful trail in the Mirsharai area is the Horinmara Trail. It is called the Harinmara Trail because deer used to be hunted in the spring. On the Horinmara Hatuvanga Trail you will find Harinmara, Hatuvanga and Sorpopropat. Upon entering this route, you will find the magnificent Nilambar Lake.

C. SOCIAL ENVIRONMENT

Economic Activity

98. The subproject activity will generate employment opportunities. Both direct and indirect employment opportunities will be created. Thus, the employment generation has been considered as a VC. The main sources of income of local community are agriculture 38.93%, non-agricultural laborer 3.61%, industry 0.57%, commerce 13.26%, transport and communication 2.93%, service 18%, construction 1.19%, religious service 0.34%, rent and remittance 8.84% and others 12.33% Indicating the predominance of economically active members in the HHs. Therefore, there is a huge chance of local people to be involved in the subproject development activity. To assess the present condition of economic activity 150 HHs of the subproject area was conducted.

99. Male population within economically active age range is 33.18%; while female population of the same age is 29.44%. The reason for such difference between male and female is that male over 60 years of age is 2.34%, compared to 1.87% of female of that age group.

100. Out of the 150 HH survey conducted (94.67% male and 5.33% is female) under this EIA study area, average household size and the percentage distribution of HHs by different sizes. The average family size of NSEZ area is being 4.28 persons. While 55.33% of total sample HHs have 4-5 members, 23.33% HHs have 3 members or less and the rest 17.33% have 6 or more members in their HHs. Out of the 150 HH survey, 36% (54 HHs) is considered as Vulnerable and 64% (96 HH) is considered as general type of HH.

101. Access to electricity all the wards and unions of the Upazila are under rural electrification net-work. However, 56.0% of the dwelling households have access to electricity. Sources of drinking water Tube-well 93.9%, tap 1.6% and others 4.5%.

1. Educational status of HHs population

102. The literacy rate average 55.1%; male 57.1%, female 53.3%. In addition, population aged between 16 and 60 years constitute 62.36% of total population of the sampled HHs - shows that about 76.64% of the total population have certain level education as against 7.17% illiterate. Among the literate ones, nearly 20.09% of male and 19.78% of female have only primary level of education and 1.56% of male and only 0.31% of female received graduation/post-graduation level of education. 25.55% people received Secondary Education and total 3.12% received Higher Secondary education.

Table 37: Distribution of population by education levels

Education Type and Level	Male	Female	Total	%
Children	16	28	44	6.85
Primary	129	127	256	39.88
Secondary	87	77	164	25.55
Higher Secondary	14	6	20	3.12
Graduate	4	2	6	0.93
Post graduate	6	0	6	0.93
Literacy course/Self Taught	22	18	40	6.23
Illiterate	26	20	46	7.17
Under age or Child	27	33	60	9.34
Total	331	311	642	100

2. Occupation and Employment Status of the Surveyed HH Population

2.1 Occupation of Surveyed HH Population

103. Considering only the population within the age range 15-65 years, who constitute about 66.04% of the total population of the sampled HHs, **Table 37** shows the distribution of the 15-65 years aged population by main occupations. It appears that the absolute unemployment rate in the NSEZ influence area is around 3.07%; absolute housewives constitute about 38.91% of the total population of the considered age group. Students aged above 14 years comprise about 10.84% of the population within the same age group. Small and petty business being the single most common occupation for about 5.19% of the total population of the considered age group, service holders constitute 4.25%. Agriculture and day laboring being the main occupation for about 25.95%, agricultural labor is the main income source.

Table 38: Distribution of population Age 15-65 years by main occupation

Occupation	Male	Female	Total	%
Agricultural farming	13	0	13	3.07
Business	22	0	22	5.19
Service	15	3	18	4.25
Housewife	0	165	165	38.91
Day laboring	92	5	97	22.88
Carpenter	2	0	2	0.47
Electrician	1	0	1	0.23
Fishermen	4	0	4	0.94
Expatriate	3	0	3	0.71
Driver	31	0	31	7.31
Old/ Disable	4	5	9	2.12
Student	29	17	46	10.85
Unemployed	11	2	13	3.07
Total	227	197	424	100

3. Occupation of Surveyed HH Heads

104. **Table 38** shows the distribution of household head by occupation and it shows that business, day labor and driver category dominate the project area as it accounts for 74.67 percent of the total HH head occupation. No other occupation dominates here. Farming is the main occupation of only 733 percent. 7.33 percent of them are service holders.

Table 39: Distribution of population by occupation

Occupations	Primary Occupations of the Household Heads			
	Primary Occupations			
	Male	Female	Total	%
Agricultural farming	11	0	11	7.33
Business	19	0	19	12.67
Service	10	1	11	7.33
Housewife	0	3	3	2.00
Day laboring	67	2	69	46.00
Expatriate	2	0	2	1.33
Driver	24	0	24	16.00
Electrician	1	0	1	0.67
Old/ Disable	4	0	4	2.67
Fisherman	2	0	2	1.33
Other	3	1	4	2.67
Total	143	7	150	100

4. Employment Status of HH Population

105. As it is evident from the Table 34 while children (total 85) aged below 6 combined with students (157) constitute about 37.64% of total population (excluding housewives) of the surveyed HHs. While about 56.80% of total male and 57.05% of female are fully employed, 6.34% of male and 3.52% of female members are absolutely unemployed.

Table 40: Distribution of population by employment status

Employment Status	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Aged below 6 year	38	11.48	47	15.0641	85	13.2193
Students	83	25.0755	74	23.7179	157	24.4168
Day labor	95	28.7009	5	1.60256	100	15.5521
Agriculture and Fisheries	17	5.13595	0	0	17	2.64386
Driver	7	2.1148	0	0	7	1.08865
Service	44	13.2931	4	1.28205	48	7.46501
Housewife	0	0	166	53.2051	166	25.8165
Unemployed	21	6.34441	11	3.52564	32	4.97667
Business	22	6.64653	0	0	22	3.42146
Old	1	0.30211	2	0.64103	3	0.46656

Employment Status	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Other	3	0.90634	3	0.96154	6	0.93313
Total	331	99.9996	312	100	643	100

5. Household Assets and Capital Resources

Land:

106. As it is evident from Table-12, 60.67 % of the interviewed HHs is being land less, 30.67% HHs reported to have less than acre of one or other type of land and 3.33% has land in between acre; while only 2.67% has land above acres. The rest 133% has land above 3.5 acres (Table 40)

Table 41: HHs by land ownership status

Percentage distribution of HHs reported to have cultivable land by land holding size							
Landless	Below 0.50 acre	0.50 – 1.00 acre	1.00 – 1.50 acre	1.51 – 2.50 acre	2.51 – 3.50 acre	Above 3.50 acre	Total
91	46	5	4	2	0	2	150
60.67	30.67	3.33	2.67	1.33	0	1.33	

107. As it is shown in Table 36, the average land owned per HH is acre; of which 8.34 acre is homestead land and 23.11acre is cultivable land.

Table 42: Average Amount of land per HH

Land types	Average Land per HH (Acre)							Total Net Operated Land
	Own	Sharecropped		Mortgaged		Leased		
		In	Out	In	Out	In	Out	
Cultivable land	23.11	-	-	-	-	-	-	23.11
Homestead land	8.34	-	-	-	-	-	-	8.34
Orchard/Fruit Garden	-	-	-	-	-	-	-	0
Kitchen Garden	-	-	-	-	-	-	-	0
Pond/Ditch	1.5	-	-	-	-	-	-	1.5
Other	0.5	-	-	-	-	-	-	0.5
All category	33.45	-	-	-	-	-	-	33.45

7. Value of land owned by the sampled HHs

108. Estimated at the average present market rate, the total value of land owned by the sampled HHs is shown in Table 42

Table 43: Value of land owned by the sampled HHs

Land Type	Average amount of own land (Decimal/HH)	Average Value (TK/Decimal)	Total Value (TK/HH)	Remarks
Agriculture	39.17	130400	5107768	Value of land has been estimated based on the average present market rates given by the FGD participants and respondents
Homestead	14.19	210570	2987988.3	
Pond /Ditch	3.39	95580	324016.2	
Commercial	None of the sample HH reported the possibility of any commercial land			

8. Livestock and Poultry

109. As Table 43 shows, about 58.93% of interviewed HHs reported having one or other type of livestock, while another 47.32% of HHs reported having any poultry birds. The average number of livestock heads under the management of the sampled HHs is 2.42 per HH, including 7 HHs having 18 bullocks.

Table 44: Average number of livestock and poultry per household

Livestock types and poultry	Average Number Per HH							
	Under Own Management		Sharecropped-in		Sharecropped-out		Net total per HH's mgt.	
	Total No. of HHs	Ave. Per HHs	Total No. of HHs	Ave. Per HHs	Total No. of HHs	Ave. Per HHs	Total No. of HHs	Ave. Per HHs
Livestock								
Bullock	15	1.73					7	1.73
Cow	40	2.45	1	2			41	2.44
Buffalo	1	1					1	1
Goat	17	1.47					17	1.47
Sheep	2	9					2	9
Pig	3	1.33					3	1.33
Total	66		1					
Poultry								
Chicken	73	6					73	6
Poultry farm	2	557					2	557
Duck/Goose	71	4.38					71	4.38
Total								

9. Average Value of Livestock and Poultry per Household

110. **Table 44** shows the estimated average value of livestock and poultry birds per household of the sampled households. The average value per unit of buffalo TK100000 cow per unit is TK 94960, chickens TK 450, and ducks TK 462. The total value of all livestock and poultry stands at TK7411487.

Table 45: Average value of livestock and poultry

Type of Livestock and Poultry	Average number per HH	Average Unit Price	Total Value[i]	Remarks
Bullock	1.73	54890	94959.7	Average per unit value is based on estimates made in consultation with FGD participants in different area.
Cow	2.45	54890	134480.5	
Buffalo	1	100000	100000	
Goat	1.47	7819	11493.93	
Sheep	9	7222	64998	
Pig	1.33	625	831.25	
Sub-total -livestock				
Chicken	6	450	2700	
Duck/Goose	4.38	462	2023.56	
Sub-total -Poultry				
Grand Total (livestock + poultry)				

10. Access to utility and wash facilities

111. As a socio-economic indicator, the surveyed HHs were asked about access to electricity, water and toilet facilities. As may be seen in Table 45, only 4% of the HHs are connected to the piped water supply system, while 92% depend on hand tube wells, and 4% HHs collect water from other HHs. Having sanitary latrines, only 13.33% of HH have sanitary latrines, and 68% of HH have ring slab/non-sanitary latrines. 14% have a Pit latrine, 74.67% of HHs have an electric connection, 3.33% have no electric connection, 3.33% depend on other houses, 12% use Solar Power, and 6.67% use other sources.

Table 46: Amenities available in the residential houses of the sample HHs

Type of Amenities		HHs reported to have the amenity	
		Number	Percent=(n=150)
(A) Drinking Water Supply Sources			
HHs Using:	Piped Water Supply	6	4%
	Own Deep/ Shallow Tube	138	92%

	Other	6	4%
(B) Toilet Facility			
HHs using:	Sanitary Latrines	20	13.33%
	Non-Sanitary Latrines	102	68.00%
	Pit Latrines	21	14.00%
	Ring Slab	7	4.67%
(C) Energy sources			
HHs Using:	HHs connected to electricity supply line	112	74.67
	No electricity supply	5	3.33
	Connected to another house	5	3.33
	Solar Power	18	12.00
	Other	10	6.67

11. Accessibility to Health Care Facilities

112. As it is evident from Table 46 52% of people of the surveyed area mainly goes to the govt. hospitals and 21.33% HHs go to private doctors/clinics for health care services, 98.67% HH go to the village doctor, and 12.67% HHs go to the pharmacy when any of their members are sick.

113. Whereas 2% of HHs reported having a qualified doctor is available in their locality, 98% of HHs reported having no qualified doctor available in their locality

Table 47: Accessibility and frequencies of visit to health care services centers

Types of Health Care	Description	Number	Percent=(n=150)
Human Health Care			
HHs contact first if any family member is sick	Quack/Pharmacy	46	30.67
	Community Health Centre / Village Doctor	148	98.67
	Private Doctor/ Hospital/Clinic	32	21.33
	Govt. Hospital	78	52.00
	Pharmacy	19	12.67
	Kabiraj	11	7.33
A qualified doctor is available in your area	Yes	3	2.00
	No	147	98.00

11. Income and Expenditure

114. Estimated the income and expenditure of the sample HHs to have an idea of their overall economic conditions and standard of living, income estimate embraced: (i) Farm Income, (ii) Off-farm Income, and (iii) Farm & Off-Farm Income of the HHs.

115. Estimate of 'Farm Income' covered all agricultural income including the sales proceeds of crops, vegetable, fruits, livestock, poultry, fish culture and the like; while the 'Off-farm Income' included Wage/Salary/Pension etc. as well as the income from Trade/Business, Transport operation and/or transport related business, Remittance, Rent, Interest (Bank, FDR etc.) and Sale of any Capital Asset. On the other hand, expenditure is the summation of agricultural farming costs, household consumption costs (covering healthcare, clothing, and education costs), transportation costs, and the purchase value of any capital asset during the same reference period.

116. Out of the total 112 HHs interviewed, agricultural farming (including livestock, poultry, fishery) is the only income source for 24.11% HHs, and 98.21 % depend exclusively on off-farm income; while the rest 14.29% HHs depend on both farm and non-farm income sources.

Table 48: Distribution of HHs by sources of income

District	Distribution of HHs by Sources of Income					
	Farm Income		Off-Farm Income		Farm & Off-Farm Income	
Number & Percentage of HH	33	22%	141	94%	15	10%

12. Average Annual Income and Expenditure

117. **Table 48** shows that the average monthly income of surveyed HHs is TK 17048.67/- HH, and the annual average expenditure per HH.

Table 49: Average annual income (TK/HH)

Annual Income (TK/HH)			
Total income of all sampled HHs			Average Income per HHs
Farm Income	Off-Farm Income	Both	
443800	2113500	2557300	17048.67

13. Average Annual Expenditure

118. **Table 49** presents the average monthly household expenditures on the major accounts - including agricultural farming cost, HH consumption expenditures, transportation cost and others, etc. The overall area average of monthly expenditure is being TK1716422.6/HH, leaving a balance of TK 626.07/- per HH.

Table 50: Household expenditure

Annual Expenditure (TK/HH)					
Total expenditure of all sampled HHs					
(A) Agri. Farming Cost	(B) HH Consumption Cost (excluding transportation cost)	Transportation Cost	Health Cost	Total Expenditure	Average Expenditure per HHs
114200	2141230	145060	62900	2463390	16422.6

14. Overall Economic Condition Sample HHs

119. Based on the poverty rate in Bangladesh, the overall economic status of the sampled HHs is presented in **Table 50** wherefrom is evident that 66% of total HHs have faced deficit, and 18.67% fell into deficit at times or medium income family. On the other hand, 15.33% of HHs have surpluses.

Table 51: Distribution of HHs by overall economic condition

	Number and Percentage distribution of HHs by overall economic conditions		
	Poor	Medium	Above Medium Income
No.	99	28	18+5
%	66%	18.67%	15.33%

Source: (Poverty rate 6.85 USD per day income): https://en.wikipedia.org/wiki/Poverty_in_Bangladesh#Poverty_rate_by_division

15. Community Safety and Social Conflict

120. The community safety and social conflict have been considered as VCs, due to subproject activity. Cultural adjustment, criminal activity, poverty, unemployment, transportation, etc., will lead to social conflict and threaten community safety. Besides, women's safety, GBV and child labour engagement in the subproject also and issues regarding the social conflicts.

121. Road construction to be the number one problem by 74.67% of respondents; Unemployment is a common problem reported by 39.33% of respondents. Local conflicts and poverty issues were mentioned by 92% of HHs.

122. Among the proposed measures against poverty, assistance from the government and general demand for industrial establishments, it is recommended to develop new industries and create employment opportunities to alleviate unemployment and poverty. Those who mentioned unemployment as a problem, wanted the government. assistance towards establishing a new factory, Table 51

Table 52: Major problems and recommended solutions

Type of problems reported	HHs reported the problem (n=150)		Most common recommended solutions
	No.	%	
Conflict with Local People	81	54.00	▪ Assistance from Government
Cultural Adjustment	27	18.00	▪ Assistance from Government and NGO organization
Non-comparative	12	8.00	▪
Criminal Activity	66	44.00	▪ Assistance from Government ▪ Need social and Law Enforcement Surveillance

Type of problems reported	HHs reported the problem (n=150)		Most common recommended solutions
	No.	%	
Poverty	57	38.00	- Assistance from Government - Need more industries in this area
Unemployment	59	39.33	- Assistance from Government - Need more industries in this area - Vocational Training
Transport	112	74.67	Repair/improve existing Road

16. Status of Women in the Project Area

123. Social discrimination, gender-based violence, social conflict, etc., may arise within the subproject area. Therefore, the women's educational qualification, capacity, occupation, decision-making power, violence against women, etc., were analyzed during the study.

Education

124. Despite the fact that women constitute half of the population, analysis of survey findings reveals that women in many aspects fall behind men. As Table 47 shows, the male literacy rate is still a bit high in the survey areas – about 7.85% of males compared to 6.43% of females. Although the male students and recipients of secondary and higher secondary levels of education are higher than females, the scenario at graduation levels is just the opposite. Male students and recipients of graduate-level education is 3.02% as against 0.64% of females; whereas females at the graduation/post-graduation level are far behind their male counterparts.

Table 53: Comparative position of women in terms of education

Education Level	Percentage Distribution of Sampled HH Population Aged above 14 years			Remarks
	Male	Female	Total	
Illiterate	26(7.85)	20(6.43)	46	
Primary Level	129(38.97)	127(40.84)	256	Male enrollment at the primary and secondary levels is relatively higher than females.
Secondary Level	87(26.28)	77(24.76)	164	
Higher Secondary Level	14(4.23)	6(1.93)	20	
Graduate/Post-graduate Level	10(3.02)	2(0.64)	12	Males are a little bit higher than females in getting higher education.

Occupation and Employment

125. As Table 53 below shows, excluding the absolute housewives and students aged above 14 years, 63.75% of the sampled HH members aged between 15-65 years reported to be fully employed in any income-earning occupation; about 55.29% of males and 39.94% of females are fully employed. The absolute unemployment rate for males is 2.79% and 0.31%, absolute housewives being considered employed.

Table 54: Men versus Women in employment

Occupation/Employment	Percentage Distribution of Sample HH population aged 15- 65 Year			Remarks
	Male	Female	Total	
Fully employed in any income earning occupation	55.29	39.94	82.97	83.77% of total women within the reference age range are 'Housewives' considered fully employed
Student	6.81	4.02	10.84	Lower percentage of female student aged above 15 years is discontinuation of education mainly due to early marriage.
Unemployed	2.79	0.31	3.10	Considered only those who are willing to work but not finding any opportunity.

Participation in Social Organizations and NGOs

126. Whereas 36% of total sampled HHs reported to have any family member associated with NGOs like ASA, BRAC, Grameen Bank.

Women's Mobility and Accessibility to Markets

127. To be taken with caution that 24.11% of sampled HHs heads do not support women working outside home, 91.96% women members of interviewed HHs reported to have visited any place outside home during a year before interview and 38.46% of total women interviewed reported to have visited any market place as shown in **Table 54**.

Table 55: Indicators of Women's mobility accessibility to markets

Indicators	Percentage of reporting HHs
HH Heads having objection to women working outside home	24.11%
Interviewed women visited any place outside home (excluding visit to relatives)	91.96%
Interviewed women visited any market place	38.46%

Women's Participation in Decision Making

128. **Table 55** presents the survey findings about women's participation in important family matters like children's education, children's marriage, and their health care; wherefrom it appears that women are very good position in regard to deciding about their children's education. About 94.64% of women taking part in deciding about their children's education, about 5.36% cannot at all play any role in this regard, or were not applicable as they do not have any children yet to go to school.

129. Only 89.29% of women having children of that age group reported full freedom to participate in any decision about their children's marriage, while 5.36% reported the possibility of participation in decision making only on limited issues concerning their children's marriage.

130. About their own health, 97.32% of women reported having absolute freedom of making decision, while about 2.68% cannot make decisions.

Table 56: Women in development and level of empowerment

Women by degree of freedom to take part in decision making about:		Percentage of reporting women
Children's Education	Cannot take always	10
	Cannot take at all	4
	Can take always	86
	Not applicable	0
Children's Marriage	Cannot take always	0.67
	Cannot take at all	7.33
	Can take always	92
	Not applicable	0
Own Health Care	Cannot take always	0
	Cannot take at all	12.67
	Can take always	87.33
	Not applicable	0

Women's Awareness of STDs

131. Although HIV/AIDS infected people in Bangladesh is still at a relatively low level, there is, however, a concentrated HIV epidemic among the injecting drug users (IDU), primarily due to sharing of unclean syringes and needles. As a result, the rate of new infections is still on the rise, and Bangladesh is the only country in the South Asia Region where new infections are rising⁹. Risk arises mainly from unprotected paid sex, sharing of used needles and syringes by IDU, and unprotected sex between men who have sex with men. There is also a risk of epidemic among female sex workers (FSW) in towns bordering India.

132. Having that in view, the study has investigated the knowledge level of the respondents about HIV/AIDS. In response to a question about whether they know about Sexually Transmitted Diseases (STD), 24% of women reported having heard of HIV/AIDS, and about 12.67% claimed to be aware of the reasons for spreading HIV/AIDS, as shown in Table 56.

⁹ FEATURE STORY; HIV/AIDS in Bangladesh, July 10, 2012, World Bank

Table 57: Women aware of HIV/AIDS and the causes of spreading the diseases

Issues		Percentage of reporting women
Women know of HIV/AIDS		24
Women know the reasons for spreading HIV/AIDS		12.67
Percentage of women who know the reasons for spreading HIV/AIDS	Copulation with HIV/AIDS infected people	64.00
	Sexual interaction with multiple partners	64.00
	Sexual interaction with sex workers	64.00
	Blood infusion of HIV/AIDS infected people	16.67
	Using a needle/injection syringe or a sharp instrument used by HIV/AIDS infected people	16.00
	An HIV/AIDS-infected pregnant mother's baby can get HIV/AIDS in the womb	16.00

17. Violence against Women

133. The term violence against women means any act of gender-based violence that results in, or is likely to result in, physical, sexual, or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private life.

134. In Bangladesh, women are easy targets of violence because of the patriarchal social system, economic backwardness, traditional norms and values, and religious misinterpretation. The government of Bangladesh has revised the existing laws and adopted new strategies to combat violence against women.

135. Dowry cases and familial conflict were the main background behind Violence against Women. Violence against women occurs in all settings, within the household, and in almost all cases, perpetrated by the patriarchal order. For victims, consequences were physical, sexual, reproductive, psychological, and economic. For the children of the victims, the consequences were mostly behavioral and psychological, while for family members of the victims, the consequences were mainly economic and psychological.

136. Table 58 presents the results of violence against women; about 36.67% of the survey respondents heard about violence, and 34% did not hear any violence in their area.

137. On the one hand, 26.7% reported physical violence, only 0.7% reported murder, 38% dowry, 4 % child marriage, and 22.7% multiple marriages, and so on. So, dowry, physical violence and polygamy are the main violence in this society (**Table 57**).

Table 58: Reasons of violence against women

Issue	Yes	No
Do you hear about any violence?	55 (36.42%)	51(33.770%)
Reason of violence against woman	Number	%
Physical Violence	40	26.7
Killing	1	0.7
Divorce	10	6.7
Food hardship	2	1.3
Dowry	57	38.0
Child Marriage	6	4.0
Multiple marriage	34	22.7

Annex- 4: KIIs, FGD and Public Consultation Meetings

Key Informant Interviews (KII)

During the survey conducted by BCL Associates Limited, the following key informant interview (KII) with the different stakeholders: BEZA officials, NSEZ officials, Utility service provider (KGDCL), local representatives, schoolteacher, religious leaders, NGO Worker, Farmer and Fishermen taken place to disseminate and disclose information on the project activities. Summary of the KII and photographs are given below:

1. KII with Upazila Agriculture Officer

Protap Chandra Roy Upazila Agriculture Officer Mirsharai, Chattogram Mobile:01718-066684 Date: 11.12.2023		
Sl. No	Questions	Answers/Comments
1	What are the general agricultural practices in the study area?	Generally, Boro, Aman and vegetables are cultivated within the influence area of the gas pipeline
2	What are the existing cropping patterns in the area?	At present there are Amon rice and vegetables in the fields
3	Do you think the proposed project will have hampered agricultural production	As the dredging pipeline is within the economic zone, it will not any hamper to agricultural production
4	Will the people of the influence area get any benefits if the dredging pipeline is installed?	They will get some benefits such as: employment opportunities will increase, business areas will increase, communication system will be better, etc.
5	Will the population of the area be affected by the installation of dredging pipeline?	The dredging pipelines will be installed within the Economic Zone so there is no problem for the local people. However, there are some risks for the communities around the dredging pipeline from Boro Takia to Economic Zone, such as dredging pipeline leakage. Local forest drains and irrigation channels may be destroyed. Besides, many cows and buffaloes used to graze in the economic zone which will not be possible anymore and when the boundary wall is put in the economic zone, we will have to travel a lot.
6	Do you have any suggestions or comments that needs to be considered during the implementation of the proposed Project	Must monitor the activities to mitigate the social impact. No social forest/drainage system/irrigation channels should be disturbed while installing the gas pipeline.

2. KII with Farm Manager

Md. Motasim Bella (Hafiz) Farm Manager Fish Seed Multiplication Farm Mirsharai, Chattogram Mobile:01677-515999 Date:11.12.2023		
Sl. No	Questions	Answers/Comments
1	How many fishermen families live in Ichakhali and Maghadia Union?	There are 56 fishermen families live in Osmanpur under Ichakhali union and 100 fishermen families live in Sarkerpara under Maghadia union.
2	Do you think the proposed project will have hampered to catching fish	As the dredging pipeline is within the economic zone, it will not any hamper to catching fish.
3	Whether there will be any benefit on the fishermen families if the gas line will be installed in the economic zone	The fishermen families will get some benefits, such as: employment opportunities will increase, business areas will increase, communication system will be better etc.
4	Will the population of the area be affected by the installation of dredging pipeline?	The Dredging Pipeline will be installed within the Economic Zone so there is no problem for the local people. However, there are some risks for the communities around the dredging pipeline from Borotakia to Economic Zone, such as Dredging Pipeline Leakage. Ponds and canals may be destroyed. Besides, there is a possibility of spreading various types of crime, addiction, diseases etc. in the area due to the arrival of many people from outside.
5	Do you have any suggestions or comments that needs to be considered during the implementation of the proposed Project	If a fisherman's family is harmed due to the dredging activities and pipe line, they should be compensated. To ensure security for the population. Care should be taken to ensure that the families of fishermen are not affected.

KII with UP Member

Md. Yunus Mia UP Member, Ward No-9 Maghadia Union, Mirsharai, Chattogram Mobile:01830-140115 Date:11.12.2023		
Sl. No	Questions	Answers/Comments
1	What about your perception of the project (Positive or Negative)	It is a very good initiative for the development of localand country as well but currently the people of the area are not getting any direct benefits but, in the future, they will get few benefits.
2	Will there be any positive impact on the society as a result of the implementation of the proposed project?	At the present the people of the area are not getting any benefits but, in the future, they will get few benefits, like: increase

		employment, development of communication system, development of business over all the quality of life will be improved.
3	Will there be any negative impact on the society as a result of the implementation of the proposed project?	There may be conflict between the local community and the laborers coming from outside. Crime (theft, robbery, rape) may increase. Addiction and different kinds of diseases can spread.
4	Do you have any suggestions or comments that needs to be considered during the implementation of the proposed Project	Providing compensation if any family is affected. Employment of local people should be arranged on priority basis. People will be greatly benefited by connecting gas lines outside the economic zone. Workers from outside will actually provide them with the necessary facilities.

KII with Imam

Md. Rashadul Islam Imam Ichakhali Central Mosque Ichakhali Union Mirsharai, Chattogram Mobile:01830-159956 Date:9.12.2023		
Sl. No	Questions	Answers/Comments
1	Gas line will be installed in the economic zone; do you know it?	Yes, I know
2	What are the benefits of the local people if the gas line is installed in the economic zone?	The people of the area will get some benefits, like: local people will get employment opportunity. The communication system of the area will be improved. Improve business. Demand for house rent will increase.
3	If the proposed project is implemented, there will be any negative impact on the area or not.	Yes, there will be some negative impact on the area, like: Outsiders borrow from locals and leave without repaying. Some outsiders speared addiction among the locals. Some outsiders speared various diseases among the locals.
4	Do you have any suggestions or comments that needs to be considered during the implementation of the proposed Project	Since many people will come from outside, they have to be managed well. Local people will be benefited by gas connection outside the Economic Zone. Everyone should be aware so that crime, addiction cannot speared among the locals.

KII with BEZA Officials

Md. Ferdous Wahid Assistant Engineer (Civil) & Focal Person National Special Economic Zone (NSEZ) Mirsharai, Chattogram Mibile:01620142860 Date:12.12.2023		
Sl. No	Questions	Answers/Comments
1	If this project is implemented what will be the positive impact on the society?	There will be some positive impact on the society, for example: increase employment, development of communication system, development of business over all the quality of life will be improved.

2	If this project is implemented what will be the negative impact on the society?	There will be some positive impact on the society, for example: There may be conflict between the local community and the laborers coming from outside. Crime (theft, robbery, rape) may increase. Addiction and various diseases can spread.
3	Do you have any suggestions or comments that needs to be considered during the implementation of the proposed Project	Health & safety of all those working in the project must be ensured. Gas wastage should be prevented. Training and employment of local people should be arranged on priority basis.

Md. Ibrahim Miah
Executive Engineer
NSEZ Development Project, BEZA
Mobile:
Date: 02/04/2024



Sl. No	Questions/Topic	Answers/Comments
1.	What are the concept of IMD Zone?	IMD zone will be specially developed for green and sustainable industries.
2.	Amount of sand required for the land development of proposed zone?	Approximately 10,000,000 m ³ sand needed for the land development of Zone 12, 13 & 17
3.	Please dateline the technical specifications of the dredging	2.5 feet/30-inch pipe will be used for transporting sand from dredging source to land fill area
4.	How to discharge the water which will come to the landfill site with sand?	Firstly, water will deposit into the settling pond for deposit the sand then clear water pass through the existing canals of the project area.
5.	How many labors required for landfilling to the Part of Precinct F (IMD zone and Housing Facilities) and Precinct B?	Actually, land filling activities required due its scope of work. Labor only required for change the pipe, change the location and operation and maintenance of the dredger. Approximately 100 labors may need for this work.
6.	How many labors camp need to be established for landfilling to the Part of Precinct F (IMD zone and Housing Facilities) and Precinct B?	I think one (1) labor camp is enough for the labor related to the landfilling of the IMD zone with proper facilities like potable drinking water, sanitation, utilities etc.

Md. Nazrul Islam
Deputy Project Director
NSEZ Development Project, BEZA
Mobile:
Date: 02/04/2024



Sl. No	Questions/Topic	Answers/Comments
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1.	What is the concept of IMD Zone?	IMD zone will be specially developed for green and sustainable industries. Mainly light engineering and less environmentally concern industries will establish in this zone.
2.	How many labors required for landfilling to the Part of Precinct F (IMD zone and Housing Facilities) and Precinct B?	Yet not fixed. You can consult with relevant contractors for the technical specifications, resource need for the work, manpower needed and utility required.
3.	What types of facilities need to be provided to the labor by contractors?	Potable drinking water facilities, proper sanitation, healthy accommodation and first aid facilities have to be provided to the labor.

Md. Shahadat Hossain Jr. Urban Planner (Consultant) Bangladesh Economic Zones Authority (BEZA) Mobile: 01731291426 Date: 03.04.2024		
Sl.No	Questions	Answers/Comments
1	Tell me about IMD Zone	IMD Zone consists of approximately 450 acres of land. IMD Zone consists of zone 12 and 13. IMD Zone will be green Zone.
2	What kind of industries will be in IMD Zone and when will it start?	There is no plan in this regard yet.
3	How many labors will be required in for landfilling to the Part of Precinct F (IMD zone and Housing Facilities) and Precinct B, is there any plan about their management?	There is no plan in this regard yet.
4	Is there any plan on how much sand will be required to fill the IMD Zone and what type of Dredger will be used for dredging?	There is no plan in this regard yet.
5	What are the sources of water used in for landfilling to the Part of Precinct F (IMD zone and Housing Facilities) and Precinct B?	There are three sources of water used in the IMD Zone. Namely: 1. Ground Water (Temporary/construction phase); 2. Water Treatment Plant (WTP)-100 MLD/work in progress; 3. Meghna water river.
6	Has the process to free the Daborkhali canal flowing through the IMD zone started?	Yes, the canal digging has already started.
7	Tell me about Gas line	Mr. Shahadat Hossain said that there will be 30-35 km gas line in the Economic Zone. This gas will only be used in mills/factories. No connection will be provided outside the factory.
8	Many people used to graze cows and buffaloes in the economic zone, now it has stopped. Do BEZA have any plans for the cow-buffalo's breeders?	There is no concrete plan yet, but BEZA is thinking of doing something for them.

KII of Utility Service Provider (KGDCL)

Md. Fuad Deputy Manager Dhaka Liaison Office Karnaphuli Gas Distribution Company Limited (KGDCL) Mobile: 01713014791 Date: 03/04/2024		
Sl. No	Questions	Answers/Comments
1	Do you concern about gas distribution line inside the NSEZ project	Yes, we have already gas distribution network inside the NSEZ project and it will extend in future.
2	How many DRS inside the NSEZ in Mirsharai portion	We have already two DRS and it will increase in to four. For BR Powergen an individual DRS also will be established.
3	Any suggestions/opinion	For further information please contact with GM (planning)

KII with Teacher

Abdur Rab School Teacher Char Sarat Model High School, Mirsaarai, Chattogram Mobile:01836-395661 Date:9.12.2023		
Sl. No	Questions	Answers/Comments
1	Gas line will be installed in the economic zone, do you know it?	Yes, I know.
2	What about your perception of the project (Positive or Negative)	It is a very good initiative for local and country development and the people of the area will get many benefits in the future.
3	What is the positive social impact of the proposed project?	There will be some positive impact on the society, like: increase employment, development of communication system, development of business over all the quality of life will be improved and
4	What is the negative social impact of the proposed project?	There will be some negative impact on the society, like: there may be conflict between the local community and the laborers coming from outside. Crime (theft, robbery, rape) may increase. Addiction and various diseases can spread. Cattle rearing will stop within the economic zone.
5	Do you have any suggestions or comments	Local people will be benefited by gas connection outside the Economic Zone. Everyone should be aware so that crime, addiction cannot spear among the locals. Employment of local people should be arranged on priority basis

KII with NGO Office

Md. Shahadat Hossain Manager CODEC Abu Turab Branch Abu Turab Bazar, Moghadia Union Mirsaarai, Chattogram Mobile:01708-508164 Date:12.12.2023		
Sl. No	Questions	Answers/Comments
1	Will there be any impact on NGO activities if the dredging pipeline is installed in the economic zone?	There will be some impact on NGO activities, like: As the population in the area will increase, the demand for loans will increase on the other hand some people will run away with loans.
2	What about your perception of the project (Positive or Negative)	After the installation of gas lines, many factories will go into production, as a result of which there will be a lot of development in this area and the country.
3	What is the positive social impact of the proposed project?	There will be some positive impact on the society indirectly. Like: increase employment, development of communication system, development of business over all the quality of life will be improved and
4	What is the negative social impact of the proposed project?	There will be some negative impact on the society indirectly, like: There may be conflict between the local community and the laborers coming from outside. Crime (theft, robbery, rape) may increase. Addiction can spread. Various diseases can spread.
5	Do you have any suggestions or comments that needs to be considered during the implementation of the proposed Project	Local people will be benefited by gas connection outside the Economic Zone. Employment of local people should be arranged on priority basis. Health & safety of all those working in the project must be ensured.

KII with Labour inside the NSEZ Industry

Name: Alomgir Hossen Occupation: Labor Place of interview: Nippon Point Village : Est Ichakhali Union : Ichakhali Upazila : Mirsharai District: Chattogram Date: 04.03.2024	
Alamgir Hossain has been working in a small hotel at Nippon Point for the past 3 years at a daily wage of Tk 450. Discussions were held with him regarding to land development of the part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ. Following are the comments he made during the discussion: • We have no problem for dredging from Sandwip Channel to land development of the part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ. Because there is no agricultural land, fish culture and roads between the Economic Zone and Sandwip Channel; • Earlier each family depended on the land in the economic zone for cattle rearing, wood collection and fishing. But now, as the economic zone is closed, there is no opportunity for cattle rearing, wood collection and fishing;	

- BEZA is not giving us jobs, fishing has stopped, and wood harvesting has stopped in the forest. As a result, our income has stopped. So, we want to work to live;
- We are hearing that the boundary wall will be built on the east side of the road. If the boundary wall is built on the east side, we will be blocked. We want the boundary wall to be along the west side of the road;
- Daborkhali canal is very useful for our area. BEPZA has closed this canal. We want this canal to be re-opened.

Name of interviewee: Zohirul Islam
Occupation: Labor
Place of interview: Nippon Point
Village: Charsarat
Union: Ichakhali
Upazila: Mirsharai
District: Chattogram
Mobile No: 01865177232
Date: 04.03.2024



Zahirul Islam has been working as a laborer in Nippon Company for 2 years with a monthly salary of Tk 15080. Discussions were held with him regarding to land development of the part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ. Following are the comments he made during the discussion:

- The entire (12Dec.) land of my house has been acquired by Beja. I hear that we have to leave soon. I don't know where to go. I have no place of my own;
- I have not received the land money yet. It is not possible to buy new land by getting this money. Because the land price is much higher than the money we will get. We will be greatly benefited if BEZA arranges accommodation for us;
- Earlier our important sources of income were cattle rearing, timber harvesting, fishing and agriculture work. But due to the Economic Zone our income from cattle rearing, timber harvesting and fishing has completely stopped and due to acquisition of land, agricultural opportunities also have reduced a lot. The people of this area should be given job opportunities on priority basis;
- We are hearing that the boundary wall will be built on the east side of the road. If the boundary wall is built on the east side, we will be blocked. We want the boundary wall to be along the west side of the road;
- The water of our area goes to the sea through the Daborkhali canal. But BEPZA has closed this canal, the field water cannot go out during the monsoon season. As a result, waterlogging occurs, crops are damaged. We want the Daborkhali canal to be opened;
- We have no problem for dredging from Sandwip Channel to land development of the part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ. Because there is no agricultural land, fish culture and roads between the Economic Zone and Sandwip Channel.

Focus Group Discussion (FGD)

138. During the preliminary survey the following focus group discussion was conducted with **different** groups of people to disseminate and disclose the information of propose Gas pipeline Sub-project under National Special Economic Zone (NSEZ) Development Project and to know their opinions about the project

1. FGD with Local Community

Village: Char Sarat, Upazila: Mirsharai, District: Chattogram

Date: 9.12.2023

Place: Shop of Mosharof Member

139. On 9.12.2023, FGD was conducted at the tea stall of former UP member Mosharof Hossain of Charsarat village of Mirsharai Upazila. There was attended a total of ten participants which represent small business man, student, day labor, Farmer and local leader. The FGD discussion minutes and attendance list are as follows



Figure 1: Photographs of FGD with local community at Charsarat of Ichakhali Union under Mirsharai Upazila

Summary of Focus Group Discussion (FGD-1):

- Mosharraf Hossain said that we are not getting any benefits directly because the EZ development;
- Abdus Salam says many people will come from outside to work on Zone development and we may have conflict with them;
- Monirul Islam said that people who come from outside can activate various types of crime, such as theft, robbery, intoxication etc.;
- Abdul Hai said that we will be greatly benefited if utilities particularly gas connection is provided outside the economic zone;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-1):

No.	Name of Participant	Designation	Mobile Number	Signature
1	Mosharraf Hossain	Former UP member	0181228879	[Signature]
2	Abdus Salam	Small business man	0181228879	[Signature]
3	Monirul Islam	Student	0181228879	[Signature]
4	Abdul Hai	Farmer	0181228879	[Signature]
5	Abdul Kader	Farmer	0181228879	[Signature]
6	Mosharraf Hossain	Former UP member	0181228879	[Signature]
7	Abdus Salam	Small business man	0181228879	[Signature]
8	Abdul Hai	Farmer	0181228879	[Signature]
9	Abdul Kader	Farmer	0181228879	[Signature]
10	Abdul Kader	Farmer	0181228879	[Signature]

2. FGD with Local People

Village: Char Sarat, Upazila: Mirsharai, District: Chattogram

Date: 9.12.2023

Place: Member's Office, Daborkhali Point

140. On 10.12.2023, FGD was conducted at Member's Office, Daborkhali Point of Charsarat village of Mirsharai Upazila. There was attended a total of nine participants which represent farmer, auto driver and cook. The FGD discussion minutes and attendance list are as follows



Figure-2: FGD with local people at Daborkhali Point of Ichakhali Union

Summary of Focus Group Discussion (FGD-2)

- Ajmir said that we are not getting any benefits directly because of the economic zone;
- Biplab Kumar Das said that BEZA should provide job opportunities on priority basis in the economic zone;
- Jamal said that in the future increase employment, development of communication system, development of business over all the quality of life will be improved;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-2):

Bangladesh Sustainable Development Program (BSDP) - Environment Project
 Environmental and Social (EVS) Policy Review (Package No. 1901-00-00000-0000)
 Bangladesh Economic Zones Authority (BEZA)

Title: Attendance Sheet of Focus Group Discussion (FGD) for: Char Sarat village
 Name of District: Chattogram Name of Union: Daborkhali point
 Name of Upazila: Mirsharai Name of Location: Member's office
 Name of Union: Ichakhali Date: 10.12.2023
 Name of Village: Charsarat Time: 5.20 PM
 Name of Group: At-Large Session: 1

No.	Name of Participants	Designation	Phone Number	Signature
1.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
2.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
3.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
4.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
5.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
6.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
7.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
8.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
9.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক
10.	মুঃ মাহমুদুল হক	মুঃ	০১৭-১১১১১১১১	মুঃ মাহমুদুল হক

FGD with Local People

Village: South Moghadia-Kajirtaluk, Union: Shaerkhali, Upazila: Mirsharai, District: Chattogram

Date: 24.01.2024

Place: House of Shukur Ali near about CP Point

141. On 24.01.2024, FGD was conducted at the house of Shukur Ali near about CP Point, Village: South Moghadia-Kajirtaluk, Shaerkhali union of Mirsharai Upazila. There was attended a total of twelve participants which represent only landowner/affected persons. The FGD discussion minutes and attendance list are as follows



Figure-3: FGD with land owner/affected persons at South Moghadia-Kajirtaluk of Shaerkhali Union

Summary of Focus Group Discussion (FGD-3)

- Md Shariful Islam said before our income was good but after developing EZ we are in a lot of trouble. Earlier fishing, wood collection and grazing of cattle and goats could be done within the zone. But now there is no such opportunity;
- Md. Didarul Alom said that due to the zone the roads in our area are getting better, the price of land is increasing, people from outside are coming to our area, the demand for house rent is increasing;
- Md. Shakil Hossen said we want training for skill development;
- Md. Nasir Ahmed said that many people from outside can actually spread theft, robbery, addiction and various diseases in our area;
- Md. Kamal Hossen said BEZA has acquired crop fields so now we can't do agricultural work in the EZ area;
- Md. Amir Hossen says BEZA is not giving us any job opportunities. We want work;
- Md. Rakib Hossen said we want gas connection.

Attendance sheet of Focus Group Discussion (FGD-3)

Barisal City Development Project (BDDP) Development Project
 Environmental and Social Impact Assessment (EIA) Report No. EIA/10/05/00000000
 Bangladesh Economic Zones Authority (BEZA)

Site Address: House of Shukur Ali near about CP Point, South Moghadia-Kajirtaluk, Shaerkhali Union, Mirsharai Upazila, Chattogram District.

Name of the FGD: FGD with land owner/affected persons Name of the Place: House of Shukur Ali

Name of the Facilitator: Md. Amir Hossen Name of the Date: 24-01-2024

Name of the Union: Shaerkhali Union Name of the Upazila: Mirsharai

Name of the District: Chattogram Name of the Date: 24-01-2024

No.	Name of Participant	Signature	Mobile Number	Signature
1.	Md. Shariful Islam	[Signature]	01818958009	[Signature]
2.	Md. Didarul Alom	[Signature]	01818958009	[Signature]
3.	Md. Shakil Hossen	[Signature]	01818958009	[Signature]
4.	Md. Nasir Ahmed	[Signature]	01818958009	[Signature]
5.	Md. Kamal Hossen	[Signature]	01818958009	[Signature]
6.	Md. Amir Hossen	[Signature]	01818958009	[Signature]
7.	Md. Rakib Hossen	[Signature]	01818958009	[Signature]
8.	Md. Amir Hossen	[Signature]	01818958009	[Signature]
9.	Md. Amir Hossen	[Signature]	01818958009	[Signature]
10.	Md. Amir Hossen	[Signature]	01818958009	[Signature]
11.	Md. Amir Hossen	[Signature]	01818958009	[Signature]
12.	Md. Amir Hossen	[Signature]	01818958009	[Signature]

FGD with Business Group

Ichakhali Sluicagate Bazar, Upazila: Mirsharai, District: Chattogram

Date: 10.12.2023

Place: Ichakhali Sluicagate Bazar

142. On 10.12.2023, FGD was conducted at in front of Iqbal Hotel & Restaurant, Ichakhali Sluicagate Bazar Ichakhali union of Mirsharai Upazila. There was attended a total of nine participants which represent only business man. The FGD discussion minutes and attendance list are as follows



Figure-4: FGD with Business Group at Ichakhali Sluicagate Bazar of Ichakhali Union.

Summary of Focus Group Discussion (FGD-4)

- Mohammad Hossain said that many people from outside will come to this area to work in the development work, so our business will be better;
- Nurul Afser said we want utilities particularly gas connection;
- Abul Kalam said some people may leave the shop without paying money;
- Abul Hossain said the area will improve;
- Md. Tarek Hossain said that people who come from outside can spear various types of crime, such as theft, robbery, intoxication etc.;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-4)

Bangladesh South Asia Hub (BSAH) Development Project
 Environmental and Social Consultancy services (Package No. POC-24-03009-0220)
 Bangladesh Economic Zones Authority (BEZA)

Sub: Attendance Sheet of Focus Group Discussion (FGD) for: Gas Pipeline

Name of District: Chittagong Name of the project of Iqbal Hotel: _____
 Name of Upazila: Mirsharai Name of location: _____
 Name of Union: Ichakhali Date: 10.12.2023
 Name of Village: Ichakhali Sluicagate Market Time: 3.30 PM
 Name of Group: Business Group

No.	Name of Participants	Designation	Mobile Number	Signature
১	মোহাম্মদ হোসেন	বিস্তারিত	০১৮০৪২২২০৭৭	[Signature]
২	নুরুল আফসর	"	০১৮০৪২২২০২০	[Signature]
৩	আবুল কলাম	"	০১৮০৪২২০০৭০	[Signature]
৪	আবুল হোসেন	বিস্তারিত	০১৮০৪২২০০৭৭	[Signature]
৫	মোহাম্মদ হোসেন	বিস্তারিত	০১৮০৪২২০০৭৭	[Signature]
৬	আবুল কলাম	বিস্তারিত	০১৮০৪২২০০৭৭	[Signature]
৭	আবুল হোসেন	বিস্তারিত	০১৮০৪২২০০৭৭	[Signature]
৮	আবুল কলাম	বিস্তারিত	০১৮০৪২২০০৭৭	[Signature]
৯	আবুল হোসেন	বিস্তারিত	০১৮০৪২২০০৭৭	[Signature]

FGD with Local Community

Village: Char Sarat, Upazila: Mirsharai, District: Chattogram

Date: 10.12.2023

Place: Shop of Saiful Islam, Daborkhali Point

143. On 10.12.2023, FGD was conducted at the shop of Saiful Islam, Daborkhali Point, Ichakhali union of Mirsharai Upazila. There was attended a total of seven participants which represent small business man, day labor, farmer and local leader. The FGD discussion minutes and attendance list are as follows



Figure-5: FGD with local community at Daborkhali Point of Ichakhali Union.

Summary of Focus Group Discussion (FGD-5)

- Kabir Ahmmed said we want utility connection such as gas;
- Shamchul Haque said we should get job/working opportunity in the economic zone;
- Md. Rahat said if there is any massive accident occur for example gas line leaks, or chemical spillage, the surrounding people will be affected;
- Md. Ismail said that if anyone is affected, he should be compensated;
- Abdul Khalek said the area will be improved with infrastructure, road network etc.;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-5)

Bangladesh Inland Waterways Corporation (BIWC) Development Project
 Environmental and Social Consultancy services (Package No. PSC 14 (INMA-0414))
 Bangladesh Economic Zones Authority (BEZA)

Sub: Attendance Sheet of Focus Group Discussion (FGD) for Char. Ichakhali Union

Name of Group: Char Sarat Name of Place: Shop of Saiful Islam
 Name of Union: Ichakhali Name of Upazila: Daborkhali Point
 Date: 10.12.2023 Time: 12.40

Name of Group: Local community

Sl. No.	Name of Participant	Signature	Mobile Number	Signature
1	কবির আহমেদ	কবির	১৭৩২৬০৭৩০	কবির
2	শামচুল হােক	শামচুল	১৭৩২৬০৭৩০	শামচুল
3	মদ. রাহাত	মদ. রাহাত	১৭৩২৬০৭৩০	মদ. রাহাত
4	মদ. ইসমাইল	মদ. ইসমাইল	১৭৩২৬০৭৩০	মদ. ইসমাইল
5	মদ. খালেক	মদ. খালেক	১৭৩২৬০৭৩০	মদ. খালেক
6	মদ. হােক	মদ. হােক	১৭৩২৬০৭৩০	মদ. হােক
7	মদ. হােক	মদ. হােক	১৭৩২৬০৭৩০	মদ. হােক

FGD with Farmer Group

Village: Sariatpara, Union: Maghadia Upazila: Mirsharai, District: Chittogram

Date: 11.12.2023

Place: Shop of Belal Hossen

144. On 11.12.2023, FGD was conducted at the shop of Belal Hossen, Sariatpara (inside of UP Member house) Maghadia union of Mirsharai Upazila. There was attended a total of eight participants which represent only farmers. The FGD discussion minutes and attendance list are as follows



Figure-6: FGD with farmer group at Sariatpara of Maghadia Union.

Summary of Focus Group Discussion (FGD-6)

- Ekramul Haq said that our crop land has been acquired as a result we have lost our farming opportunity;
- Md Moksed said, fishing has been closed in the economic zone area, we used to access to the sea for fishing through the EZ area;
- Md. Tareq said that we are not being used in the economic zone;
- Md. Imam Hossen said we want job opportunity in the economic zone on priority basis;
- Md. Didarul Alom said we want gas connection;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-6)

Bangladesh Electric Supply Company Limited (BESCO) Development Project Environmental and Social Consultancy Services (Project No. ESMU/2018/02/01) Managed with Economic Policy Authority (PEEA)				
Sub-Attendance Sheet of Focus Group Discussion (FGD) for: <u>Chittagong</u>				
Topic of Focus: <u>Chittagong</u>		Name of Host: <u>Shop of Belal Hossen</u>		
Name of Union: <u>Maghadia</u>		Name of Location: <u>Inside of member's house</u>		
Name of Village: <u>Sariatpara</u>		Date: <u>11.12.23</u>		
Name of Group: <u>Agriculture group</u>		Time: <u>9:30 PM</u>		
No.	Name of Participants	Designation	Mobile Number	Signature
1	<u>MD. EKRAMUL HAQ</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
2	<u>MD. MOKSEED</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
3	<u>MD. TAREQ</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
4	<u>MD. IMAM HOSSEN</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
5	<u>MD. DIDARUL ALOM</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
6	<u>MD. SAHABUDDIN</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
7	<u>MD. ABU HASIN</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>
8	<u>MD. ABU HASIN</u>	<u>Farmer</u>	<u>0171-1234567</u>	<u>[Signature]</u>

FGD with Labor Force Group

Village: Noyapara, Union: Shaerkhali, Upazila: Mirsharai, District: Chittogram

Date: 23.01.2024

Place: House of Soleman near about Noyapara Zame Mosque

145. On 23.01.2024, FGD was conducted at the house of Soleman near about Noyapara Zame Mosque, Village: Noyapara, Shaerkhali union of Mirsharai Upazila. There was attended a total of thirteen participants which represent only labor force. The FGD discussion minutes and attendance list are as follows



Figure-7: FGD with labor force at Noyapara of Shaerkhali Union

Summary of Focus Group Discussion (FGD-7)

- Md. Kamal Uddin said, the main occupation of most of the people in this area is agriculture, fishing, livestock and poultry rearing and transport workers. The daily average wage rate for male agricultural workers at the Upazila level is 600 taka and 400 takas for female workers. The rate of wages for masons and carpenters is 1000. Md. Kamal Uddin also said that BEZA has acquired the land where we used to grow crops or work as a day-labour in the field;
- Md. Anwar says BEZA is not giving us any job opportunities. We want work in the Zone;
- Md. Soleman said we want training for skill development;
- Md. Shohel said before our income was good but now, we are experiencing difficulties in our income. Earlier fishing, wood collection, rearing and grazing of cattle and goats could be done within the zone, but at present there is no such opportunity;
- Md. Abdul Qader said that due to the zone the roads in our area are getting better, the price of land is increasing, people from outside are coming to our area, the demand for house rent increasing;
- Mrs. Selina Akter said that many people from outside can actually spread theft, robbery, addiction and various diseases in our area;
- Mrs. Rojina Begum said we want gas connection.

Attendance sheet of Focus Group Discussion (FGD-7)

Replicate of the South West Delta Region (SWDR) Development Project
 Environmental and Social Consultancy services (Package No. PMZ-15-00000-0004)
 Bangladesh (Government), Date: February 2024

Sub-Attendance Sheet of Focus Group Discussion (FGD) for: Gas pipeline

Name of Union: Shaerkhali Name of Block: House of Soleman
 Name of Village: Noyapara Name of Location: 74170, Pancha, Shaerkhali
 Name of Date: 23.01.2024
 Name of Time: 12.00pm

Sr.	Name of Participant	Signature	Mobile Number	Signature
1	Mr. Kamal Uddin	[Signature]	01555 22444	[Signature]
2	Mr. Anwar	[Signature]	01555 22444	[Signature]
3	Mr. Soleman	[Signature]	01555 22444	[Signature]
4	Mr. Shohel	[Signature]	01555 22444	[Signature]
5	Mr. Abdul Qader	[Signature]	01555 22444	[Signature]
6	Mr. Selina Akter	[Signature]	01555 22444	[Signature]
7	Mr. Rojina Begum	[Signature]	01555 22444	[Signature]
8	Mr. Kamal Uddin	[Signature]	01555 22444	[Signature]
9	Mr. Anwar	[Signature]	01555 22444	[Signature]
10	Mr. Soleman	[Signature]	01555 22444	[Signature]
11	Mr. Shohel	[Signature]	01555 22444	[Signature]
12	Mr. Abdul Qader	[Signature]	01555 22444	[Signature]
13	Mr. Selina Akter	[Signature]	01555 22444	[Signature]

FGD with Fishermen

Village: Sarkerpara, Union: Maghadia, Upazila: Mirsharai, District: Chittogram

Date: 12.12.2023

Place: House of Shishuram Das

146. On 12.12.2023, FGD was conducted at the house of Shishuram Das, Sarkerpara (inside of Abu Turab bazar) Maghadia union of Mirsharai Upazila. There was attended a total of eleven participants which represent only fishermen. The FGD discussion minutes and attendance list are as follows



Figure-8: FGD with fishermen at Sarkerpara of Maghadia Union

Summary of Focus Group Discussion (FGD-8)

- Shishuram Das said fishing within the zone is closed;
- Ratan Das said BEZA should provide employment;
- Porimol Das said areas will be developed a lot;
- Arjun Das said communication system will be developed;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-8)

Chittagong Branch Multi-Modal Project (BMMMP) Development Project
 Environmental and Social Consultancy Services (Phase III: EIS to BMMMP EIS)
 Bangladesh Economic Zones Authority (BEZA)

Subj: Attendance Sheet of Focus Group Discussion (FGD) for Shishuram Das House

Name of District: Chittagong Name of Union: Maghadia
 Name of Village: Sarkerpara Date: 12.12.2023
 Name of group: Fishermen group Time: 11:00 AM

No.	Name of Participants	Designation	Mobile Number	Signature
1	শিশুরাম দাস	ফিসার	৯৯৩৪৬৬১৭০৭	শিশুরাম দাস
২	রতন দাস	"	০১৩৪৭৪১৩৩৬	রতন দাস
৩	পরিমল দাস	"	০১৪৪২৩৬০১৬	পরিমল দাস
৪	আরজুন দাস	"	০১৪৩৩৫০৭৭৭৭	আরজুন দাস
৫	মুহম্মদ দাস	"	০১৪১৪৪৪৪৩০২	মুহম্মদ দাস
৬	মিলন দাস	"	০১৪১০২৭২৭৭	মিলন দাস
৭	মুহম্মদ দাস	"	০১৪৬৩৫৪৪০০৭	মুহম্মদ দাস
৮	আব্দুল দাস	"	০১৪৫১৭৩০২৭	আব্দুল দাস
৯	আব্দুল দাস	"	০১৪২৭৭২৭৭৭	আব্দুল দাস
১০	আব্দুল দাস	"	০১৪৩৫০৬২৭৭	আব্দুল দাস
১১	মুহম্মদ দাস	"	০১৪২৭৭৭৭৭৭	মুহম্মদ দাস

FGD with Fishermen Group

Village: Badiullahpara, Union: Moghadia, Upazila: Mirsharai, District: Chittogram

Date: 25.01.2024

Place: House of Misir Ahmed near about Ahmed Member's house

147. On 25.01.2024, FGD was conducted at the House of Misir Ahmed near about Ahmed Member's house, Village: Badiullahpara, Moghadia union of Mirsharai Upazila. There was attended a total of eight participants which represent fishermen and who used to catch fish but is currently engaged in other professions. The FGD discussion minutes and attendance list are as follows



Figure-9: FGD with fishermen at Badiullahpara of Moghadia Union

Summary of Focus Group Discussion (FGD-9)

Attendance sheet of Focus Group Discussion (FGD-9)

- Mr. Misir Ahmed said that before the zone, 120-150 families from our neighborhood used to fish in the zone. Now fishing in the zone is stopped. We are forced to change our occupation. Still 50-60 families are involved in fishing. Currently outside the zone and some go fishing in Sandwip Channel;
- Md. Karim said we want training for skill development;
- Md Rajib Hossen said before our income was good but we are in a lot of trouble. Earlier fishing, wood collection and grazing of cattle and goats could be done within the zone but there is no such opportunity;
- Md.Nayem Islam says BEZA is not giving us any job opportunities. BEZA is bringing in outsiders to work. We have to give job opportunities to those who are affected on a priority basis;
- Md. Mosharof said, due to the zone, the roads in our area are improving, land prices are increasing, people are coming to our area from outside, demand for house rent is increasing, business and trade are increasing, and some people are getting jobs;
- Md. Azizul Haque said, many people from outside actually we can have different kinds of conflict with them. Many people from outside can actually spread theft, robbery, addiction and various diseases in our area;

Bangladesh Inland Water Transport Sector (BIMTS) Development Project
Environmental and Social Consultancy Services (Package No. PAC-10-BMST-6124)
Bangladesh Inland Water Transport Authority (BIWTA)

Sub: Attendance Sheet of Focus Group Discussion (FGD) for Char Pipeline

Name of District: Chittagong Name of Place: Haraz of Union: Alimuddin
Name of Upazila: Pir Alimuddin Name of Location: Reside the Union Member
Name of Union: Mughadiah Date: 25-03-2024
Name of Village: Badulla's Farm Time: 12:00 PM
Name of GSC: Fisher men

Sl. No.	Name of Participants	Designation	Mobile Number	Signature
1.	Mr. Md. Masud	Chairman	01883450566	<i>[Signature]</i>
2.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
3.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
4.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
5.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
6.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
7.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
8.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
9.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
10.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
11.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
12.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
13.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
14.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
15.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
16.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
17.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
18.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
19.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>
20.	Mr. Md. Masud	Member	01883450566	<i>[Signature]</i>

FGD with Women Group

Village: Badiullahpara, Union: Maghadia, Upazila: Mirsharai, District: Chattogram

Date: 11.12.2023

Place: House of Mafij Shoudagor

148. On 11.12.2023, FGD was conducted at the house of Mafij Shoudagor, Badiullahpara (inside of Technology) Maghadia union of Mirsharai Upazila. There was attended a total of ten participants which represent only women. The FGD discussion minutes and attendance list are as follows



Figure-10: FGD with women group at Badiullahpara of Maghadia union

Summary of Focus Group Discussion (FGD-10)

- Jesmin akter said, our house was destroyed when the gas line went from Borotakia to the economic zone. Due to the living in khash land only compensation for house demolition and trees supposed to be paid but still nothing;
- Bibi Rehena said, we want to gas connection;
- Laki Akter said, we have to arrange work;
- Shabana said, compensation should be given to the affected families due to the gas line going from Borotakia to the economic zone;
- Finally, everyone says that if the Economic Zone is stablished, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-10)

Bangladesh Economic Zones Authority (BEZA) the outcome of Project
 Environmental and Social Consultancy services (Package No. TMC 24-000004-0014)
 Bangladesh Economic Zones Authority (BEZA)

Sub-Mission Sheet of Focus Group Discussion (FGD) for Chattogram
 Name of Union: Maghadia Name of Village: Badiullahpara
 Name of Group: Women's Group Date: 11.12.23
 Name of Facilitator: Mafij Shoudagor Time: 3:15 PM

S. No.	Name of Participants	Designation	Mobile Number	Signature
১	জেসমিন আক্তার	স্বামী	০১৭০০১১১১১১	জেসমিন
২	বাবি রেহানা	স্বামী	০১৭০০১১১১১১	বাবি রেহানা
৩	লাকী আক্তার	স্বামী	০১৭০০১১১১১১	লাকী আক্তার
৪	শাবানা	স্বামী	০১৭০০১১১১১১	শাবানা
৫	মাসুমা	স্বামী	০১৭০০১১১১১১	মাসুমা
৬	আবাসিনা	স্বামী	০১৭০০১১১১১১	আবাসিনা
৭	ফাহিমাতা	স্বামী	০১৭০০১১১১১১	ফাহিমাতা
৮	ফাহিমাতা	স্বামী	০১৭০০১১১১১১	ফাহিমাতা
৯	ফাহিমাতা	স্বামী	০১৭০০১১১১১১	ফাহিমাতা
১০	ফাহিমাতা	স্বামী	০১৭০০১১১১১১	ফাহিমাতা

FGD with Women Group

Village: Char Sarat, Upazila: Mirsharai, District: Chattagram

Date: 14.02.2024

Place: House of Ekramul Haque

149. On 14.02.2024, FGD was conducted at the house of Ekramul Haque of Charsarat (Gov. Housing) village, Ichakhali union of Mirsharai Upazila. There was attended a total of ten participants which represent only women. The FGD discussion minutes and attendance list are as follows



Figure 11: Photographs of FGD with women group at Charsarat (Gov. housing) village of Ichakhali Union under Mirsharai Upazila

Summary of Focus Group Discussion (FGD-11)

- Mrs. Parvin said we got a house but not a job;
- Fatema said, there are no agricultural lands, fisheries and roads between the Sandip Channel and the Economic Zone. Therefore, dredging from Sandip Channel in IMD zone is unlikely to cause any damage to agricultural lands, fisheries and roads;
- Arju Moni says many people will come from outside to work on IMD zone and we may have conflict with them;
- Goljahan said that people who come from outside can spear various types of crime such as theft, robbery, intoxication and can also spear different diseases;
- Gonga Rani said that we will be greatly benefited if gas connection is provided outside the economic zone;
- Mrs. Salma Begum said, communication system is and will be better because of the economic zone. Simultaneously, employment will increase, business will expand and women will be empowered;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-11)

Bangladesh South West Delta Region (SWDR) Development Project
 Environmental and Social Consultancy Services (Package No. POC 14-03/EN/02/24)
 Bangladesh Economic Zone Authority (BEZA)

Sub-Attendance Sheet of Focus Group Discussion (FGD) for IMD-Zone

Name of District: Chittagong Name of Post: Charsarat (Gov. Housing)
 Name of Upazila: Mirsharai Name of Location: Ekramul Haque House
 Name of Union: Ichakhali Date: 14.02.2024
 Name of Village: Charsarat Time: 11:00 AM

Name of Group: Women

Sl. No.	Name of Participants	Designation	Mobile Number	Signature
1	মিসেস. পারভীন	স্বামী	০১৭২৭৪৭৭৭	পারভীন
2	মিসেস. ফাতেমা	"	০১৮৭৯০৭৭৭৭	ফাতেমা
3	মিসেস. আরজু মনি	স্বামী	০১৭২৭৪৭৭৭	আরজু মনি
4	মিসেস. গোলজাহান	স্বামী	০১৭২৭৪৭৭৭	গোলজাহান
5	মিসেস. গঙ্গা রানী	স্বামী	০১৮৭৭৭৭৭৭৭	গঙ্গা রানী
6	মিসেস. সালমা বেগম	স্বামী		সালমা
7	মিসেস. সালমা বেগম	স্বামী		সালমা বেগম
8	মিসেস. সালমা বেগম	"	০১৮৭৭৭৭৭৭৭	সালমা বেগম
9	মিসেস. সালমা বেগম	"	০১৮৭৭৭৭৭৭৭	সালমা বেগম
10	মিসেস. সালমা বেগম	স্বামী	০১৮৭৭৭৭৭৭৭	সালমা বেগম

FGD with Women Group

Village: Badiullahpara, Union: Maghadia, Upazila: Mirsharai, District: Chattagram

Date: 13.01.2024

Place: Besides of Eunus Member's house

150. On 13.01.2024, FGD was conducted at besides of Eunus Member's house, Village Badiullahpara, Maghadia union of Mirsharai Upazila. There was attended a total of eight participants which represent only women. The FGD discussion minutes and attendance list are as follows



Figure-12: FGD with women at Badiullahpara of Maghadia Union

Summary of Focus Group Discussion (FGD-12)

- Mrs. Josna opined before our income was good but we are in a lot of trouble. Earlier fishing, wood collection and grazing of cattle and goats could be done within the zone but there is no such opportunity;
- Mrs. Sharmin informed that BEZA has acquired our crop fields so now we can't do agricultural work anymore;
- Rehana Akter stated that BEZA is not giving us any job opportunities. We want work;
- Mrs. Jhorna Begum said that in our area there are no incidents like human trafficking, eve teasing, women torture;
- Mrs. Nur Khatun believed that due to the zone the roads in our area are getting better, the price of land is increasing, people from outside are coming to our area, the demand for house rent increasing;
- Bibi Fatema said we want gas connection,
- Najma Khatun said that many people from outside can actually spread theft, robbery, addiction and various diseases in our area;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-12)

Kangra District Health Supply Office Hapur (BIMANE) Development Project
(Environmental and Social Consultancy service Package No. PRC-14-0000000224)
Bhagwati Economic Zone Authority (BEZA)

Sub-Station Street of Focus Group One power (PSC) for Long pipeline

Name of District: Chitragang Name of Block: Boduloh para/bo
Name of Upazila: Mirsharai Name of Upazila: TF BUDING Mirsharai
Name of Union: Mirsharai Date: 13-04-2024
Name of Village: Boduloh para Time: 3:50 PM

Name of Group: Women Group

Sl. No.	Name of Participants	Designation	Mobile Number	Signature
1	মহাঃ সৌম্য	Chairman	0342 9982193	03/04/24
2	মহাঃ সৌম্য	"	0342 280950	03/04/24
3	মহাঃ সৌম্য	"	0342 2829410	03/04/24
4	মহাঃ সৌম্য	"	0342 2829410	03/04/24
5	মহাঃ সৌম্য	"	0342 2829410	03/04/24
6	মহাঃ সৌম্য	"	0342 2829410	03/04/24
7	মহাঃ সৌম্য	"	0342 2829410	03/04/24
8	মহাঃ সৌম্য	"	0342 2829410	03/04/24
9	মহাঃ সৌম্য	"	0342 2829410	03/04/24
10	মহাঃ সৌম্য	"	0342 2829410	03/04/24
11	মহাঃ সৌম্য	"	0342 2829410	03/04/24
12	মহাঃ সৌম্য	"	0342 2829410	03/04/24
13	মহাঃ সৌম্য	"	0342 2829410	03/04/24
14	মহাঃ সৌম্য	"	0342 2829410	03/04/24
15	মহাঃ সৌম্য	"	0342 2829410	03/04/24
16	মহাঃ সৌম্য	"	0342 2829410	03/04/24
17	মহাঃ সৌম্য	"	0342 2829410	03/04/24
18	মহাঃ সৌম্য	"	0342 2829410	03/04/24
19	মহাঃ সৌম্য	"	0342 2829410	03/04/24
20	মহাঃ সৌম্য	"	0342 2829410	03/04/24
21	মহাঃ সৌম্য	"	0342 2829410	03/04/24
22	মহাঃ সৌম্য	"	0342 2829410	03/04/24
23	মহাঃ সৌম্য	"	0342 2829410	03/04/24
24	মহাঃ সৌম্য	"	0342 2829410	03/04/24
25	মহাঃ সৌম্য	"	0342 2829410	03/04/24
26	মহাঃ সৌম্য	"	0342 2829410	03/04/24
27	মহাঃ সৌম্য	"	0342 2829410	03/04/24
28	মহাঃ সৌম্য	"	0342 2829410	03/04/24
29	মহাঃ সৌম্য	"	0342 2829410	03/04/24
30	মহাঃ সৌম্য	"	0342 2829410	03/04/24
31	মহাঃ সৌম্য	"	0342 2829410	03/04/24
32	মহাঃ সৌম্য	"	0342 2829410	03/04/24
33	মহাঃ সৌম্য	"	0342 2829410	03/04/24
34	মহাঃ সৌম্য	"	0342 2829410	03/04/24
35	মহাঃ সৌম্য	"	0342 2829410	03/04/24
36	মহাঃ সৌম্য	"	0342 2829410	03/04/24
37	মহাঃ সৌম্য	"	0342 2829410	03/04/24
38	মহাঃ সৌম্য	"	0342 2829410	03/04/24
39	মহাঃ সৌম্য	"	0342 2829410	03/04/24
40	মহাঃ সৌম্য	"	0342 2829410	03/04/24
41	মহাঃ সৌম্য	"	0342 2829410	03/04/24
42	মহাঃ সৌম্য	"	0342 2829410	03/04/24
43	মহাঃ সৌম্য	"	0342 2829410	03/04/24
44	মহাঃ সৌম্য	"	0342 2829410	03/04/24
45	মহাঃ সৌম্য	"	0342 2829410	03/04/24
46	মহাঃ সৌম্য	"	0342 2829410	03/04/24
47	মহাঃ সৌম্য	"	0342 2829410	03/04/24
48	মহাঃ সৌম্য	"	0342 2829410	03/04/24
49	মহাঃ সৌম্য	"	0342 2829410	03/04/24
50	মহাঃ সৌম্য	"	0342 2829410	03/04/24
51	মহাঃ সৌম্য	"	0342 2829410	03/04/24
52	মহাঃ সৌম্য	"	0342 2829410	03/04/24
53	মহাঃ সৌম্য	"	0342 2829410	03/04/24
54	মহাঃ সৌম্য	"	0342 2829410	03/04/24
55	মহাঃ সৌম্য	"	0342 2829410	03/04/24
56	মহাঃ সৌম্য	"	0342 2829410	03/04/24
57	মহাঃ সৌম্য	"	0342 2829410	03/04/24
58	মহাঃ সৌম্য	"	0342 2829410	03/04/24
59	মহাঃ সৌম্য	"	0342 2829410	03/04/24
60	মহাঃ সৌম্য	"	0342 2829410	03/04/24
61	মহাঃ সৌম্য	"	0342 2829410	03/04/24
62	মহাঃ সৌম্য	"	0342 2829410	03/04/24
63	মহাঃ সৌম্য	"	0342 2829410	03/04/24
64	মহাঃ সৌম্য	"	0342 2829410	03/04/24
65	মহাঃ সৌম্য	"	0342 2	

FGD with Local Community

Village: Charsarat, Union: Ichakhali, Upazila: Mirsharai, District: Chattogram

Date: 14.02.2024

Place: House of Tarek

151. On 14.02.2024, FGD was conducted at the house of Tarek Village Charsarat, Ichakhali union of Mirsharai Upazila. There was attended a total of eight participants which represent local community. The FGD discussion minutes and attendance list are as follows



Figure-13: FGD with local community at Charsarat of Ichakhali Union

Summary of Focus Group Discussion (FGD-13)

- Mrs. Taslima said, "In the past, our income was sufficient, but now we're facing considerable hardship. We used to be able to fish, collect wood, and graze our cattle and goats within the project area, but those opportunities no longer exist;
- Mahamuda Akter claims that BEZA (Bangladesh Economic Zones Authority) isn't providing any job opportunities for us. We are seeking employment opportunities;
- Nilufar Easmin said we have been living on this Government land for at least ten years. We have no won land so we don't know where will we go if we are evicted;
- Saleha Khatun said that in our area there are no incidents like human trafficking, eve teasing, women torture;
- Md. Tarek said that due to the zone the roads in our area are getting better, the price of land is increasing, people from outside are coming to our area, the demand for house rent increasing;
- Mrs. Ruksana said we want gas connection;
- Monowara Begum said that many people from outside can actually spread theft, robbery, addiction and various diseases in our area.

Attendance sheet of Focus Group Discussion (FGD-13)

Bangladesh Sheikh Mujib Shilpa Nagar (BSMNSN) Development Project
 Environmental and Social Consultancy services (Package No. PMU-26-BEMSN-023)
 Bangladesh Economic Zones Authority (BEZA)

Sub: Attendance Sheet of Focus Group Discussion (FGD) for IMP-ZONE

Name of District: Chittagong Name of Union: Charsarat (Zone-13)
 Name of Upazila: Ichakhali Name of location: Tarek's House
 Name of Union: Mirsharai Date: 14/02/2024
 Name of Village: Charsarat Time: 03:50 PM

Sr. No.	Name of Participants	Designation	Mobile Number	Signature
1.	মিস. মনজুর	স্বত্বাধী	01829119561	মিস. মনজুর
2.	মিস. মনজুর	-	01927477985	মিস. মনজুর
3.	মিস. মনজুর	-	01966646267	মিস. মনজুর
4.	মিস. মনজুর	-	01990426035	মিস. মনজুর
5.	মিস. মনজুর	-	01872084067	মিস. মনজুর
6.	মিস. মনজুর	স্বত্বাধী	01327477385	মিস. মনজুর
7.	মিস. মনজুর	স্বত্বাধী	01849328529	মিস. মনজুর
8.	মিস. মনজুর	-	-	মিস. মনজুর

FGD with Students (School Girls) Group

Village: Charsarat, Union: Ichakhali, Upazila: Mirsharai, District: Chattagram

Date: 25.01.2024

Place: Banglabazar Model High School, Charsarat

152. On 25.01.2024, FGD was conducted at Banglabazar Model High School, Village: Charsarat, Ichakhali union of Mirsharai Upazila. There was attended a total of ten participants which represent only students. The FGD discussion minutes and attendance list are as follows



Figure-14: FGD with school girl at Banglabazar Model High School, Charsarat of Ichakhali Union

Summary of Focus Group Discussion (FGD-14)

- Tahsina believed that if the economic zone starts full there will be employment for people in the area, development of communication system, expansion of business and trade, increase in people's income will improve the quality of life;
- Ismita Akter said that many people from outside will actually disrupt our security, such as ivtising, social conflict, theft, robbery, addiction and speared of various diseases;
- Romana Akter opined that the agricultural land will decrease if the workers who come from outside are to be accommodated;
- Mithila Rani Das specified the arrival of outsiders can lead to the infiltration of cultures from other areas into our culture;
- Farhana Easmin believed we want gas connection;
- Fahmida Akter said more schools and Hospitals will be needed when more people come from outside;
- Marina Akter specified the demand for house and house rent will increase;
- Finally, everyone says that if the Economic Zone is stablished, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-14)

Bangladesh Electric Supply Corporation Limited (BESL) Development Project
 Industrial and Social Cereals Service Storage, No. 14-200/24-4024
 Bangladesh Electric Supply Corporation Limited (BESL)

Sub-Attendance Sheet of Focus Group Discussion (FGD) for Gas pipeline

Name of District: Chittagong Name of Place: Banglabazar Model High School
 Name of Upazila: Ichakhali Name of Union: Bangla Bazar
 Name of Village: Charsarat Date: 25-01-2024
 Name of Group: School Girls Time: 11-30 am

S. No.	Name of the respondents	Designation	Mobile Number	Signature
1	Esmila Akter	Student	01820342509	Esmila
2	Mahsuda Akter	Student	01805811461	Mahsuda
3	Romana Akter	Student	01845004394	Romana
4	Tahsina	Student	01830008048	Tahsina
5	Mithila Rani Das	Student	01815014790	Mithila
6	Fahmida Akter	Student	01847510744	Fahmida
7	Farhana Easmin	Student	01855575045	Farhana
8	Fahmida Akter	Student	01822502031	Fahmida
9	Marina Akter	Student	01848790036	Marina
10	Farhana Akter	Student	01853093011	Farhana

FGD with Student (School Boys) Group

Village: Badiullahpara, Union: Maghadia, Upazila: Mirsharai, District: Chattagram

Date: 13.01.2024

Place: Badiullahpara Govt. Primary School field

153. On 13.01.2024, FGD was conducted at the field of Badiullahpara Govt. Primary School, Maghadia union of Mirsharai Upazila. There was attended a total of seven participants which represent only students. The FGD discussion minutes and attendance list are as follows



Figure-15: FGD with school boys at Badiullahpara of Maghadia Union

Summary of Focus Group Discussion (FGD-15)

- Md. Farvez opined; the name of our school is Moghadiya Secondary School. Our school is 2.5 kms away from here. 20-25 students from our neighborhood go to Moghadiya School;
- Tareque Hossen informed, 10-15 families of students have shifted due to the Economic Zone;
- Md. Shajib stated, we have lost our playground due to the Economic Zone. We also help with family work as well as education;
- Md. Emran Hossen said, communication system is and will be better because of the economic zone. Simultaneously, employment will increase, business will expand and women will be empowered;
- Md. Arman opined many people from outside will come to work in the Economic Zone. And through them, different types of crimes will be committed in the area such as: theft, robbery, rape, drug addiction and even different types of diseases can spread;
- Finally, everyone says that if the Economic Zone is established, the area will develop in various ways. For example, our employment opportunities will be created, income will increase, roads will improve, etc.

Attendance sheet of Focus Group Discussion (FGD-15)

Bangladesh Rural Infrastructure Project (BRIP) (Government Project)
 (Environmental and Social Consultancy Service Package No. PNC 18-04/04-0124)
 Bangladesh Economic Development Authority (BEDA)

Sub-Activity Sheet of Focus Group Discussion (FGD) for: Open Pipeline

Name of Village: Chitragong Name of Union: Maghadia para and village
 Name of Upazila: Mirsharai Internal Location: School
 Name of Union: Maghadia Date: 13-01-2024
 Name of Village: Badiullah para Time: 3:00 PM
 Name of Group: Student Group

No.	Name of Participant	Project Role	Mobile Number	Signature
1	মোঃ ফারভ	Student	0171153 0125	[Signature]
2	মোঃ তরেক হোসেন	Student	0171153 0125	[Signature]
3	মোঃ শহীদুল ইসলাম	Student	0171153 0125	[Signature]
4	মোঃ আরমান হোসেন	Student	0171153 0125	[Signature]
5	মোঃ শহীদুল ইসলাম	Student	0171153 0125	[Signature]
6	মোঃ শহীদুল ইসলাম	Student	0171153 0125	[Signature]
7	মোঃ শহীদুল ইসলাম	Student	0171153 0125	[Signature]

PCM-1 (Meeting Minutes)

154. On 16/01/2024 Moghadiya Union Parishad chairman Mr. Md. Jahangir Hossin presided over a public consultation meeting in the Moghadiya Union Parishad Hall room with the presentation of Dr. Tajul Islam as part of environmental and social impact assessment of gas line network under National Special Economic Zone (NSEZ) Development Project. Also present were Upazila Agriculture Extension Officer, Senior Fisheries Officer, Assistant Engineer (DPHE), UP members, political personalities and people from various professions of the area. The topics discussed in the meeting are described below

Sl. No	Name, designation and mobile number	Topics and discussions
1	Md. Jahangir Hossin Chairman, Moghadiya UP, Mirsharai, Chattogram Mobile No-01829807721	Md. Jahangir Hossain, the Honorable President of today's public consultation meeting, inaugurated the meeting by greeting everyone and wished the meeting success.
2	Abu Sufian Farmer, Mobile-01831414402	- Beza has acquired our three crop lands; - Some people did not get proper land money, those who used to live on government land have become homeless; - Beza is not giving us jobs, fishing has stopped, and wood harvesting has stopped in the forest; - Our source of income has become very narrow; - What should we do now? In reply, social expert Mr. Mamun Ar Rashid said- - As far as I know, Beja has made a list of victims; - Beja will give priority to the family in this list if he has any support (eg house, job); - He also said that everyone should try alternative livelihood; - He also said that he would request Beza to arrange accommodation for those who have become homeless.
3	Md. Nurul Haque Farmer Mobile-01885221931	- Compensation was supposed to be given to the victims while taking the gas line from Baratakia to the economic zone but no compensation has been given so far; - Will we get gas connection outside the zone? In reply, Mamun Ar Rashid said - - The decision to provide gas connection outside the economic zone has not been made yet.
4	Arif Ullah Chodhuri UP Member Mobile-01828400200	Arif Ullah Chowdhury's speech is described below- ➤ A large number of fish was produced in Mirsharai Upazila Due to economic zone; fish production has suffered greatly; ➤ There were many plants and many animals and birds in the Economic Zone. Wildlife habitats have been destroyed due to deforestation. Mr. Arif Ullah Chowdhury suggested forestry; ➤ In the case of land acquisition, there are some mistakes which must be resolved by all; ➤ Advise those who have lost their residence to arrange home loans; ➤ Pipe lines and road areas should be marked and advised not to allow anyone to use them; ➤ In terms of employment, he suggested setting quotas for the people of the area.
5	Md. Zobaidur Rahman Vashani Upazila Agriculture Extension Officer, Mirsharai, Chattogram Mobile-01737126532	Mr. Zobaidur Rahman Vashani said: ➤ Without development of industry, the country will not progress; ➤ National Special Economic Zone (NSEZ) Development Project will be established in coastal areas of three Upazila. The Upazila are Mirsharai, Sitakunda under Chattogram district and Sonagazi Upazila under Feni district; ➤ To increase the production of agricultural products; ➤ After land acquisition, if 1-1.5 decimal of land is left then vegetable garden can be done there; ➤ In this regard, the most cooperation will be given to the affected areas due to the economic zone;

		➤ Mr.Zobaidur Rahman Vashani also said, since the gas line will pass under the ground, there will be no damage to agriculture.
6	Nasim Al Mahmud Upazila Senior Upazila Fisheries Officer, Mirsharai, Chattogram Mobile-01723834974	Mr. Nasim Al Mahmud said ➤ The fisheries sector is and will be severely affected; ➤ I can't claim anything on their behalf as the places are govt/khash. Yet when they leave this place, they will suffer; ➤ Those who are successful here may not be successful elsewhere; ➤ Those who fish in the sea are not interested in alternative work; ➤ As a result of dredging, fish are not available in the sea like before. Due to the environmental disaster the fishes have moved far away; ➤ Those who fish in the sea are weak and helpless, so they should be compensated; ➤ However, fishermen are unlikely to be harmed by the gas line unless water bodies are affected.
7	K.M Sayed Mahmud Assistant Engineer –DPHE, Mirsharai, Chattogram Mobile-01712914453	Mr.K.M Sayed Mahmud said ➤ 50 deep tube wells have been provided from DPHE to provide water to the economic zone; ➤ Without the industries in the economic zone, the remaining areas will be green; ➤ Must have waste disposal plan; ➤ Water will come from Chandpur and Muhuri projects to run industries in the economic zone. Deep tube wells will be used during emergencies so there will be no water problem here; ➤ Care should be taken to ensure that the garbage does not fall into the sea.
8	Sanjib Barua Social Counsior, BEZA Mobile-01819884061	Mr. Sanjib Barua said ➤ No development of economic zone is possible without gas; ➤ I will hear good and bad from you.
9	Mahfuja Khatun Social Counsior, BEZA Mobile-01747164914	Mrs. Mahfuja Khatun said- ➤ Due to the Economic Zone the communication system has improved; ➤ Outsiders will come and stay here; ➤ Six factories have been started; ➤ If the garments are launched, priority will be given to the people of the area; ➤ Mrs. Mahfuja also said “if you come to us for jobs in Economic Zone, we will try to recommend you.
10	Joyanal Abedin Local Elite Mobile-01818949731	Prime minister Sheikh Hasina said that there will be a university here, you will recommend that it be implemented.
11	Md. Jahangir Hossin Chairman, Moghadia UP, Mirsharai, Chattogram Mobile No-01829807721	Mr. Jahangir Hossin said- ➤ Due to the economic zone, especially the residents of Moghadiya Union are affected from all sides; ➤ The size of the land has been reduced due to the acquisition of land in the Economic Zone; ➤ Three crop lands were acquired; ➤ After acquiring the road side land, Beja is preventing the construction of houses/shops on the remaining land. The rest of the land should be allowed to be used. That's why people are angry; ➤ The Anser prevented them from fishing; ➤ Many people are getting involved in illegal activities due to reduced sources of income; ➤ Factories are hiring outsiders for the sake of qualifications, cheating the local people; ➤ The homeless of this area should be rehabilitated in this area.

At the end, the president announced the end of the public consultation meeting by wishing all those present.

3. Attendance List of Participations for PCM-1:

Bangladesh Shakti High Voltage Super (BHS) Development Project
Environmental and Social Consultancy Services (Package No. PSC-2015/01/01)
Mirshat, Chittagang

Subject: Attendance Sheet of Public Consultation Meeting of EIA for Gas Pipeline Network in BHSZ

Project Title: _____ Location: _____ District: Chittagang

Date: _____

Sl. No.	Name of Participants	Designation	Village	Mobile Number	Signature
1	Mr. M. M. Rahman	Chairman	SETAR	01727-807921	
2	Mr. M. M. Rahman	Member	SETAR	01727-807921	
3	Mr. M. M. Rahman	Member	SETAR	01727-807921	
4	Mr. M. M. Rahman	Member	SETAR	01727-807921	
5	Mr. M. M. Rahman	Member	SETAR	01727-807921	
6	Mr. M. M. Rahman	Member	SETAR	01727-807921	
7	Mr. M. M. Rahman	Member	SETAR	01727-807921	
8	Mr. M. M. Rahman	Member	SETAR	01727-807921	
9	Mr. M. M. Rahman	Member	SETAR	01727-807921	
10	Mr. M. M. Rahman	Member	SETAR	01727-807921	
11	Mr. M. M. Rahman	Member	SETAR	01727-807921	
12	Mr. M. M. Rahman	Member	SETAR	01727-807921	
13	Mr. M. M. Rahman	Member	SETAR	01727-807921	
14	Mr. M. M. Rahman	Member	SETAR	01727-807921	
15	Mr. M. M. Rahman	Member	SETAR	01727-807921	
16	Mr. M. M. Rahman	Member	SETAR	01727-807921	
17	Mr. M. M. Rahman	Member	SETAR	01727-807921	
18	Mr. M. M. Rahman	Member	SETAR	01727-807921	
19	Mr. M. M. Rahman	Member	SETAR	01727-807921	
20	Mr. M. M. Rahman	Member	SETAR	01727-807921	

Sl. No.	Name of Participants	Designation	Village	Mobile Number	Signature
21	Mr. M. M. Rahman	Member	SETAR	01727-807921	
22	Mr. M. M. Rahman	Member	SETAR	01727-807921	
23	Mr. M. M. Rahman	Member	SETAR	01727-807921	
24	Mr. M. M. Rahman	Member	SETAR	01727-807921	
25	Mr. M. M. Rahman	Member	SETAR	01727-807921	
26	Mr. M. M. Rahman	Member	SETAR	01727-807921	
27	Mr. M. M. Rahman	Member	SETAR	01727-807921	
28	Mr. M. M. Rahman	Member	SETAR	01727-807921	
29	Mr. M. M. Rahman	Member	SETAR	01727-807921	
30	Mr. M. M. Rahman	Member	SETAR	01727-807921	
31	Mr. M. M. Rahman	Member	SETAR	01727-807921	
32	Mr. M. M. Rahman	Member	SETAR	01727-807921	
33	Mr. M. M. Rahman	Member	SETAR	01727-807921	
34	Mr. M. M. Rahman	Member	SETAR	01727-807921	
35	Mr. M. M. Rahman	Member	SETAR	01727-807921	
36	Mr. M. M. Rahman	Member	SETAR	01727-807921	
37	Mr. M. M. Rahman	Member	SETAR	01727-807921	
38	Mr. M. M. Rahman	Member	SETAR	01727-807921	
39	Mr. M. M. Rahman	Member	SETAR	01727-807921	
40	Mr. M. M. Rahman	Member	SETAR	01727-807921	

Sl. No.	Name of Participants	Designation	Village	Mobile Number	Signature
41	Mr. M. M. Rahman	Member	SETAR	01727-807921	
42	Mr. M. M. Rahman	Member	SETAR	01727-807921	
43	Mr. M. M. Rahman	Member	SETAR	01727-807921	
44	Mr. M. M. Rahman	Member	SETAR	01727-807921	
45	Mr. M. M. Rahman	Member	SETAR	01727-807921	
46	Mr. M. M. Rahman	Member	SETAR	01727-807921	
47	Mr. M. M. Rahman	Member	SETAR	01727-807921	
48	Mr. M. M. Rahman	Member	SETAR	01727-807921	
49	Mr. M. M. Rahman	Member	SETAR	01727-807921	
50	Mr. M. M. Rahman	Member	SETAR	01727-807921	
51	Mr. M. M. Rahman	Member	SETAR	01727-807921	
52	Mr. M. M. Rahman	Member	SETAR	01727-807921	
53	Mr. M. M. Rahman	Member	SETAR	01727-807921	
54	Mr. M. M. Rahman	Member	SETAR	01727-807921	
55	Mr. M. M. Rahman	Member	SETAR	01727-807921	
56	Mr. M. M. Rahman	Member	SETAR	01727-807921	
57	Mr. M. M. Rahman	Member	SETAR	01727-807921	
58	Mr. M. M. Rahman	Member	SETAR	01727-807921	
59	Mr. M. M. Rahman	Member	SETAR	01727-807921	
60	Mr. M. M. Rahman	Member	SETAR	01727-807921	

Bangladesh Shilpa Shiksha Nigam (BSNN) Development Project
Environmental and Social Consultancy Services Package No. PMC-36-BNEN-023A
Mirsharai, Chattogram

Subject: Attendance sheet of Public Consultation Meeting of EIA for IMD-ZONE-BNEN

Date: 12/02/24, (Date: Mirsharai) District: Chattogram

Place: Charsarat Model High School, Mirsharai, 12/02/2024

Sl. No.	Name of Participants	Designation	Village	Mobile Number	Signature
1	Mr. Nurul Mostafa	Chairman	Ichakhali	01819099699	
2	Mr. Nurul Mostafa	UP Member	Ichakhali	01819099699	
3	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
4	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
5	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
6	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
7	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
8	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
9	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
10	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
11	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
12	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
13	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
14	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
15	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
16	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
17	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
18	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
19	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
20	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	

Sl. No.	Name of Participants	Designation	Village	Mobile Number	Signature
21	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
22	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
23	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
24	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
25	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
26	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
27	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
28	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
29	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
30	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
31	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
32	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
33	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
34	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
35	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
36	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
37	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
38	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
39	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	
40	Mr. Nurul Mostafa	UP Member	BEZA	01819099699	

PCM-2 (Meeting Minutes)

Place-Charsarat Model High School, Charsarat, Ichakhali, Mirsharai, Chattagram

155. On 12/02/24 Ichakhali Union Parishad chairman Mr. Md. Nurul Mostofa presided over a public consultation meeting in the Charsarat Model High School with the presentation of Dr. Tajul Islam as part of environmental impact assessment of National Special Economic Zone (NSEZ) Development Project. Also, there were the UP member, teacher, political personalities and people from various professions of the area. The topics discussed in the meeting

Sl. No	Name, designation and mobile number	Topics and discussions
1	Md. Nurul Mostofa Chairman, Ichakhali UP, Mirsharai, Chattagram Mobile No-01819099699	Md. Nurul Mostofa, the Honorable President of today's public consultation meeting, inaugurated the meeting by greeting everyone and wished the meeting success.
2	Abdus Salam UP Member, Mobile-01831154645	- Beza has acquired our three crop lands; - If BEZA puts a boundary wall on the east side of the road, we will be trapped. We demand that a boundary wall be provided on the west side of the road; - We have no problem for dredging from Sandip Channel to IMD Zone. Because there is no agricultural land, fish culture and roads between the Economic Zone and Sandip Channel; - Bamonsundar and Daborkhali are two canals flow over the IMD Zone. BEZA has closed the Daborkhali canal. As a result, the water in our area will not be able to go out, the fields will sink and the farmers will suffer; - Some people did not get proper land money, those who used to live on government land have become homeless, In the beginning, it was said from BEZA that those who are living in government places in IMD zone will not be evicted without providing accommodation to them. But now

Sl. No	Name, designation and mobile number	Topics and discussions
		when dredging starts in IMD zone, they will have to leave without accommodation; • Beza is not giving us jobs, fishing has stopped, and wood harvesting has stopped in the forest; • Earlier every family depended on the land of Economic Zone for cattle rearing. But now due to the closure of the economic zone there is no opportunity to raise cattle; • Our source of income has become very narrow; • What should we do now? In reply, social expert Mr. Mamun Ar Rashid said- • A boundary wall will be provided for the security of the IMD zone but the residents will have to look at the pros and cons; • As far as I know, Beja has made a list of victims; • Beja will give priority to the family in this list if he has any support (eg house, job); • Economic Zone will provide employment to many people, but it will take some time; • He also said that everyone should try alternative livelihood; • Local dignitaries and public representatives will continue discussions with BEZA officials; • Daborkhali canal is very important for the people of this area. We will discuss with BEZA if the Daborkhali canal is closed; • He also said that he would request BEZA to arrange accommodation for those who have become homeless.
3	Md. Samchul Haque Farmer Mobile-01732610730	• Earlier our important sources of income were cattle rearing, timber harvesting, fishing and agriculture work. But due to the Economic Zone our income from cattle rearing, timber harvesting and fishing has completely stopped and due to acquisition of land, agricultural opportunities also have reduced a lot. Right now, we need employment, but BEZA is not giving us opportunities; • As wood source is closed, we need gas connection. Will we get gas connection outside the zone? In reply, Social Councillor, BEZA Mrs. Mahfuza Khatun said • As far as I know the few factories are operational are suffering from manpower shortage because; • Lack of qualified and skilled workers in this area; • There are many conservative families, due to which women are not interested in work; • Those who are interested to work are considered ineligible as per company policy; • Finally Mrs. Mahfuza Khatun said “You will contract us, we will help you as much as we can. Mamun Ar Rashid said - • The decision to provide gas connection outside the economic zone has not been made yet.
4	Mushlim Uddin Teacher Mobile:01811358824	Mr. Mushlim Uddin’s speech is described below- • First of all, IMD Zone needs security, for this a boundary wall should be provided. If security is not guaranteed, foreigners will not come to invest; • A boundary wall should be provided on the west side of the road; • The families living in the IMD zone should be rehabilitated before they are evicted; • Relaxation of competence and skills in the field of work; • In terms of employment, he suggested setting quotas for the people of the area; • Bamonsundar and Daborkhali canals are very important for us. Both canals are canals of record. Already Daborkhali canal has closed BEZA. We want both canals to remain operational;

Sl. No	Name, designation and mobile number	Topics and discussions
		If the canal is closed, the water will not be able to go down, the area will be flooded, agriculture will be threatened
5	Ismail Hossen Businessman Mobile:01846491226	Mr. Ismail Hossen said: - Without development of industry, the country will not progress; - National Special Economic Zone (NSEZ) Development Project will be established in coastal areas of three Upazila. The Upazila are Mirsharai, Sitakunda under Chattogram district and Sonagazi Upazila under Feni district; - Business and trade will expand; - We are hearing that the boundary wall will be built on the east side of the road. If the boundary wall is built on the east side, we will be blocked. We want the boundary wall to be along the west side of the road; - People living in IMD Zone should be resettled; - We have to give job opportunities on priority basis in Economic Zone.
6	Sanjib Barua Social Counsilar, BEZA Mobile-01819884061	Mr. Sanjib Barua said - MD zone will be formed with zone 12 and 13. IMD zone is a very important zone. Sand will be brought from Sandeep channel to fill the IMD zone; - We will inform the appropriate authorities about the problems we hear from you; - If you need to contract us regarding the job, we will provide maximum support.
7	Md. Nurul Mostofa Chairman, Ichakhali UP, Mirsharai, Chattagram Mobile No-001819099699	Mr. Jahangir Hossin said- - Due to the economic zone, especially the residents of Charsarat village under Ichakhali Union are affected from all sides; - The boundary wall of the economic zone should be provided on the west side of the road; we will not accept the boundary wall on the east side of the road. We are continuing discussions with the local administration and Beza authorities in this regard; - Bamonsundar and Daborkhali canals cannot be closed in any way, this canal is the canal of record. The water is drained from this area through this canal, if this canal is closed, there will be flooding in the area. Agriculture will be disrupted; - In the beginning, it was said from BEZA that those who are living in government places in IMD zone will not be evicted without providing accommodation to them. But now when dredging starts in IMD zone, they will have to leave without accommodation. They should be accommodated and then evicted; - Earlier our important sources of income were cattle rearing, timber harvesting, fishing and agriculture work. But due to the Economic Zone our income from cattle rearing, timber harvesting and fishing has completely stopped and due to acquisition of land, agricultural opportunities also have reduced a lot. The people of this area should be given job opportunities on priority basis; - Many people are getting involved in illegal activities due to reduced sources of income

156. At the end, the president announced the end of the public consultation meeting by wishing best luck.

Attendance List of Participations for PCM -2

Bangladesh Shilpa Shiksha Kago (BSKK) Development Project Environmental and Social Consultancy Services (Package No. PMC-34-BKK-023) Mirshar, Dharpagan					
Subject: Attendance sheet of Public Consultation Meeting of EIA for I.M.D. ZONE-BKK					
Date: 12.02.2024					
Base Character: Model High School, Mirshar					
S. No.	Name of Participants	Designation	Village	Mobile Number	Signature
1	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
2	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
3	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
4	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
5	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
6	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
7	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
8	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
9	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
10	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
11	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
12	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
13	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
14	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
15	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
16	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
17	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
18	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
19	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
20	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
21	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
22	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
23	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	
24	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	মোঃ হুমায়ুন কবীর	০১৭১৩৫৫৫	

Photographs of Public Consultation Meetings



Chairman of Moghadia Union Parishad present in the public consultation

Senior Upazila Fisheries Officer makes his presentation

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annexure-4: KIIs, FGD and Public Consultation Meetings

Upazila Agriculture Extension Officer is giving his opinion	Assistant Engineer –DPHE is speaking
	
Social Councilor at NSEZ is speaking	Ecologist took part in the discussion
	
Social Expert Mamun Ar Rashid is discussing in the public consultation	UP Member is speaking in the question and answer
	
Social Elite is speaking in the question-and-answer session	UP Member is speaking in the question-and-answer session
Photographs of Public Consultation Meetings (1 &2)	

Annex- 5: Checklists and Emergency Scenario

A. SAFETY CHECKLIST AND REPORTING

SAFETY DURING CONSTRUCTION CHECK LIST

(To be submitted by the Contractor)

Name of Zone under NSEZ : _____

Package Name or Contract No : _____

Construction Stage: Monthly Report : Date _____ Month _____ Year _____

Name of the Safety Officer : _____

Date of Inspection : _____

Particulars	Location-1			Location-2			Location-3			Remarks
	A	B	C	A	B	C	A	B	C	
General										
House Keeping										
Stacking of Material										
Passageway										
Lighting										
Ventilation										
Others										
Electrical										
Switches										
Wiring										
Fixed Installation										
Portable Lighting										
Portable Tool										
Welding Machine										
Others										
Fire Prevention										
Fire Fighting Appliances										
Inflammable Good Store										
Gas Welding Cylinders										
Others										

Particulars	Location-1			Location-2			Location-3			Remarks
	A	B	C	A	B	C	A	B	C	
Personal Protection										
Helmet										
Eye Protector										
Ear Protector										
Respirator										
Safety Shoes										
Safety Belts										
Others										
First Aid Equipment										
Washing Facility										
Latrine										
Canteen										
Dust Control										
Noise Control										

Submitted

Signature
Name
Designation
Contractor

Checked

Signature
Name
Environmental Officer
DSC

Approved

Signature
Name
Resident Engineer/Team Leader
DSC

ROAD SAFETY

(To be submitted by the Contractor)

Name of Zone under NSEZ : _____

Package Name or Contract No : _____

Sketch of construction zone showing all sub-zones and location of signs, etc. to be attached with format

Format on Acquisition of Temporary diversion to be attached with this format.

Construction Stage: Monthly Report. Date Month Year

Diversion No _____ Location (km _____)

Sl. No.	Item	Unit	Compliance	Remarks
	Details of Construction Zone			
1.	Length of Construction Zone	Km		
2.	Distance between this and next construction zone	Km		
3.	Length of transition sub zone (should be min 50m for a speed of 50km/hr)			
4.	Length of work sub zone in urban stretch (should be < 2km)	Km		
5.	Length of work sub zone in rural stretch (5-10 km)	Km		
6.	Distance between two work sub zones			
	Signages in Construction Zones			
1.	Sign saying 'Men at Work' 1 km ahead of transition sub zone	Y/N		
2.	Supplementary sing saying diversion 1 km provide	Y/N		
3.	Sign Saying 'Road Closed Ahead' provide	Y/N		
4.	Compulsory Right Turn/Left Turn sing provide	Y/N		
5.	Detour sing placed	Y/N		
6.	Sharp deviation sign place at end of advance warning sub zone	Y/N		
	Signage in Transition Sub Work Zone			
1.	Signage saying 'Keep Right /Left' provided	Y/N		
2.	Delineators placed along length of transition	Y/N		
	Signage in work sub zone			
1.	Hazard Marker placed where railing for CD structure on diversion starts	Y/N		
2.	Barricade on either side of work sub zone	Y/N		
	Signage in Termination of Sub Zone			
1.	Sign for indication of end of wok zone 120 m form end of termination sub zone	Y/N		
	Road Delineator			
1.	Roadway indicator provided	Y/N		

Sl. No.	Item	Unit	Compliance	Remarks
2.	Hazard Markers Provide	Y/N		
3.	Object Markers Provided	Y/N		

Submitted

Signature
Name
Designation
Contractor

Checked

Signature
Name
Environmental Officer
CSC

Approved

Signature
Name
Resident Engineer/Team Leader
CSC

ACCIDENT REPORTING

(To be submitted by the Contractor)

Name of Zone under NSEZ : _____

Package Name or Contract No : _____

Construction Stage: Monthly Report. Date Month

Part-I

Type of Accident

D01()	Fall of person from a height	D11 ()	Explosion
D02()	Slip, trip or fall on same level	D12 ()	Fire
D03()	Struck against fixed objects	D13()	Contact with hot or corrosive substance
D04()	Struck by faying or falling objects	D14()	Contact with poisonous gas or toxic substances
D05()	Stuck by moving objects	D15()	Hand tool accident
D06()	Struck/caught by cable	D16()	Vehicles/mobile plant accident
D07()	Stepping on nail etc.	D17()	Machinery operation accident
D08()	Handling without machinery	D18()	Other (please specify)
D09()	Crushing/burying	D19()	
D10()	Drowning or Asphyxiation	D20()	

Agent involved in accident

E01()	Machinery	E11()	Excavation /underground working
E02()	Portable power appliance	E12()	Ladder
E01()	Vehicle or associated equipment/ machinery	E13()	Scaffolding/gondola
E01()	Material being handled, used or stored	E14()	Construction framework, shuttering and false work
E01()	Gas, vapor, dust fume or oxygen	E15()	Electricity supply cable, wiring switch board and associate equipment
E01()	Hand tools	E16()	Nail, slinter or chipping
E01()	Floor edge	E17()	Other (please specify)
E01()	Floor opening	E18()	
E01()	Left shaft	E19()	
E10()	Stair edge	E20()	

Unsafe action Relevant to the accident

F01()	Operating without authority	F11 ()	Failure to use eye protector
F02()	Failure to secure objects	F12 ()	Failure to use respirator
F03()	Making safety devices inoperative	F13 ()	Failure to use proper clothing
F04()	Working on moving or dangerous equipment	F14 ()	Failure to use warn others or given proper signals
F05()	Using un-safe equipment	F15 ()	Horseplay
F06()	Adopting unsafe position or posture	F16 ()	No unsafe action

ACKNOWLEDGEMENT & COMMITMENT TO THE WORKFORCE CODE OF CONDUCT

157. I acknowledge that I have received, read and will comply with the Code of Conduct as it may be amended from time to time. I also acknowledge that I will read and comply with all policies and management plans referenced in this Code, as they may be amended from time to time, to the extent that they apply to my employment activities.

First Name	Last Name	Signed	Date DD/MM/YY	Location	Company	Direct Manager

Checklist Of Contractor's/Subcontractor's/Primary Supplier's Employees/Workers Profile												
Name of Contractor:										Code:		
Date of Submission:										Issued date:		
*Note: Please tick as "√" if the document is provided and check "X" if the document is NOT provided										Version:		
No.	Name of Employee	Position	Gender	Date of Birth	Date Hired	Nationality	If the personnel have been hired	Copy of labor contract	Copy of Identity Card	Copy of Health Certificate	Copy of Insurance	Copy of relevant Health and Safety (H&S) Training Certificate (Please specify what kind of H&S training certificates are provided)
1												
2												
3												
4												
5												
6												

Investigation Form	
Investigation Form	
Code: Issued date: Version:	
Date of investigation	
Reference Number	

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annexure-5: Checklists and Emergency Scenario

Employee Full Name (who causes the damage)				
Damage Investigation and consultation	Description of Damage			
	Employee Opinion			
	Proposed Resolution			
Statement to accept the resolution and close out the case	The investigation and consultation undertaken involved the employee, other affected people, and relevant parties. The following resolution is proposed: This record is made with the related parties to demonstrate investigation and consultation have been undertaken. And that the employee has agreed with the resolution stated above.			
Signature				
Agreed	Acknowledged	Acknowledged	Acknowledged	Others
(Employee)	(Investigation team)	(Related Unit/ Department)	(Related External Parties)	(Name)

Employees' Information																
No.	Full Name	Gender	Date of Birth	Nationality	Address	Identity Card (NID) Number	Qualification	Job Title	Labor Contract			Date of Hiring	Gross Salary	Number of annual leave	Occupational Health and Disease	Remarks
									Type	Starting Date	Termination Date					
																</

Contractor/Subcontractor/Supplier Management Audit Checklist			
Name of Contractor:		Code:.....	
Date of Audit:		Issued date:	
Auditor:		Version:	
No.	Findings	Compliance (Yes/No)	Description
1.	Are employees provided with the term of the labor contract in compliance with the legal requirement? Note: In-defined term-labor contract shall be provided after two (02) defined term-labor contracts.		
2.	Are employees provided with a copy of the labor contract in a language the employee understands?		
3.	Do/does the contractor and its subcontractors/supplier maintain sufficient employee profiles, including a copy of the aging document?		

4.	Do/does the contractor and its subcontractors/supplier's practices on child labor are in line with the Projects' Labor-Management Plan and Applicable Standards?		
5.	Do/do the contractor and its subcontractors/supplier's practices on prison labor or slave labor are in line with the Projects' Labor-Management Plan and Applicable Standards?		
6.	Do/does the contractor and its subcontractors/supplier's practices on human trafficking are in line with the Projects' Labor-Management Plan and Applicable Standards?		
7.	Do/do the contractor and its subcontractors/supplier not retain original documents of employees?		
8.	Do employees not pay a deposit during the recruitment process?		
9.	Do/do the contractor and its subcontractors/supplier not withhold any part of the worker's salary, benefits, properties, or documents?		
10.	Do employees have the right to leave the workplace premises after completing the standard working hours?		
11.	Do employees free to terminate their employment that they inform the contractor promptly in line with legal requirements?		
12.	Do/dose the contractor and its subcontractors/supplier's practices on non-discrimination are in line with the Projects' Labor-Management Plan and Applicable Standards?		
13.	Do/does the contractor and its subcontractors/supplier's practices on gender equity are in line with the Projects' Labor-Management Plan and Applicable Standards?		
14.	Do/does the contractor and its subcontractors/supplier provide employees with equal opportunities?		
15.	Do/does the contractor and its subcontractors/supplier's practices on harassment and abuse are in line with the Projects' Labor-Management Plan and Applicable Standards?		
16.	Do/does the contractor and its subcontractors/supplier's practices on freedom of association and workers' organization are in line with the Projects' Labor-Management Plan and Applicable Standards		
17.	Do employees free to join their union or workers' organization?		
18.	Are employees paid at least meet the regional minimum wage?		
19.	Are employees provided with sufficient compulsory benefits? Confirm insurance coverage of all employees/workers.		
20.	Are employees paid on time?		
21.	Is overtime payment sufficient?		
22.	Does the contractor maintain adequate timesheets and payrolls for the past 05 years?		
23.	Are employees' working hours recorded sufficiently?		
24.	Are employees provided with an adequate break?		
25.	Are employees' overtime hours in compliance with the legal requirement? Note: Not excess 4 hours/day, 40 hours/month, 300 hours/ year.		
26.	Are employees provided with adequate monthly rest days? (at least 4 days/month)		
27.	Do/does the contractor and its subcontractors/supplier develop a worker grievance mechanism in line with the Projects' Labor-Management Plan and Applicable Standards		
28.	Do/does the contractor and its subcontractors/supplier record all employees' grievances adequately?		
29.	Are all employees' grievances resolved promptly?		
30.	Are all labor-related incidents/issues (including employee relations and occupational health and safety) resolved?		
31.	Do the termination practices of the contractor and its subcontractors/supplier follow the legal requirement and the Project's Applicable Standards?		
32.	Have/has the contractor and its subcontractors/supplier not been involved in retrenchment practices during the past 05 years? If yes, does the contractor follow legal requirements and the Project's Labor-Management Plan and Applicable Standards of doing retrenchment?		

33.	Do/does the contractor and its subcontractors/supplier use safety equipment to separate around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions?		
34.	Do/does the contractor and its subcontractors/supplier apply locally regulated or internationally recognized building codes to ensure structures are constructed following sound architectural and engineering practice, including aspects of fire prevention and response?		
35.	Are the contractor and its subcontractors/supplier's engineers and architects responsible for constructing facilities, buildings, plants, and other structures certified for the applicability and appropriateness of the structural criteria employed?		
36.	Do/does the contractor and its subcontractors/supplier use hazardous material? If yes, does the contractor they're a procedure for handling hazardous material properly?		
37.	Do/does the contractor and its subcontractors/supplier have a pre-employment screening process to check the health of workers before recruiting?		
38.	Do the contractor and its subcontractors use a worker's camp? If yes, do the contractor develop and implement a worker's camp management procedure in place?		
39.	Do/does the contractor and its subcontractors/supplier prepare an EPRP corresponding to their risks and impacts and in line with the Projects' EPRP and Applicable Standards? Is the EPRP's drill conducted promptly?		

Subcontractor's/Primary Supplier's Monthly Performance Report		
(Construction Phase)		
Name of Contractor/Primary Supplier:		Code:
Date of Submission:		Issued date:
		Version:
Prepared by:	Position:	
Approved by:	Position:	
CONTRACTOR'S/PRIMARY SUPPLIER'S LABOR AND WORKING CONDITION PERFORMANCE		
The number of workers working on the Projects in the reported period:	Total:	
	No. of male:	No. of female:
The number of workers working on the Projects in the reported period is local people:	Total:	
	No. of male:	No. of female:
The number of workers working on the Projects in the reported period is members of ethnic minority groups:	Total:	
	Name of ethnic minority group 1:	
	No. of male:	No. of female:
	Name of ethnic minority group 2:	
	No. of male:	No. of female:
	(Please add more rows when needed)	
The number of workers working on the Projects who have conducted health check-ups in the reported period:	Total:	
	No. of male:	No. of female:
The number of workers working on the Projects who have been vaccinated against diseases:	Total:	
	No. of male:	No. of female:
Type of diseases that workers have been vaccinated for:		
The number of workers working on the Projects in the reported period who are under 18 years old:	Total:	
	No. of male:	No. of female:
The number of workers working for the Projects in the reported period is members of Trade Union/Workers' Organization:	Total:	
	No. of male:	No. of female:
The number of workers working for the Projects in the reported period who have signed labor contracts:	Total:	
	No. of male:	No. of female:
The number of workers working for the Projects in the reported period is under probation period:	Total:	
	No. of male:	No. of female:
The number of workers working on the Projects in the reported period has been provided with compulsory insurance:	No. of workers provided with Social, Health, and Unemployed Insurance:	
	No. of workers provided with Accident Insurance:	

Subcontractor's/Primary Supplier's Monthly Performance Report		
(Construction Phase)		
The number of workers working for the Projects in the reported period working excess legal monthly overtime hours and what department:	Total: No. of male: No. of female:	
The number of workers working for the Projects in the reported period is paid under the regional minimum wage:	Total: No. of male: No. of female:	
The number of grievances in the reported period:	The total number of grievances: Number of resolved grievances: Number of pending grievances:	
The number of workers working for the Projects provided with accommodation:	Total: No. of male: No. of female:	
The number of security guards working for the Projects:	Total: Please specify the location of monitoring:	
Hazardous material being used for the Projects:	Please specify the name of hazardous material, and location of use (which area) and provide a full safety data sheet in both English and the local language.	
What kind of disease was identified related to the contractor's operation concerning the Projects? Please list all activities taken by the contractor during the reporting period to prevent disease exposure to the community.		
Date and type of emergency drills taken. Please attach drill minutes and photo evidence.		
CORRECTIVE ACTIONS TAKEN AND TIMELINE		

Internal Labor and Working Conditions Management Audit Checklist			
Name of the Projects:		Code:	
Date of Audit:		Issued date:	
Auditor:		Version:	
No.	Findings	Compliance (Yes/No)	Description
1	Do the Projects have an updated ILR approved by the local authority?		
2	Do the Projects have an updated wage scale approved by the local authority?		
3	Do the Projects have valid C&B Procedures in compliance with the legal requirements?		
4	Do the Projects have valid R&T Procedures in compliance with the legal requirement?		
5	Do the Projects have valid CBA in compliance with the legal requirement?		
6	Are employees provided with the term of the labor contract in compliance with legal requirements? Note: In-defined term-labor contract shall be provided after two (02) defined term-labor contracts.		
7	Are employees provided with a copy of the labor contract?		
8	Do the Projects maintain sufficient employee profiles, including a copy of the aging document?		
9	Do the Projects not employ child labor?		
10	Do the Projects not employ prison labor or slave labor?		
11	Do the Projects not involve human trafficking?		
12	Do the Projects not retain the original document of employees?		
13	Do employees not pay a deposit during the recruitment process?		
14	Do the Projects do not withhold any part of the worker's salary, benefits, properties, or documents?		
15	Do employees have the right to leave the workplace premises after completing the standard working hours?		

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annexure-5: Checklists and Emergency Scenario

16	Are employees free to terminate their employment that they inform VAPCO promptly in line with legal requirements?		
17	Do the Projects recruit employees with no discrimination?		
18	Do the Projects provide employees with equal opportunities?		
19	Do the Projects free from harassment and abuse?		
20	Do employees free to join their union or workers' organizations?		
21	Are employees paid at least the legal minimum wage?		
22	Are employees provided with sufficient compulsory benefits?		
23	Are employees paid on time?		
24	Is overtime payment sufficient?		
25	Do the Projects maintain adequate timesheets and payrolls for the past 05 years?		
26	Are employees' working hours recorded sufficiently?		
27	Are employees provided with adequate breaks?		
28	Are employees' overtime hours in compliance with the legal requirement? Note: Not more than 4 hours/day, 40 hours/month, 300 hours/ year.		
29	Are employees provided with adequate monthly rest days? (at least 4 days/month)		
30	Do the Projects monitor their contractor in terms of labor and working condition management and maintain the records?		
31	How many percentages of female employees work for the contractor/ subcontractors?		
32	How many percentages of local people work for the contractor/ subcontractors? In which, how many percentages of female employees?		
33	How many percentages of members of ethnic minority working for the contractor/ subcontractors? In which, how many percentages of female employees?		
34	Are all labor-related incidents/issues (including employee relations and occupational health and safety) resolved?		

Template Of Corrective Actions Implementation Status Report								
Name of the Projects/Contractor/Subcontractor/Primary Suppliers: Date of Audit: Auditor name:							Code:	
								
							Issued date:	
								
							Version:	
								
No.	Audit/Assessment	Identified Issue	Root causes	Corrective Actions				Status (In process/ Closed)
				Action	Person In-charge	Starting Date	Completion Date	

Emergency Contact Numbers
Incident Command Center (ICC)

Name	Designation	Designation in ICC (Incident Command Center)	Contact No.

Site Emergency Response Team SERT (First Aid Team)

Name	Designation	Department	Contact Number

Ambulance Contact Number

Site Emergency Response Team SERT (Fire Fighting and Rescue Team)

Sl. No.	Name	Designation	Fire Control Room Number.
1.			0130-7773525; 30156
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

B. EMERGENCY SCENARIO

158. Hazardous materials that are generally used at construction projects as below:

- LPG gas cylinders
- Paints
- Solvents
- Petroleum products including:
 - Fuel
 - Oil
 - Grease
- Curing compounds
- Soil stabilizers and binders
- Plaster
- Asphalt components and concrete components
- Pesticides and herbicides.

159. Storage: The site has stored some diesel for construction purposes. Repeated or prolonged contact with diesel may result in defatting, inflammation, and possible secondary infection. This is a potential carcinogenic agent and triggers slip-trip hazard as well.

Identification of Potential Source of Spills

160. The hazard management process requires the identification of reasonably foreseeable hazards. Once a potential chemical spill hazard has been identified a risk assessment must be completed. This risk assessment is intended to identify risk control measures to reduce the risk and harm to people and the environment.

161. Primarily, the Site EHS Manager shall identify specific areas on the worksite that have the potential for the occurrence of spill-related incidents during construction and commissioning operations.

162. Below are the identified areas that need to be focused in view of high hazards:

a. Area

- Fuel Storage
- Oil Storage
- Hazardous Material and Waste Accumulation
- Fuel Delivery and Handling
- Electrical Switch Yard and Transformer

b. Equipment

- Crane, Excavator, Rig Machine
- Grease at equipment's
- Other Mobile Equipment or Plant

163. The utmost potential for spills of hazardous materials will be at tanks / containers storage, loading / unloading areas, and spills from plant and equipment (e.g., hydraulic leaks, liquid fuel spills).

Gas Leakage / Fire Scenarios

164. For the construction sites the following Gas leakage / fire scenarios are anticipated:

LPG Gas Leakage from Cylinder and Fire

165. The site has a storage of approximately 9-10 numbers LPG cylinders at construction site for the purpose of hot work.

- Any LPG cylinder which develops a leak should be promptly removed to an isolated open place away from any source of ignition;
- Area Supervisors will inform fire station on phone.
- Firefighting crew will reach at incident site as per Area Supervisor guidance.
- Cylinder with valve leakage needs must be capped immediately and tagged by mentioning the defect;
- In case of leak from the LPG pipe, the cylinder regulator knob/ valve needs to be close;
- Do not try to repair the appliance or any part of the system when pipe line or appliance in use;
- Use adequate PPEs;

- Do not use naked lights to detect the leak;
- In case of heavy Leak, stop all ignition sources in the vicinity and evacuate all the people to a safe area.
- In case of outbreak of fire, trigger the firefighting procedures as specified in section 6.1 of this manual.
- Call first aid team and get medical attention as quickly as possible. In case of any accident such as burn and asphyxiation send the affected people to the OHC and hospital.

Medical Emergency

166. The site has identified the sudden onset of a medical condition manifesting itself by acute symptoms of sufficient severity including severe pain as medical emergency scenario. The following medical emergencies as identified by the site resulting from:

- Major injuries caused by traffic accident caused by on-site vehicular movement.
- Fall from height.
- Burn injury from electrocution, fire, exposure to hot steam and lightening.
- Exposure to gas and other chemical.
- Apart from the above-mentioned medical emergencies, the site has also identified following health crisis:
- Difficulty and shortness of breathing.
- Fainting.
- Chest pain or and high/ fluctuation in blood pressure.
- Uncontrolled bleeding after injury.
- Sudden severe pain.

Anthropogenic Emergency Sources

The following emergencies have been identified under this section:

- Terrorist attack.
- Workers and local community agitation;
- Malicious act such as theft and vandalism.

Natural Calamities

167. The following emergencies have been identified under this section:

- **Earthquake:** Earthquakes are unpredictable natural disasters which are of short duration but the consequences can be severe. Based on the information available in the public domain and research publications indicates that the Jashore district comes under the seismic zone – II which indicates that this district falls under the ‘Low Damage Risk Zone’.

The Emergency Contact Numbers for External Agencies	
Emergency Telephone Numbers:	
Police Contact Number	
Police Helpline	999
Police Headquarter (Operation control Room)	
Police Control Room Mirsharai	
Superintendent of Police, Chattogram	
Addl. SP (Crime & Ops)	
Thana	
OC - PS)	
OC (Chattogram PS)	
Inspector (Investigation) Mirsharai PS	
RAB	
FIRE SERVICE	
Fire Service Headquarters: Chattogram	02-223355555, 02-9555555, 9556666-7, 01713-038181
Mirsharai Fire Station	0421-65114
Hospital Contact Number	
Mirsharai General Hospital	042161090, 01730324795
Chattogram Medical College Hospital	01713488460
Ambulance	01713488460
Mirsharai Upazilla Health Complex	01766896724

List Of Emergency Equipment			
Sl. No.	Equipment Name	Unit	Total
List of Equipment for Fire Emergency			
1.	Fully Equipped Water Fire Truck	Set	10
2.	Fully Equipped Foam Fire Truck	Set	08
3.	Torch Light	PCS	04
4.	Lock Cutter	PCS	03
5.	Fire Hydrant	Liter	41
6.	Fire Bitter	Liter	12
7.	Fire Blanket	NOS	12
8.	Fire Hook	Liter	12
9.	Fire Bucket	PCS	24
10.	Fire Drum	PCS	6
11.	DCP Fire Extinguisher	Liter	498
12.	Co ₂ Fire Extinguisher	Liter	68
13.	Foam Fire Extinguisher	Liter	18
14.	Fixed Fire Foam (Tank Farm Area)	Liter	01 ()
15.	Riser Point	NOS	73
16.	Fire Hose	NOS	185
17.	Hose Box	NOS	140
18.	Fire Water Pump	Set	2
Medical Aid			
19.	Ambulance	NOS	4
20.	First Aid Box	PCS	25
Safety Device & Equipment's			
21.	Life Jacket	PCS	20
22.	Life Buoy	PCS	8
23.	Multi Gas Detector (O ₂ , LEL, H ₂ S, CO)	NOS	03
24.	Single Gas Detector (VOC)	NOS	03
25.	Single Gas Detector (Cl ₂)	NOS	02

Record Book on the Training for Fire Extinguishment of the Bangladesh Labor Rules 2015

Form-22 (PER Section 62(8) of the Bangladesh Labor Act 2006 and Rule 55(10) of the Bangladesh Labor Rules 2015

Record Book on the Training of Fire Extinguishment

Name _____ of _____ Factory/Establishment:

.....

Address of

Factory/Establishment:.....

.....

Number of Total Workers and Employees:.....

Male:

Female:.....

Sl.No.	Date & Time	Type of Training			Name of the Training Institution	Number of Participants in Training			Duration of Training	Signature of Owner/ Manager	Remark
		Fire Extinguishment	Rescuer	First Aid		Male	Female	Total			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

Risks Of Hazardous Spills and Uncontrolled Pollution					
Sl. No.	Work area/ Possible Incident	Rescue Operations as part of Emergency	Responsible Persons	Location of Emergency Response equipment and tools	Action of the emergency services
01	Chemical Spill	1. Emergency Action Procedures will follow steps in	Operator: Dispatcher on duty at the Emergency Control Center		Reconnaissance-rescue team; first aid team and SERT
		2. Prepare PPE	All managers/supervisors		Perform reconnaissance
		3. Check for injured people and if any, provide air breathers and remove them from the area	Emergency Rescue Service		Remove any injured persons out of the gas impact area
		4. Suspend are all hazardous activities and evacuate any unauthorized persons	Operator: security guards		Administer first aid Mark the gas impact area

Risks Of Hazardous Spills and Uncontrolled Pollution					
Sl. No.	Work area/ Possible Incident	Rescue Operations as part of Emergency	Responsible Persons	Location of Emergency Response equipment and tools	Action of the emergency services
		5. Shut off the power supply at the respective workshop/work area if required	Shift In Charge		Regional Fire Service and Civil Defense Dept. A team arrives at the incident scene Perform reconnaissance and identifies the fire potential Conduct preliminary dislocation of forces Assist the accountable manager to ensure the fire safety and use of the special firefighting equipment as part of the emergency response operation. Emergency Medical Services (EMS) Provide emergency medical services Transport victims to medical facilities Monitors the health condition of emergency team members and provides assistance in case of injuries Local Police Department Cordon off the gas impact area Provide access to persons involved in the emergency response only Perform visual inspection and collects evidence to identify the cause of the accident.
		6. Shut off the power supply of any buildings and facilities or the entire site if required	Electrical technician on duty		
		7. Summon an emergency team	Operator:		
		8. Brief the emergency team about the specific measures to isolate the accident and the relevant hazards and inspect their PPE	Rescue operations accountable manager		
		9. Collect the spilled material and clean the area	Emergency response team		
		10. Identify recovery measures, provide safety induction and access to repair and construction work teams	Rescue operations accountable manager		
		11. Accept repair/construction works and authorize reopening of the facility	Area Manager		
		12. Investigate the cause and suggest measures to prevent recurrence	SERT		
		13. Final recovery measures	Area Manager		
02		1. Notification of the entire personnel	Operator: Dispatcher on duty		Reconnaissance-rescue team; ERS

Risks Of Hazardous Spills and Uncontrolled Pollution					
Sl. No.	Work area/ Possible Incident	Rescue Operations as part of Emergency	Responsible Persons	Location of Emergency Response equipment and tools	Action of the emergency services
	Waste Rock/Product Spill		at the Emergency Control Center		1. Perform reconnaissance
		2. Summon the emergency response team	Accountable manager; Operator;		2. Remove any injured persons 3. Administer first aid
		3. Check equipment and PPE of the emergency response team	Accountable manager;		Emergency Rescue Service A team arrives at the incident scene
		4. Arrange for monitoring of the scene; discontinue hazardous activities and keep unauthorized persons off the site	Patrol personnel Security personnel		Perform reconnaissance and identifies the fire potential
		5. In case the incident scene has not been identified, perform reconnaissance by: notifying the rescue team involving an emergency response team in the patrol	Security: Operator: Accountable manager;		Conduct preliminary dislocation of forces Assist the Executive
		6. Check for injured people and if any, provide air breathers, remove them from the area and transport to emergency medical service	Accountable manager;		Director to ensure the fire safety and use of the special firefighting equipment as part of the emergency response
		7. Assess the incident and any risk for humans and the environment	Accountable manager;		operations Emergency Rescue Service Provide emergency medical service
		8. Assessment report including requirements for additional equipment and forces for emergency localization, isolation and response	Accountable manager;		Transport victims to medical facilities Monitors the health condition of emergency team members and provides assistance in case of injuries
		9. Provide extra equipment and forces	Dispatcher on-duty Departmental manager		Local Police Department Cordon off the gas impact area
		10. Brief the emergency team about the specific measures to isolate the accident and the relevant hazards and inspect their PPE	Accountable manager;		Provide access to persons involved in the emergency response only
		11. Collect and haul the spilled material	Accountable manager;		Perform visual inspection and collects evidence
		12. Accept repair/construction works and authorize reopening of the facility	Accountable manager;		
		13. Investigate the cause and suggest measures to prevent recurrence	SERT		
		14. Final recovery measures	Construction Manager		

Risks Of Hazardous Spills and Uncontrolled Pollution					
Sl. No.	Work area/ Possible Incident	Rescue Operations as part of Emergency	Responsible Persons	Location of Emergency Response equipment and tools	Action of the emergency services
					to identify the cause of the accident.

Annex- 6: Cumulative Impact Assessment

Objective of the CIA

168. The main objective of this study is to Assess Cumulative Impact assessment (CIA) on the Valued Environmental and Social Components (VESC) based on IFC's guidelines. Cumulative impact is the combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in the case of standalone projects.

- To determine if the combined impacts of: the project, other projects and activities, and natural environmental drivers will result in VESC condition that may put the sustainability of a VEC at risk (i.e., exceed a threshold for VESC condition which is an unacceptable outcome); and
- To determine what management measures could be implemented to prevent unacceptable VESC condition, this may include additional mitigation of the project being assessed, additional mitigation of other existing or predictable future projects, or other regional management strategies that could maintain VESC condition within acceptable limits.

Methodology

169. The objectives of the study are to assess Cumulative Impact Assessment (CIA) for both present and future condition on the identified VESCs following the six steps process guidelines and develop management plans/procedures to avoid/eliminate/minimize impacts on the VESCs. IFC six step process is as follows:

Valued Environment and Social Components (VESCs)

170. Valued Environment and Social Components (VESCs) are environmental and social attributes that are Important in assessing risks as given in IFC handbook. Some examples of VESCs are as follows:

- physical features, habitats, wildlife populations (e.g., biodiversity),
- ecosystem services,
- natural processes (e.g., water and nutrient cycles, microclimate),
- social conditions (e.g., health, economics), or
- Cultural aspects (e.g., traditional spiritual ceremonies).

171. The VESCs may be directly or passively affected by a specific development, they often are also affected by the cumulative effects of several developments. VESCs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways. VESCs thus refer to sensitive or valued receptors of impact whose desired future condition determines the assessment end points to be used in the CIA process

Summary of VESCs of Landfilling Activities

172. To assess the contribution landfilling of the part of Precinct F (IMD Zone and Housing Facilities) and Precinct B 1200-acre land areas, key cumulative impact issues are summarized from existing Valuable Environmental Components (VESCs) this report as follows:

Physical Environment

1. After dredging the channel 'shore may become to erosion or accession. Also in newly reclaimed IMD zone may prone to flooding.
2. Surface Water Quality: Dredging can allow saltwater and heavy metal from the Sandwip Channel and Feni River to move further into inner water bodies.
3. Air Quality: Establishment of baseline air quality. Release of air pollutants from various emission sources during construction/operation activities due to construction pipeline, use of equipment and movement of vehicles; may be occurred such as dust and PM2.5, PM10 from construction/operation activities and road traffic.
4. Noise Quality: Establishment baseline noise level because increase in ambient noise levels from construction/operation activities, equipment, and vehicles, pipeline construction etc. may be occurred

5. Surface water Quality: Surface water quality may be deteriorated due to dredging wastewater discharge into canals and ponds in the study area.
6. Ground water Quality: Groundwater quality may be deteriorated due to leachate the heavy metals from the dredging material into the ground
7. Spillage of oil/effluent/dredging spoils, accidental release in appropriate disposal of oil from the dredging equipment/ vehicles and disposal of dredging liquid waste
8. Physiological stress and lethal effects on benthic invertebrates and to a lesser extent, fin- fishes.
9. Sediment Quality loss of dredged soils will disturb the channel bottom habitat and marine ecology, like benthos, zooplankton, phytoplankton. etc.
10. Toxic heavy metals of dredging material can pollute the groundwater through leachate into land filling area, IMD Zone, will pollute the groundwater quality. However, analysis findings indicate that the levels of heavy metals (Zinc, Copper, Mercury, Lead, and Cadmium) in the collected sediment samples are within the recommended toxicant default guideline values set by the Australian Government Initiative for sediment quality standard and Dutch Intervention Values on Soil quality standard. Therefore, the results showed all sediments from the different six locations are free from heavy metals toxicity and will have no impacts on the IMD zone due to landfilling.
11. Channel's morphological and bathymetric analysis, dredging location will be depends on the Channels bottom elevation.
12. Change of Land use and land cover due to dredging activities. Erosion and sedimentation risks especially in newly reclaimed areas may occur and may prone to flooding.
13. After dredging the channel 'shore may become to erosion or accession.
14. Water logging and drainage congestion may be occurred during dredging activities construction works and operation stage
15. Soil composition, fertility and quality may degrade due to dredging, reclamation IMD land
16. Disposal Activities in IMD Zone and offshore dredge disposal may deteriorate the lands, surface water as well ground water qualities.
17. Movement of water vessels/road traffic disrupted/obstacle of water vessels movement route during dredging activities;
18. Road traffic disruption at offshore dredge disposal area
19. Climate Change Vulnerability: Necessary to evaluate the vulnerability to climate change impacts, such as sea-level rise, extreme weather events, and temperature changes. GHG Emission and Carbon footprint related to the land reclamation and dredging operations.

Marine ecology, aquatic life, terrestrial flora and fauna

1. Ecological Environment (Marine Ecology Analysis Natural/Critical Habitat, Forest, Biodiversity Hotspot and Eco-sensitive Area. Channel bank erosion may be occurred during dredging activities but natural habitats may create after completion of dredging.
2. Breeding of some species may be impacted for short time but will be favorable for long time due to increase of water depth for dredging.
3. Terrestrial Flora and Fauna: New terrestrial flora and fauna may form community after dredging activities. Thus, flora and fauna may provide ecological services.
4. Phytoplankton Disturbance of seafloor, the suspension of fine sediments and the re-deposition of coarse factions affects marine phytoplankton, but there will be scope of forming phytoplankton community.
5. Zooplanktons community may be impacted but new community of zooplankton may form after dredging.
6. Benthic Community species diversity and abundance may reduce but there is a scope of natural recovering the benthic community after dredging.
7. Marine Fish Resources and Migratory Bird may increase due to dredging.
8. Disturbance of seafloor, the suspension of fine sediments and the re-deposition of coarse factions affects marine habitat, aquatic flora and fauna with other living organisms.
9. Terrestrial and aquatic flora and fauna may be affected by the dredging activities

Social Aspect

1. Disturbance of agricultural land and produce due to dredging pipeline alignment passes over the agricultural lands.
2. Disruption of smooth movement of vehicles and pedestrian by local access/roads due to dredged material transport pipeline
3. Occupational Health Safety and Community Health Safety: accident of the workers and project personnel may occur as well as to local community.
4. Health and safety also concern during dredging activities and OHS and CHS needs for compliance
5. Livestock based livelihood (fishing, Buffalo Grazing etc.) of the local economy may disrupted due to dredging activity.
6. Labor Influx will create negative impacts due to employment of workers/ workforce from different places. Conflict between local workers and far-off workers and local community. Unhygienic conditions resulting from day-to-day activities of workers during construction stage may spread various diseases and other adverse impacts.

Key CIA of the Activities

173. Based on the foregoing assessment of key issues, the following Valued Environmental Components (VESC) were considered in the CIA:

1. Air quality
2. Water quality
3. Sediment quality
4. Labor Influx/ Employment during the construction phase

Selection of Valued Components for the CIA

174. Based on a review of baseline information and the determination of key environmental and social issues, five VESCs were selected as shown below in table. This number was reduced from a larger list of key environmental and social issues, based on the following considerations:

Table 1: Valued Environmental and Social Components (VESC) selected for the CIA of Zones Development Activities

VESC	Rationale	Current Status	Construction	Operation
Air Quality	This has been selected as a VESC due to the potential for air pollutants to be released during the operation of the various facilities and subprojects included within the Project.	Ambient air quality at all the points found within the allowable Bangladesh standards. In zones, PM _{2.5} and PM ₁₀ values also within the Bangladesh standard	√	√
Water Quality	This has been selected as a VESC due to the potentially harmful quality of surface and water quality.	All surface waters should be within the standards (ECR, 2023) Shallow Aquifer (50 -60m): Mostly saline water with sweet water pockets. Deep Aquifer (180m): Fresh water. Parameters such as arsenic, iron and manganese level are above the acceptable drinking water quality in the the study area.	√	√
Sediment Quality	Sediments will be sourced from an area 6.0 km to 8.5 km from the project site. Included because of potential for contamination of the site	Analysis of the dredged material shows presence of nickel and chromium. Concentrations are within international standards for clean filling	√	
Social				

VESC	Rationale	Current Status	Construction	Operation
Labor Influx/Employment	Included due to the impact the Project will have on jobs in the area and the potential for labor influx.	Local laborers are not receiving job opportunities in the EZ preparatory activities. Influx of laborers for preparatory activities.	√	√

Assessment of Cumulative Impacts

Construction Phase

175. The assessment of cumulative impacts of various completed and ongoing activities in and around the proposed additional area on each selected VESC is discussed in Table 2 below. The following assumptions of additional landfilling activities were made for the CIA:

1. This will form part of the full CIA as part of the EIA. The CIA only considers the impacts of IMD Zone land development activities or being carried out in and around the area.
2. Proposed land filling by dredged seabed material and other completed, ongoing and proposed works such as super dyke, power Plant, access road construction, gas line network has been added.
3. Proposed CIA area considered cumulative impacts on the four selected VESCs. It does not include consideration of cumulative impacts of future proposed projects and impacts during the operation phase for which sufficient information are not available currently.
4. The temporal boundary of the assessment is only during the construction phase.
5. The spatial boundary of the CIA is the entire project area.
6. No public consultation was conducted regarding the selection of VESCs. This however should be an integral component of the full CIA.
7. Impacts were assigned in three categories: low, moderate and high (descriptions are provided on the following page)

Table 2: Cumulative Impact Assessment of Project and Other Activities on Valued Components

Activity	Valued Component				Overall Cumulative Impact
	Air Quality	Water Quality	Sediment Quality	Employment	
Project Activity					
Dredging of bottom sediments					
Transport of dredged material by pipeline to shore					
Drying of dredged material					
Grading and leveling of dredged material					
Compaction of surface					
Other Activities					
Widening of access roads					
Construction of an administration building					
Setting up labour camps					
Revegetation and establishment of green buffers					
Categorization of Impact					
	Low (L)	Impacts are localized, of short duration and are expected to have an insignificant effect on the valued component			
	Medium (M)	Impacts are more widespread, of moderate duration and are expected to have a limited to moderate effect on the valued component			

Activity		Valued Component				Overall Cumulative Impact
		Air Quality	Water Quality	Sediment Quality	Employment	
	High (H)	Impacts are widespread, of longer duration and are expected to have an adverse effect on the valued component				

Table 3: Summary of Potential Cumulative Impact and Mitigation Measures of Landfilling Activities on each VESC

VESC	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact	Mitigation Measure
Air Quality	PM2.5, PM10, SO2, NO2, CO, O3	Particulate emissions may exceed standards for short period at the construction site and along access roads.	Impacts are expected to be localized, of moderate duration in the construction phase and no adverse cumulative impacts are anticipated.	Water needs to be sprinkled at construction site and haul roads. Use of clean fuel like LPG, low Sulphur diesel need to be considered. Industries should adopt latest technology, methodology, and machinery involving minimal air emissions. Power Generators should emit at a height higher than nearest building to ensure enough dispersion of emission All Industries should obtain clearance from DoE and clearance evaluation needs to be renewed periodically
Water Quality	Surface water parameters - Temperature, Total Suspended Solid (TSS), Electrical Conductivity (EC), Turbidity, pH, Salinity, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Mercury (Hg), Lead (Pb), Cadmium (Cd), Zinc (Zn), Chromium (Cr), Total Coliform (TC)	Surface water quality may be affected from potential leaks of fuel or oil from machinery for construction. Potential for contamination from sanitary waste if proper toilet facilities are not installed for workers.	Impacts are expected to be localized and no adverse cumulative impacts are anticipated.	Water Demand management Efficient water distribution system Rainwater harvesting Aquifer artificial recharge No leachate wastewater and waste material should be stored in pervious unlined area/pond
	Groundwater parameters to be selected – pH, Cl, TDS, TSS, EC, oil/grease, coliform, metals (e.g. arsenic)	Fuel, oils, and chemicals may seep into groundwater from leaks or the inadequate disposal of waste.	Impacts are expected to be localized and no adverse cumulative impacts are anticipated.	
Sediment Quality	Concentrations of Zinc, Copper, Mercury, Lead, Cadmium need to be assessed	Run off from the site may introduce contaminants into adjacent drainages	Localized impacts on marine water quality are expected. Fill quality of dredged material meets international	Ensure planned drainage network. Dredging should be carried out into the targeted areas as stretched by the BWDB

VESC	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact	Mitigation Measure
			standards. No adverse cumulative impacts expected.	Excess dredged material should not be disposed at any location other than the project location Sediment/dredged material extracted should be tested for toxicity & contamination Dredger should be selected as per the strata to be dredged
Employment	Workforce numbers	Land development will result in additional but limited job creation for the area. The project should ensure that local people are given employment opportunities. Labor influx to the area is not expected at the construction stage.	Localized and no adverse cumulative impacts are anticipated.	Ensure engaging local people About 150 squatters identified those will be affected, who will be suitable options for engaging in the project Ensure appropriate OHS measures for the workers Implement GRM and GRC at all level Provide waste management system, hygienic sanitary/toilet, drinking water, healthy labour camps for the workers Arrange emergency response facility, first aid box, health check for all the staffs

Annex- 7: Pollution Load Calculation

Estimation of Pollution Load

176. An emission inventory (EI) is a comprehensive listing by source of air pollutant and /or GHG emissions in a geographic area during a specific time period. Emission inventories are one of the fundamental components of Air Quality Management Plans to measure progress/changes overtime to achieve cleaner air and to determine compliance with environmental regulations. Emission inventories are also very useful in air quality model applications and for understanding long-range transport of pollutants. The variability of emissions over short periods can be described using temporal resolution. Depending on the purpose of an inventory of key ABC pollutants will focus on primary gaseous and particulates pollutants, such as PM₁₀, PM_{2.5}, gaseous pollutants (SO₂, CO₂, NO_x, NH₃, CO) and other greenhouse gases (GHGs). The pollutants listed above should be included in any inventory in order to obtain an overall picture of atmospheric processes that allow for evaluation of the effects of secondary air pollutants, such as ozone, and secondary aerosols through photochemical reactions. EI, the resolution can be annual, seasonal, monthly, daily, hourly, or for a shorter period.

Air Quality Index (AQI)

177. EPA establishes an AQI for five major air pollutants regulated by the Clean Air Act. Each of these pollutants has a national air quality standard set by EPA to protect public health:

- ✓ Ground-level ozone
- ✓ Particle pollution (also known as particulate matter, including PM_{2.5} and PM₁₀)
- ✓ Carbon monoxide
- ✓ Sulfur dioxide
- ✓ Nitrogen dioxide

178. An air quality index is a scale used to show how polluted the air is, along with the risks associated with each rating. An AQI is calculated using established standards based on medical research for the acceptable levels of major air pollutants. Air quality indexes serve two main purposes:

- ✓ To inform the public about air quality in a comprehensible manner so that they may take action to protect their health
- ✓ To help countries develop and assess policies for better air quality

179. The air quality index is a piecewise linear function of the pollutant concentration. At the boundary between AQI categories, there is a discontinuous jump of one AQI unit. To convert from concentration to AQI this equation is used: (If multiple pollutants are measured, the calculated AQI is the highest value calculated from the above equation applied for each pollutant.)

$$I = \frac{I_{high} - I_{low}}{C_{high} - C_{low}} (C - C_{low}) + I_{low}$$

Where,

I = The (Air Quality) index

C = The pollutant concentration

C_{low} = the concentration breakpoint that is $< C$

C_{high} = the concentration breakpoint that is $> C$

I_{low} = the index breakpoint that is $< I$

I_{high} = the index breakpoint corresponding to C high

180. There are six AQI categories with colour denotes, namely Good, Satisfactory, moderately polluted, Poor, Very Poor, and Severe **Table 1**. Each of these categories is decided based on ambient concentration values of air pollutants and their likely health impacts (known as health breakpoints).

Table: 1 Sub category of Air Quality Index as per rating scale

AQI-Rating Scale	Impacts
Good (0–50)	Minimal Impact
1 Satisfactory (51–100)	Minor breathing discomfort to sensitive people
Moderate (101–200)	Breathing discomfort to the people with lung,
Poor (201–300)	Breathing discomfort to people on prolonged exposure
Very Poor(301–400)	Respiratory illness to the people on prolonged exposure
Severe (>401)	Respiratory effects even on healthy people

181. Pollution load of project area was found under range of 51-100 AQI which indicates that air quality of the area is satisfactory with minor discomfort to the sensitive people **Table 2**. Overall, the pollution load is minimal and suitable for human settlement.

Table 2. AQI Value of the Study Area

Location	Parameters	AQI Value	Quality
AAQ-1	SPM PM ₁₀ PM _{2.5} SO ₂ NO ₂ CO CO ₂ O ₃	80	Satisfactory (51–100)
AAQ-2		57	Satisfactory (51–100)
AAQ-3		57	Satisfactory (51–100)
AAQ-4		60	Satisfactory (51–100)
AAQ-5		57	Satisfactory (51–100)
AAQ-6		57	Satisfactory (51–100)
AAQ-7		58	Satisfactory (51–100)
AAQ-8		58	Satisfactory (51–100)
AAQ-9		57	Satisfactory (51–100)
AAQ-10		71	Satisfactory (51–100)

Estimated pollution load from vehicles

182. With air pollution being the top environmental cause of premature death (EEA, 2014), there is an increased concern about human population. Although transport sector has considerably reduced its emissions of air pollutants in 2000 (EEA, 2016a), this sector still remains the largest contributor to emissions such as NO_x. Emission inventories are used as inputs to air quality models, to study the dispersion of pollutants, in conjunction with local meteorology, topography, and composition of pollutants.

183. Among many features that a good emissions inventory depends on, one is better understanding of the sources and their strengths. Sources of air pollution are many. In an urban environment, most common are fuel combustion and non-combustion (volatile) sources from industries; vehicular activity –direct vehicular exhaust and indirect fugitive dust from roads; combustion of conventional (coal and kerosene) and non-conventional (wood and cow dung) fuels in the domestic sector; wind-blown dust in the dry areas; construction activities; seasonal forest fires and dust storms.

Project site

184. The site can be accessed through Abu Torab Beribandh Road which connects NSEZ to N1 (~10 km) at Barotakia. Along this stretch two lane road-Sheikh Hasina Saroni is proposed, the alignment is as shown in **Map 1**. Currently two-lane works are underway and it will be later upgraded to four lanes. The main arterial proposed abutting the site in the west is connected to N1 through Muhuri Project road in the north and MohanagarBarodarogarhat in the south. Nearest Bus Stand to the site is Barotakia Bus Stand at N1 located at a distance of 11 km by road. The Dhaka-Chattogram railway line is situated parallel to N1 with Barotakia railway station being the closest at a distance of 16 km. The Mirsharai railway station is around 29 km. The current last mile connectivity to the site is only through private vehicle/IPT. This last mile connectivity road connectivity to N1 needs to be upgraded at priority to ensure growth of EZ and that industries planned herein have a smooth flow of input raw materials and output.



Map 1: Project location road network

Traffic estimation

185. As per the master plan land use the Green smart Economic Zone does not have the proposal for residential building therefore all the employed are going to access the project site from nearby settlement. Based on the above assumption and other data including sector wise area statement of the proposed Green smart Economic Zone, total estimated traffic per day through various mode of vehicles and is presented **Table 3**.

Table 3.: Traffic Estimation

Vehicular Mode	Type of Vehicular	% of Vehicular contribution	Number of Vehicles Estimated
Passenger Vehicles	Heavy Motor Vehicle	30%	1328
	Light Motor Vehicle	40%	1770
	Two- Three Wheelers	30%	1328
Commercial vehicle	Heavy Motor Vehicle	50%	15922
	Light Motor Vehicle	40%	12737
	Two- Three Wheelers	10%	3184

Source: Draft preliminary viability assessment report of PPP project of Master Development for 200-hectare Green, Smart Zone, 2022.

Approach Methodology

186. Beyond the obvious (emission factors), largest uncertainty in this equation lies with the “Number of Vehicles” for each category. It is assumed that most of the cities have access to the registered number of vehicles, but an ideal emissions inventory would include the in-use fleet, which could be different from what is registered. While estimating the in-use fleet, it is often hard to estimate how many of the registered are in-use in the city limits or outside and vice versa (vehicles registered outside and in-use in the city). First order approximation is to use the registered numbers; as and when further details arise and if there is a provision for full scale survey, adjust the calculations.

187. Vehicle kilometres travelled (VKT), is a survey data, most commonly evaluated in the units of “kilometres travelled per day”. There is no single established method to obtain this data, but to survey. Possible approximations are.:

- Public transport buses, operating on fixed or non-fixed routes, operate at an average speed is 30 km/hr for 8 hours a day, which accounts for 240 km per day.

- Public transport buses operating on long distance routes, travel in and out of the city, which means distance travelled in the city limits is the distance between the depots to the city limits.
- Passenger vehicles, on average operating at 30-40 km/hr for 1-2 hours on the road. A quick survey among the colleagues, work places, or on road for a day or two will provide an approximate VKT for this category.
- Another possibility for passenger vehicles is the information from the vehicle registrations, the distance travelled over a year(s) will give an idea of average VKT's per day.
- Commercial small trucks in the city, again operating at 30-40 km/hr for 8 hours a day, will provide an estimate.
- Motorcycles (2Ws) are expected to travel at speeds higher than the other modes and for short time periods; unless you are in the cities like Bangkok, Hanoi, or HCMC, where 2 Ws are extensively used for commercial purposes and as small distance taxis.
- Please note that these approximate numbers (theories) are for conditions observed in the developing countries, where the congestion levels are on the rise and doesn't allow the vehicles to operate at speeds observed in the developed countries.
- Emission Factors (EF), by definition, represent the release of a pollutant due to combustion of fuel, with common units of gm/veh-km, under a variety of conditions, e.g., loaded and unloaded; idling; cold starts; and cruising. An emission factor is typically established based on testing a number of vehicles (with varying age and mix) under conditions listed above, to arrive at an average number. Table below presents an average set of emission factors for major vehicular categories for three fuel types (LDV = light duty commercial vehicles).

188. Equation is emissions estimator of all parameters as per traffic volume count. Equations and parameters included are explained below;

$$\text{Emission (Tons/Year)} = \frac{\text{No. of Vehicle} \times \text{VKT} \times \text{EF}}{\text{CF is 1000000}}$$

Where,

No. of Vehicle = Monitored data

VKT = Vehicle kilometres travelled (Survey Data)

EF= Emission Factor (obtained from published Data)

CF = Conversion Factor for Tonnes/Year

Result & discussion

189. Monitored data were characterized by three segments viz. Heavy Motor Vehicle, Light Motor Vehicle and Two and Three Wheelers for calculation **Table 4**. Result show that the traffic emission load which is about **162.81 & 1667.46** tonnes/year in passenger and commercial vehicle respectively. Overall total traffic pollution load is **1830.26** tonnes/year including sum of PM10, PM2.5, SO2, NO2, CO and CO2 in the studied area.

Table 4. Emission Calculated value as per monitored and survey data

Vehicular Mode	Parameters	Number of Vehicles	Vehicle KM travel (Km/Day)	EF (gm/km)	Vehicular KM Traveled (Km/Year)	Emission (Tonnes/Year)
A. Passenger Vehicles						
Heavy Motor Vehicle	PM10	1328	100	2	31000	0.266
	PM2.5	1328	100	1	31000	0.133
	SO2	1328	100	1	31000	0.133
	NO2	1328	100	10	31000	1.328
	CO	1328	100	3.5	31000	0.465
	CO2	1328	100	850	31000	112.88
Light Motor Vehicle	PM10	1770	40	1.25	12400	0.089
	PM2.5	1770	40	0.5	12400	0.035

Vehicular Mode	Parameters	Number of Vehicles	Vehicle KM travel (Km/Day)	EF (gm/km)	Vehicular KM Traveled (Km/Year)	Emission (Tonnes/Year)
	SO ₂	1770	40	0.3	12400	0.021
	NO ₂	1770	40	2	12400	0.142
	CO	1770	40	2.5	12400	0.177
	CO ₂	1770	40	500	12400	35.40
Two- Three Wheelers	PM ₁₀	1328	100	0.2	31000	0.027
	PM _{2.5}	1328	100	0.08	31000	0.011
	SO ₂	1328	100	0.02	31000	0.003
	NO ₂	1328	100	0.1	31000	0.013
	CO	1328	100	8	31000	1.062
	CO ₂	1328	100	80	31000	10.62
TOTAL (A)=						162.81
B. Commercial vehicle						
Heavy Motor Vehicle	PM ₁₀	15922	100	2	31000	3.184
	PM _{2.5}	15922	100	1	31000	1.592
	SO ₂	15922	100	1	31000	1.592
	NO ₂	15922	100	10	31000	15.922
	CO	15922	100	3.5	31000	5.573
	CO ₂	15922	100	850	31000	1353.4
Light Motor Vehicle	PM ₁₀	12737	40	1.25	12400	0.637
	PM _{2.5}	12737	40	0.5	12400	0.255
	SO ₂	12737	40	0.3	12400	0.153
	NO ₂	12737	40	2	12400	1.019
	CO	12737	40	2.5	12400	1.274
	CO ₂	12737	40	500	12400	254.74
Two- Three Wheelers	PM ₁₀	3184	100	0.2	31000	0.064
	PM _{2.5}	3184	100	0.08	31000	0.025
	SO ₂	3184	100	0.02	31000	0.006
	NO ₂	3184	100	0.1	31000	0.032
	CO	3184	100	8	31000	2.547
	CO ₂	3184	100	80	31000	25.47
TOTAL (B)=						1667.46
Total Emission Tonnes/Year (A+B) =						1830.26

Identify emission sources within the facility;

190. The industrial units are required to monitor ambient air quality and stack emission within industrial premises. The project area under feasibility condition and planning for environmental clearance. The area is existing under natural condition as no manmade activities has started. Therefore, we have made emission calculation based on the feasibility study data and similar published work.

Emissions for electrical appliances

191. All electrical appliances use energy and create greenhouse gases (GHG). By counting the number of appliances such as running of heavy machine, light fittings, computers, heaters, fridges, Smartboards etc., and estimating the amount of greenhouse gases created per item (kg CO₂). For the estimation of emission load, following equation has been taken into consideration which details are given below;

STEP-I: Calculate the kilowatt hours (kWh) of your appliances

$$\text{kWh} = \frac{\text{Hrs} \times \text{Day} \times \text{Watts}}{1000}$$

Step-II: Next multiply the kilowatt hours (kWh) by the Emissions Factor (EF) for your appliance

$$\text{GHG (kg CO}_2\text{)} = \text{kWh} \times \text{EF}$$

Step-III: Annual emission of CO₂ tonnes/year for your appliance

$$\text{GHG (Tonnes CO}_2\text{/Year)} = \text{MW} \times \text{EF} \times \text{Day}$$

192. As per feasibility study, require electricity around 62.89 MW in different sector which details are given in the **Table 5**. However, as per power demand GHG emission will generate around 12876 tonnes/Year from the different process.

Table 5. Projection of Estimated Emission Load Sector Wise

Sector	Load Capacity (MW)	Operation Time (Hr)	Operation	Emission Factor	GHG
			Day		(Tonnes/Year)
Leather and Leather Product	3.88	24	320	0.64	794
Pharmaceuticals	21.95	24	320	0.64	4495
Auto & Automobile Accessories	20.06	24	320	0.64	4108
Light Machinery	15.23	24	320	0.64	3119
Truck Terminal	0.04	10	320	0.64	8
Open & Green Space	0.097	10	320	0.64	19
Amenities	1.1	10	320	0.64	225
Utilities	0.282	10	320	0.64	57
Road	0.252	10	320	0.64	51
Total Emission Tonnes/Year=					12876

193. It is noted that as per Draft Report of NSEZ Master Plan IV (by Sheltech) report, 150 MW solar power plant is proposed in the master plan of NSEZ. Therefore, the load of the electricity demand from the non-renewable source will reduce drastically. Subsequently, GHG of the Economic zone will reduce up to 2299 TPA. The balance of carbon footprint and carbon sequestration is attached in the table 6

Table 6. Carbon Footprint & Carbon Sequestration

SN	Carbon Footprint			Carbon Sequestration	
	Activities	CO ₂ e generation (TPA)		Activities	Reduction of CO ₂ Emission (TPA)
		From Electricity	From Gas		
1	Leather and Leather Product	794	-	CO ₂ emission reduction due to Solar Plant	2299
2	Pharmaceuticals	4495	-	CO ₂ emission reduction due to use of LED light (energy conservation)	1,576
3	Auto & Automobile Accessories	4108	-	CO ₂ emission reduction due to Green Belt Development in 12 acres with 30,400 saplings	5,599.28
4	Light Machinery	3119	-		
5	Truck Terminal	8	-		
6	Open & Green Space	19	-		
7	Amenities	225	-		
8	Utilities	57	-		
9	Road	51	-		

Total GHG=	12876	Reduction of CO₂=	9474.28
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Waste load Estimation

194. Determining the amount and types of waste generated within a region is of fundamental significance for waste management planning and control. Data gathered with regard to amount, waste type and origin are important when designing a waste data collection system. A waste management system cannot be successful without complete and timely waste data that Industrial waste can be classified into two major categories as follows;

- Non-hazardous waste refers to wastes generated in manufacturing or production that are not harmful to humans, property or the environment.
- Hazardous waste refers to solid, liquid or gaseous wastes, that are harmful, such as highly flammable, corrosive, highly reactive or toxic substances, which also include treated hazardous waste.

195. To fall under the waste generator category, a factory has to generate at least 100 kilograms of hazardous substances per month. Factories are divided into two categories:

1. Large industrial waste generators generate more than 1,000 kilograms of industrial waste per month.
2. Medium industrial waste generators generate more than 100 kilograms but less than 1,000 kilograms of industrial waste per month.

196. According to the National Cadaster for Industrial and Special Wastes prepared in 2007, the overall generation of industrial waste, including non-hazardous and inert industrial waste, is 2,547,000 tons per year with a stock quantity of 4,483,500 tons. This type of waste is generated from the following: Metal related industries (50%); building materials, ceramics, and glass industries (50%); chemicals, rubber, and plastic industries (2%); food processing, tobacco, and match industries (29%); Textiles, hosiery, and confection industries (10%)

Solid Waste Generation Rate from Manpower

197. For the estimation of waste load, we have conducted survey based on the manpower working day, calendar day nature of waste generation from fabric, paper, plastic, sludge, thread, metal and wood. In the survey, we have estimated that around 0.182 kg/man/day for calendar day and 0.253 kg/man/day for working days **Table 7.**

Table 7: Waste Generation Rate by Manpower

SN	Waste Type	Solid Waste Generation Rate (kg/man/calendar days)	Solid Waste Generation Rate (kg/man/working days)
1	Fabric	0.01	0.02
2	Paper	0.12	0.16
3	Plastic	0.02	0.03
4	Sludge	0.01	0.01
5	Thread	0.01	0.02
6	Metal	0.01	0.01
7	Wood	0.002	0.003
Total Waste (kg/day)		0.182	0.253

Waste load as per Proposed Industries

198. It is estimated that the park shall generate an estimated direct employment of nearly 36869 and an indirect employment of nearly 20208 with total of 79677 employments. The share of estimated employment sector wise is presented in **Table 8.**

Table 8.: Employment Details

Sl.No.	Land Details	Direct	Indirect	Total
1	Leather & Leather Products	2430	171	4131
2	Auto & Automobile	7582	1237	29889
3	Pharmaceuticals	11270	7889	19159
4	Light Machinery & Equipment	15587	10911	26498
Total Manpower=		36869	20208	79677

199. Furthermore, as per industry characteristic, we have found that the Leather Industry, Automobile, Pharmaceutical and Light Machinery Industry will contribute around 345, 2495, 1599 and 2212 tonnes/Year respectively **Table 9**.

Table 9: Waste generation Rate by Industries

Particulars	Leather Industry	Automobile	Pharmaceutical	Light Machinery
Calendar Days	365	365	365	365
Total Working Days	330	330	330	330
Total Manpower	4131	29889	19159	26498
Waste Generation (kg/man/calendar Day)	0.182	0.182	0.182	0.182
Waste Generation (kg/man/working Day)	0.253	0.253	0.253	0.253
Waste Generation (kg/calendar day/ Year)	274422	1985526	1272732	1760262
Waste Generation (kg/working day/Year)	344897	2495432	1599584	2212318
Total Waste generation Tonnes/Year	345	2495	1599	2212

200. As per above generated waste, the composition of waste was identified as given in the Table 10.

Table 10 Composition of Municipal Waste

Sl.No.	Waste Composition	Percentage Breakup	MSW (TPD)
1	Bio-degradable News	70%	10.84
2	Recyclables	20%	3.10
3	Inert	10%	1.55
	Total	100%	15.49

Industrial solid waste (ISW)

201. The quantity of industrial solid waste (ISW) is arrived by assuming the unit quantity (in kg) of production of waste per industry per 1 hectare. The ISW quantification and percentage of ISW breakup is given below in the **Table 11**.

Table 11: Industrial solid waste generation

Sl. No.	Land Use	Area (Ac.)	Generation Factor for NHW (Kg/Ha/d)	Non-Hazardous Waste (Ton/d)	Generation Factor for HW (kh/ha/d)	Hazardous Waste (Ton/day)
1	Leather and Leather Product	48.50	7	0.14	3	0.06
2	Auto & Automobile Accessories	118.00	109.00	5.21	22	1.05
3	Pharmaceuticals	129.10	7.00	0.37	39	2.04
4	Light Machinery	89.60	165.00	5.99	19	0.69
5	Amenities	11.00	60.00	0.27		
6	Utilities	28.20	60.00	0.69		
7	Open & Green Space	48.60	30.00	0.59		
8	Road Canal & Gas station	85.70	10.00	0.28		
	Total	542.00		13.52		3.84

202. Hazardous waste shall be handed over to the proposed TSDF facility meant for the entire economic zone and also it is the proposed to provide temporary storagr sheds in MSW landfill site for a period of 90 days. The process in the TSDF would be like cleaning of clay, levelling of secondary liner, laying of HDPE liner, placing of geotextile on filter media, placing of waste, HDPE lined and finally compaction and capping with grass plantation. Recyclable waste shall be handed over to nearby recyclers and inert waste shall be sent for landfill. Integration with overall NSEZ will only require the segregated waste to be transported to the designated transfer point from a temporary shed in the green smart EZ. Hence the other facilities proposed ;like composting and landfill for siposal at source are only option.

Estimation of waste water load

203. In the Final Master Plan for NSEZ, a holistic plan for water supply to cater to entire NSEZ is laid out. Multiple water sources are considered to meet this demand which includes a combination surface water, ground water and desalination plants. Three Water Treatment Plants are being built for the surface water sources outside NSEZ. Treated water transmission main is being made available to the NSEZ boundary. NSEZ is divided into 25 water supply zones each served by an underground/semi-underground Storage reservoir cum pumping station (SRPS). Estimated One time water demand of the project is 18.03 MLD. The detail breakup is given in the **Table 12.**

Table 12.: Water demand of the project

Land Use Pattern	Total Area	Total Water Demand
	Acre	KLD
Leather & Leather Product	48.50	1920.6
Auto & Automobile	118.00	5373.7
Pharmaceuticals	129.10	5879.2
Light Machinery	89.60	3548.2
Amenities	11.00	121.5
Utilities	28.20	228.3
Open & Green Space	48.60	218.7
Road Canal & Gas station	85.70	
Fire Demand		742.23
Total (KLD)		18032.43

204. To cater to the entire NSEZ two (2) Sewage Treatment Plants (STPS) and four (4) Common Effluent Treatment Plants (CETP) are planned along with intermediate pumping stations to restrict depth of sewer facilitating the crossing of natural drainage channels. STPs will cater to Precinct A, B, C, D and K which will predominantly generate biological waste. Precinct F, I and G produces industrial and biological liquid waste, but assuming that biological will be less than 5% of industrial flow combined pipeline to carry both is recommended.

205. The proposed trunk sewer line for NSEZ is passing along the Green smart Zone in the west. Zone 12 and 13 are in the catchment of Common Effluent Pumping Stations (CEPS) 2 and 3 from wastewater is further pumped to CETP 3 which has a capacity of 150 MLD and is planned to be developed in a modular manner. This is considered while laying wastewater network for Green Smart EZ. Based on standard industry benchmarks, 70% of water demand is considered as effluent generated and 30% of water demand is considered as sewage generated. Based on the assessment, it is found that the total load of waste water is given below and its detailed breakup is given the **table 13.**

- Estimated effluent generation: 10.8 MLD
- Estimated sewage generation: 4.7 MLD
- Evaporation Loss: 1.8 MLD
- Miscellaneous: 0.7 MLD

Table 13.: Estimated Waste Water Load of the Proposed Project

Land Use Pattern	Total Area	Total Water Demand	Effluent Generation (70%)	10% Loss	Total Effluent for treatment	Sewage Generation (30%)	10% loss	Total sewage quantity for STP	Total sludge generation
	Acre	KLD							TPD
Leather & Leather Product	48.50	1920.6	1344.42	134.44	1209.97	576.18	57.61	518.56	60.49
Auto & Automobile	118.00	5373.7	3761.59	376.15	3385.43	1612.11	161.21	1450.89	169.27
Pharmaceuticals	129.10	5879.2	4115.44	411.54	3703.89	1763.76	176.37	1587.38	185.19

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annexure-7: Pollution Load Calculation

Light Machinery	89.60	3548.2	2483.74	248.37	2235.36	1064.46	106.44	958.01	111.76
Amenities	11.00	121.5	85.05	8.50	76.54	36.45	3.64	32.80	3.82
Utilities	28.20	228.3	159.81	15.98	143.82	68.49	6.84	61.64	7.19
Open & Green Space	48.60	218.7	-	-	-	-	-	-	-
Road Canal & Gas station	85.70	-	-	-	-	-	-	-	-
Fire Demand		742.23	-	-	-	-	-	-	-
Total (KLD)		18032.43	11950.05	1195.01	10755.05	5121.45	512.145	4609.305	537.7

Annex- 8: Air Quality Modelling

Air Quality Monitoring

Background

206. Modern technological man's craze for more and more material wealth and physical comforts has unknowingly pushed him into the world of unsustainable trade, commerce, and industry, for the carrying of which, several developmental activities like hazardous and non-hazardous involving excessive use of science and technology necessarily take place. In this regard, environmental degradation like air pollution has been observed in each industrial development. Therefore, it is necessary to decrease such environmental pollution and degradation through environmental management procedure. In Bangladesh, Environment Conservation Act 1995 (Amended 2010) is currently the main act governing environmental protection in Bangladesh, which replaced the earlier environment pollution control ordinance of 1992 and provides the legal basis for Air Pollution Control rule 2022 aiming to protect environmental health, the government has published a new rule based on section 20 of The Bangladesh Environment Conservation Act, 1995.

207. An issue that is becoming ever more important is identifying and mitigating potential environmental and social impacts related to the development. Therefore, a baseline study is essential in order to be able to determine the level of impact expected and to enable the monitoring of impacts after the development has occurred. To facilitate further preparation of Environment Clearance Report cognizant to the need to mitigate the negative environmental impacts of projects in its portfolio and has developed systems to safeguard the environmental concerns. To comply with the environmental safeguard requirement a baseline environmental status of project sites has to be established before activity initiates in the field. It will be done through primary monitoring and surveys for relevant parameters and secondary data collection to provide a database against which short- or long-term environmental impacts of the project can be determined, the existing baseline environmental data are to be collected.

208. To predict pollution level and its management through very sound and scientific modeling technique such as air dispersion model and noise model are used widely in the present scenario. For this this region, baseline environmental monitoring of certain environmental attributes viz. Meteorology, Ambient Air Quality, Ambient Noise Quality need to be studied surrounding projected area. Similarly, regulatory agencies rely on dispersion models as part of environment management plan and their approval processes

209. Therefore, USEPA recommended different air dispersion model and noise prediction model to assess the emission and magnitude of the contaminants to the adjacent areas of the Project site. The model AERMOD 8.9 has been used to predict and simulate the effects of criteria pollutants from major emission sources in the Project area and analysed the effect on ambient air quality for NO₂, SO₂, PM_{2.5} and PM₁₀.

210. The major objective of AQM was the prediction of dispersion of air emission from project side. The Gaussian Dispersion Modeling framework was used for the computation of GLC up to a distance of 10 Km from source. The AERMOD 9.5.0 software platform was used for the modeling exercise. The period GLC's of the air pollutant, namely PM₁₀, PM_{2.5}, SO_x, NO_x from the source operations have been computed. AERMET view has been used to create the SURFACE file (.SFC) and PROFILE file (.PFL).

211. The baseline study was done in January to March 2024 for a period of 3 months. Meteorological file has been prepared by wind direction, wind speed, temperature (in K), mixing height, stability class (urban and rural) and cloud cover etc.

Impact on Air Quality

212. The impacts on air quality from the proposed project depends on various factors like flue gas emission, design capacity of the boiler and DG set, configuration, process technology, raw materials, combusting elements, air pollution control measures, operation & maintenance and monitoring system. Air pollutant disperses to the ambient air of the study area depending on the environmental conditions like atmospheric stability, topographic features, land use land cover etc. in the study area. Emission of flue gas to the ambient environment, it will be subjected to following physical and chemical processes for discharging, dispersion and dissipating to the ambient airshed. Spatial and temporal distribution of air pollutants depends on the following

- An initial vertical rise, called plume rise, due to initial buoyancy and momentum of discharge from the stacks

- Transport by wind in its direction due to wind speed, land cover friction and atmospheric parameters like precipitation
- Diffusion by turbulence, and stability class of the atmospheric condition
- Gravitational settling, chemical transformations, dry or wet deposition, topographical features, and other complex interactions.

213. The emitted flue gas from the stacks will disperse into the atmosphere and transported through wind flow into the down wind direction. Finally, the ground level concentration of pollution will diverge depending on the atmospheric process, existing pollution level, distance from the sources, land status etc. This study will estimate the resultant maximum ground level concentration of the particular pollutants are being estimated and checked with respect to the national and international compliance standard values.

214. During operation of the Boiler & DG mainly emits the criteria pollutants like Particulate Matters (PM), Oxides of Nitrogen (NO_x), Oxides of Sulfur (SO_x), Carbon Monoxide (CO) etc. Along with the criteria pollutants, it will also emit persistent organic pollutants (e.g. dioxins), volatile organic compounds (non-methane VOCs), ammonia (NH₃) and some heavy metals (e.g. Pb, Cu, Cd, Cr, Ni, Hg), at some time. Those pollutants are usually emitted minimally to the ambient environment maintaining the international standard. However, this study is focusing on the criteria pollutants which are being mathematically modeled in this study for addressing the ground level concentration during operation stage with respect to compliance standard.

215. The emissions of total particulate matter can be comprised with PM_{2.5} and PM₁₀ (Particles $\leq 2.5\mu\text{m}$ and $\text{PM}_{\leq 10\mu\text{m}}$ in size) which will be released in the flue gas during combustion process. Emission of SO₂ in the flue gas depends on the percentage of sulfur present in the HSD which oxidized in the boiler and produce SO₂. Nitrogen oxides are products of all fuel/air combustion processes. Nitric oxide (NO) is the primary component of NO_x; however, nitrogen dioxide (NO₂) and nitrous oxide (N₂O) are also formed in smaller amounts. The rate of emission of the pollutants in the flue gas have been presented in Table-1 in compliance with the Air Pollution Control rule 2022.

Table-1: Emission rate from the stack

1.	Coal based Emission Features		Project Target Value	APCR 2022
1.1	Particulate Matter (PM)	New	30 mg/Nm ³	50 mg/Nm ³
		Old		100 mg/Nm ³
1.2	Sulfur Dioxide (SO2)	New	40 mg/Nm ³	200 mg/Nm ³
		Old		400 mg/Nm ³
1.3	Oxides of Nitrogen (NOx)	New	180 mg/Nm ³	200 mg/Nm ³
		Old		400 mg/Nm ³
2.	Oil Based Emission Features			
2.1	Particulate Matter (PM)	Old	30 mg/Nm ³	50 mg/Nm ³
		New		80 mg/Nm ³
2.2	Sulfur Dioxide (SO2)	Old	40 mg/Nm ³	200 mg/Nm ³
		New		400 mg/Nm ³
2.3	Oxides of Nitrogen (NOx)	Old	180 mg/Nm ³	200 mg/Nm ³
		New		400 mg/Nm ³

Source: Air Pollution Control rule 2022

Research Methodology

216. Regulatory agencies rely on dispersion models as part of their approval processes. The Department of Environment (DoE) in Bangladesh does not recommend any specific models for the impact assessment study. Therefore, this study has maintained the USEPA recommended air dispersion model has been used for this project to assess the ambient maximum air pollution. The latest version of the USEPA regulatory model AERMOD 9.1 has been used to predict the pollutant dispersion through the simulation of criteria pollutants from major emission sources from the factory.

Model Setup

217. The Gaussian Dispersion Modeling (GDM) is used for prediction of dispersion of air emission and the computation of Ground Level Concentration (GLC) up to a specified distance from source. The fundamental model is given below:

$$c(x, y, z) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left(\frac{-y^2}{2\sigma_y^2}\right) \left(\exp\left(\frac{-(z-h)^2}{2\sigma_z^2}\right) + \exp\left(\frac{-(z+h)^2}{2\sigma_z^2}\right) \right)$$

218. Where c is a concentration at a given position, Q is the source term, x is the downwind, y is the crosswind and z is the vertical direction and u is the wind speed at the h height of the release. The σ_y , σ_z deviations describe the crosswind and vertical mixing of the pollutant. The above equation describes a mixing process that results in a Gaussian concentration distribution both in crosswind and in vertical direction, centered at the line downwind from the source. Gravitational settling and chemical or radioactive decays are neglected.

219. The mathematical simulation model used for predictions on air quality dispersion in the airshed of study area in ISC-AERMOD View. It is the next generation air dispersion model, which incorporates planetary boundary layer concepts. The AERMOD is actually a modeling system with three separate components: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD Terrain Preprocessor), and AERMET (AERMOD Meteorological Preprocessor). Moreover, it has the ability to treat the vertical inhomogeneity of the planetary boundary layer special treatment of surface releases, irregularly shaped area sources, a plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base. The AERMAP is a terrain preprocessor designed to simplify and standardize the input of terrain data for the AERMOD.

220. To ensure compliance with the air emission criteria the following model setup has been taken into consideration in this study with integration of monitored baseline data of the project **Table-2**.

Table-2: General layout of the Model

Parameter	Details
Model name	AERMOD 9.5.0
Model type	Steady state Gaussian plume air dispersion model
Averaging time	24 Hour
Source type	Point source
Surface meteorological data	Site specific data processed by AERMET

221. The output of the modeling process includes, for each receptor, location, distance and elevations used for the computation of airflow around hills. However, the following options have been considered to predict the ground level concentrations due to emissions from the proposed activity.

- Defining the area of interest especially 10 km around the stack
- Hourly micrometeorological data has been included
- The modeling has been done only for criteria pollutants (SO₂, NO_x, PM_{2.5} and PM₁₀)
- Land use and all terrain dispersion parameters are considered
- Selection discrete and grid receptors based on the sensitivity
- Determination of the emission rates from the sources
- The predicted GLC concentration of the criteria pollutants have been added with the ambient measured pollutant concentration
- Checking the resultant maximum ambient air quality with respect to standard in the airsheds and determining the project contribution

222. Monitoring period has been considered for January to March 2024. Meteorological file has been prepared by taking the hourly data for one month and consist of wind direction, wind speed, temperature (in K), mixing height, stability class (urban and rural) and cloud cover. AERMET View version 9.5.0 has been used to create the SURFACE file (SFC) and PROFILE file (PFL).

Data Inputs

223. There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using USGS Digital Elevation Data. There are following considerations for this project

- Emission during the operation phase is mainly from the Boiler & DG sets in which DG Set which are operational during the power failure only.
- DG Stacks are proposed to be installed above the terrace level of the building as per DoE, APCR, 2022 norms.
- Reference point has been taken as the center of the project site.
- Only surface air data has been considered for the running the model for upper air, upper air estimator has been used.

A. Background Pollution Concentration

224. An area of 10 km by 10 km centering the stack has been selected for the air quality dispersion modeling. The project area and its nearby area which might be affected by the worst air quality during operation of the plant.

225. The background air quality of the criteria pollutants has been measured during baseline study. Background ambient air quality of the criterion pollutants is comprised from multiple sources. Continuous vehicular movement over the road, locomotive movement, existing industries, construction activities, road dust etc. are responsible for increasing the concentration of air pollutants in the study area. To understand the baseline situation, 10 locations in the airshed have been monitored continuously for 24 hrs. The real-time ambient air quality monitoring sites have been shown in the Table- 3 and its result is tabulated in the Table 3.

Table-3: Ambient Air Quality Monitoring Locations

Sampling Code	Sampling Locations	Geographical Coordinates
AAQ-1	Near BADC sluice gate, Char Chandia, Sonagazi, Feni	22°47'36.148"N & 91°23'34.199"E
AAQ-2	Near 7 no. Sonagazi Union parishad, Sonagazi, Feni	22°51'2.332"N & 91°24'14.888"E
AAQ-3	East side of the road, Bishumiyarhat, Zorarjong, Mirsharai	22°51'35.38"N & 91°30'31.534"E
AAQ-4	Near BEZA Administrative Building, NSEZ	22°45'37.566"N & 91°28'5.761"E
AAQ-5	South Mogadia, Mirsharai	22°42'49.566"N & 91°31'34.458"E
AAQ-6	Beribadh Road, Infront of Unigas Plant, Barabkunda, Sitakunda	22°33'57.532"N & 91°39'12.96"E
AAQ-7	Goll Chatter of Komor Ali Bazar, Mirsharai	22°41'11.543"N & 91°38'8.382"E
AAQ-8	Middle Abu Turab Bazar, Mirsharai, Chattogram	22°44'52.103"N & 91°33'26.088"E
AAQ-9	In front of the Government Technical School & College, Sitakunda	22°37'39.974"N & 91°38'46.504"E
AAQ-10	In front of the Kazi company market, CNG station, Bamansundor, Darogarhat, Mirsharai	22°47'51.09"N & 91°30'47.515"E

Table-4: Ambient Air Quality Data

Sampling Code	Parameters							
	PM _{2.5} µg/m ³	PM ₁₀ µg/m ³	SO ₂ µg/m ³	NO ₂ µg/m ³	CO mg/m ³	Pb µg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³
AAQ-1	46.38	79.51	11.63	21.18	0.08	<0.05	27.04	0
AAQ-2	33.41	55.75	25.45	29.24	0.07	<0.05	31.77	0
AAQ-3	20.15	33.90	24.38	31.06	0.12	<0.05	36.19	0
AAQ-4	35.80	59.48	21.55	27.14	0.11	<0.05	29.01	0
AAQ-5	33.19	54.32	15.40	17.91	0.06	<0.05	25.89	0
AAQ-6	10.84	19.49	26.44	19.47	0.10	<0.05	24.83	0
AAQ-7	17.29	31.67	31.52	15.98	0.14	<0.05	21.59	0
AAQ-8	34.89	58.16	22.21	18.59	0.17	<0.05	23.13	0
AAQ-9	15.97	25.65	39.90	33.06	0.22	<0.05	35.42	0
AAQ-10	40.05	71.22	18.62	15.17	0.11	<0.05	20.02	0

B. Emission Estimation from the Sources

226. In the plant, air pollutant releases mainly form the stacks. Combustion in a furnace, producing flue hot gases and a bottom ash residue for disposal. It will generate flue gas that contains pollutants such as dust, sulfur oxides, nitrogen oxides, acid gases, heavy metal, dioxin, water vapor and carbon dioxide. The pollutants can be removed through a series of air pollution control technologies if it exceeds the compliance standard. However, the rate of emission from the stack has been presented in the Table-5

Table-5: Stack Emission Features

S/L	Name of Investors/Industry	Industry Type	NSEZ Zone	Fuel Type	No. of Stack	Stack Height (m)	Stack Inside Diameter (m)	Gas exit temperature (°C)	Gas exit velocity (m/s)	Emission Concentration (mg/Nm ³)					
										PM _{2.5}	PM ₁₀	SO ₂	NO ₂	CO	SPM
1	Jinyuan Chemical Industry Ltd.	Red	6	Gas	1	12.2	1.29	120	312.2	5.8	9.7	8.2	151	212	16.4
2	Asian Paints Ltd (Boiler- 1)	Red	6	Diesel	1	19.5	0.203	223.1	5.1	6.3	9.2	11.4	67.3	231	15.3
3	Asian Paints Ltd (Boiler- 2)	Red	6	Diesel	1	19.5	0.203	214	5.2	5.1	7.8	8.9	47.1	220	21.1
4	Asian Paints Ltd (DG-1)	Red	6	Diesel	1	15.5	0.36	456.3	4.4	7.3	10.1	12.5	65.7	234	17.8
5	Asian Paints Ltd (DG-12)	Red	6	Diesel	1	15.5	0.203	441.9	4.9	8.4	11.3	11.9	59.3	241	19.3
6	BR Powergen Limited, Mirsharai	Red	2B	HFO/Gas	9	50	1.62	280	NA	NA	NA	8.6	13.8	NA	178

227. The rate of emission of the pollutants have been calculated based on the technical specification for using it for dispersion modeling study in AERMOD. However, all the estimation has been made to determine the maximum emission for addressing the worst-case situation. However, the emission of CO, SO₂, NO_x and PM₁₀, PM_{2.5} is considered with updated modern technology has been assumed in the plant during the modeling study.

Result and Discussion

Meteorological Condition

228. The Windrose was plotted with the aid of software WRPLOT which is shown in **Fig 1** and following results have been obtained.

- Predominant wind direction is NW and N.
- Second & third predominant wind direction are NWW and NE respectively.
- Calm conditions were recorded as 8.5 %

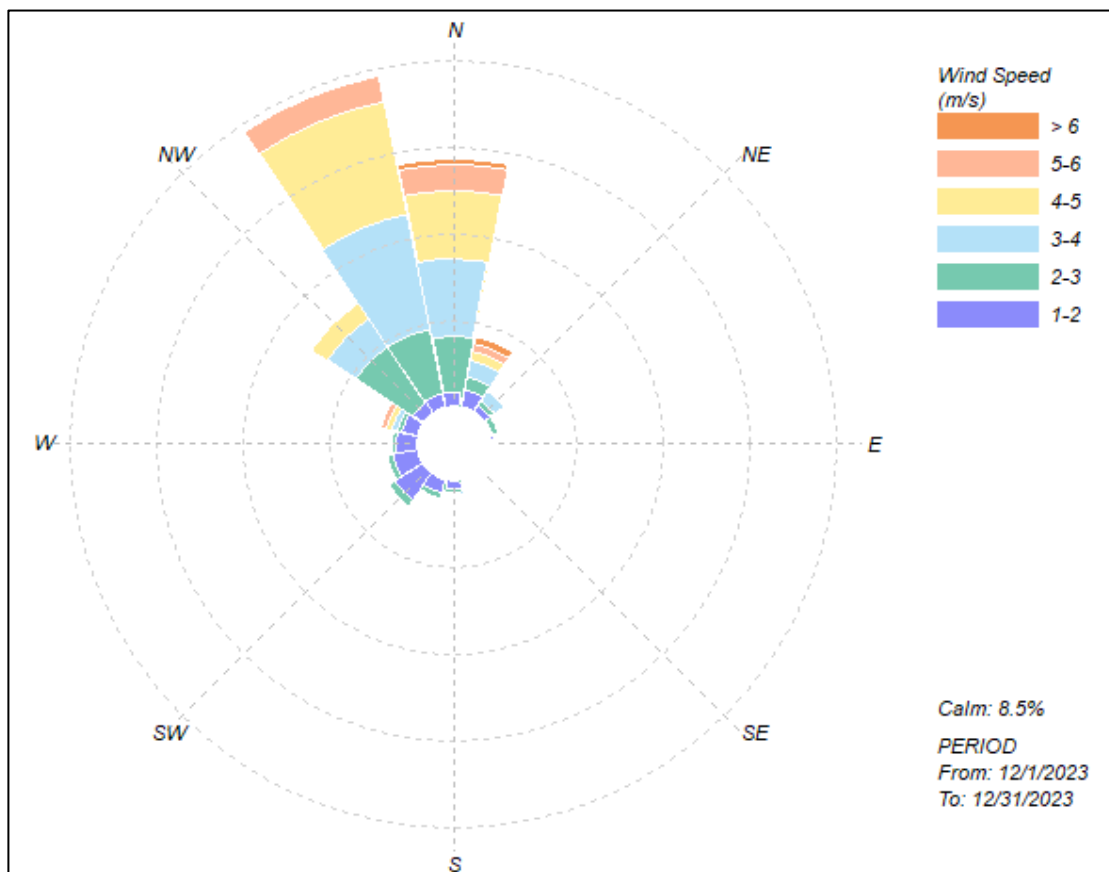


Figure. 1: Wind-rose of the study area

Predicted GLC

229. The modeling has been run for predicting the maximum ground level concentration of ambient air pollution like SO₂, NO_x, PM₁₀ and PM_{2.5} during operation phase of the incineration project. The maximum ground level concentration of the criteria pollutants has been estimated for different averaging time period in order to comply the national (ECR, 2005) and international standard (WHO, 2021).

230. The average air quality monitoring data has been assumed to be similar in different time scale. The sampling data are also considered as the background data for different hours. Therefore, the baseline air quality data has been used both long term and short-term perspective to prepare the resultant pollution level in future. Therefore, this baseline concentration of pollutants is added with the predicted pollutants concentration for assessing the resulting or collective concentration of the pollutants during operation. Table-6 shows the maximum level of ground concentration in the airshed with respect to changing averaging time period. Point sources at location of proposed Boiler and DG stack were fixed. Receptors were fixed at baseline monitoring stations as well as in uniform polar grid up to 30 km radius Centre of project site.

231. The model was run assuming for 24-hour activities. The predicted maximum incremental GLC (24-hour average) of PM₁₀, PM_{2.5}, NO_x and SO₂ was found as 15.40 µg/m³, 10.12 µg/m³, 6.16 µg/m³, and 2.98

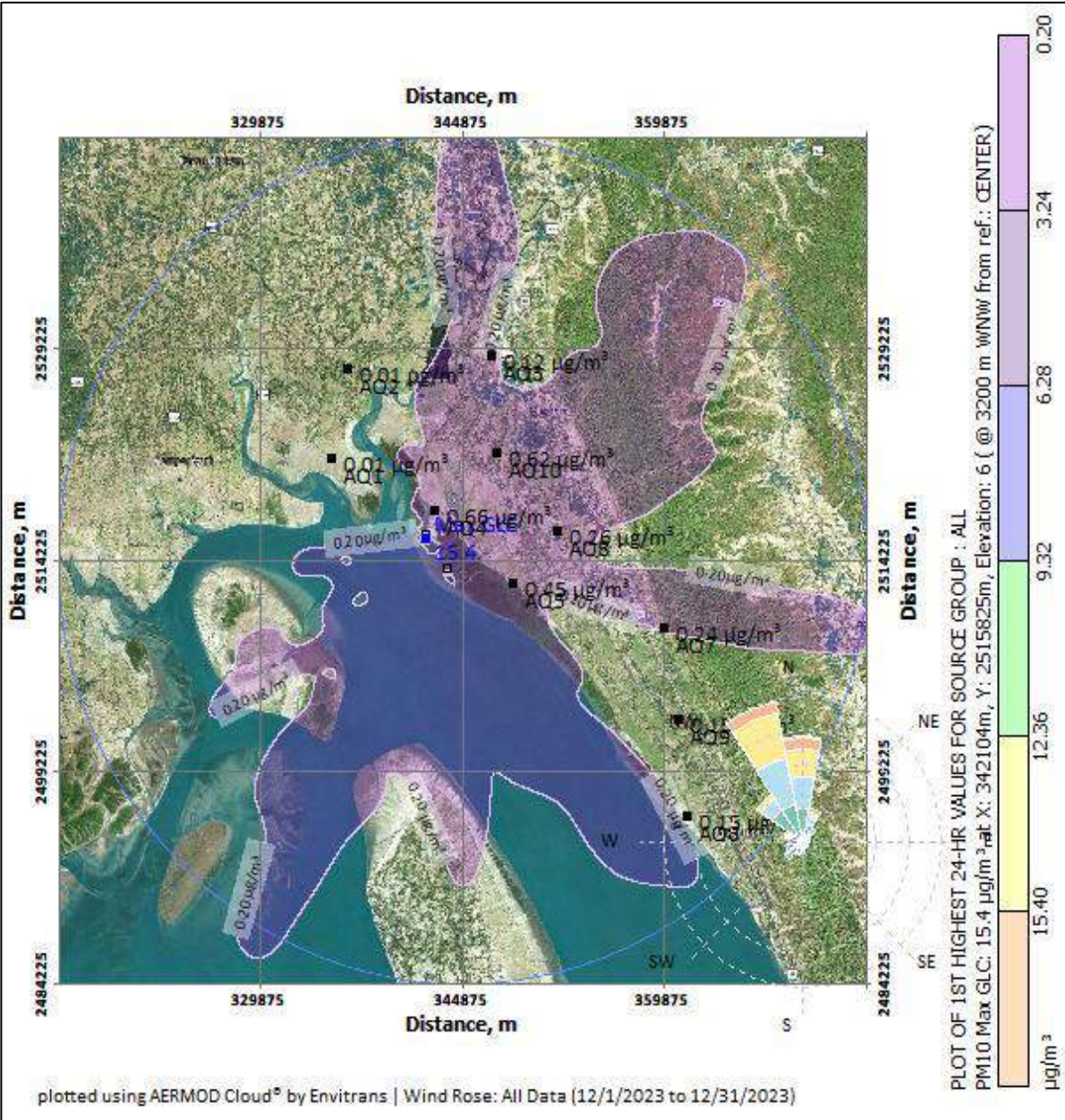
µg/m³ respectively. The predicted maximum incremental GLC (24-hour average) and predicted cumulative GLC at baseline air quality monitoring locations are presented in **Table-6**.

Table-6: Maximum GLC of the Pollutants

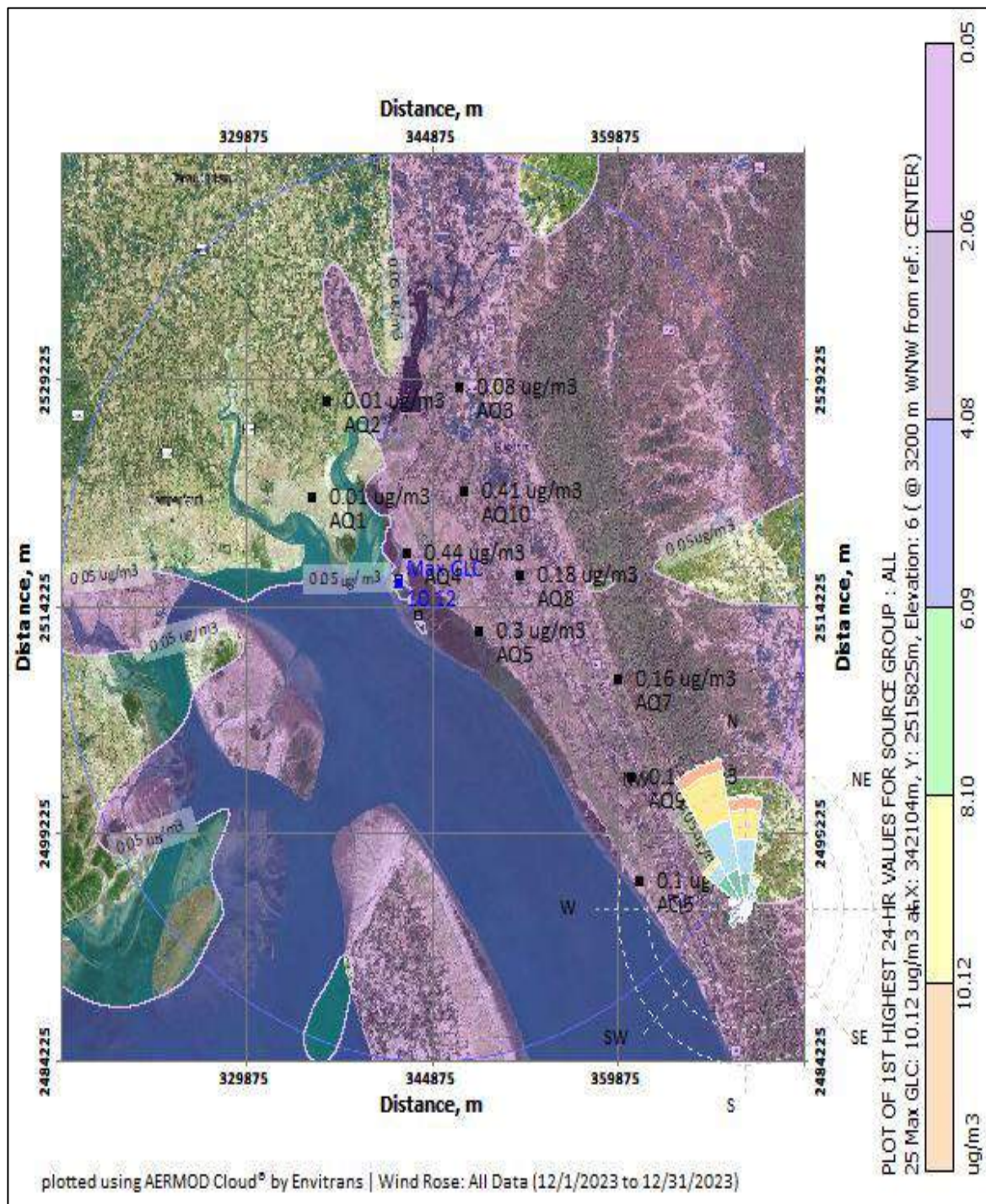
Location Code	Baseline Conc. (µg/m ³)				Predicted GLC (µg/m ³)				Total GLC (µg/m ³) (Existing + Proposed Scenario)			
	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	SO ₂	NO ₂
AQ1	79.5	46.4	11.6	21.2	0.02	0.01	0	0	79.52	46.41	11.6	21.2
AQ2	55.8	33.4	25.5	29.2	0.01	0.01	0	0	55.81	33.41	25.5	29.2
AQ3	33.9	20.2	24.4	31.1	0.12	0.08	0.03	0.05	34.02	20.28	24.43	31.15
AQ4	59.5	35.8	21.6	27.1	0.66	0.44	0.08	0.27	60.16	36.24	21.68	27.37
AQ5	54.3	33.2	15.4	17.9	0.45	0.3	0.06	0.18	54.75	33.5	15.46	18.08
AQ6	19.5	10.8	26.4	19.5	0.15	0.1	0.02	0.06	19.65	10.9	26.42	19.56
AQ7	31.7	17.3	31.5	16	0.24	0.16	0.05	0.1	31.94	17.46	31.55	16.1
AQ8	58.2	34.9	22.2	18.6	0.26	0.18	0.05	0.11	58.46	35.08	22.25	18.71
AQ9	25.7	16	39.9	33.1	0.15	0.1	0.03	0.06	25.85	16.1	39.93	33.16
AQ10	71.2	40.1	18.6	15.2	0.62	0.41	0.03	0.25	71.82	40.51	18.63	15.45

Note: The spatial distribution of PM₁₀ and PM_{2.5}

232. The incinerator will contribute negligible amount of particulate matter both PM₁₀ and PM_{2.5} for both the average duration of short term (24hr) and long-term period. But the baseline concentration of particulate matter still high which collectively raise the resultant concentration of particulate matter. Some time, the maximum ground level concentration exceeds the compliance limit both for national and international standard. Actually, the background concentration is responsible for breaching the compliance standard limit of PM₁₀ and PM_{2.5}. From the above table, it can be concluded that the predicted GLC of the criteria pollutants are significantly lower than the existing ambient situation. Figure 2 and 3 shows the resultant maximum ground level concentration of PM₁₀ and PM_{2.5} at the ambient air quality monitoring locations where the remaining status has been presented in the



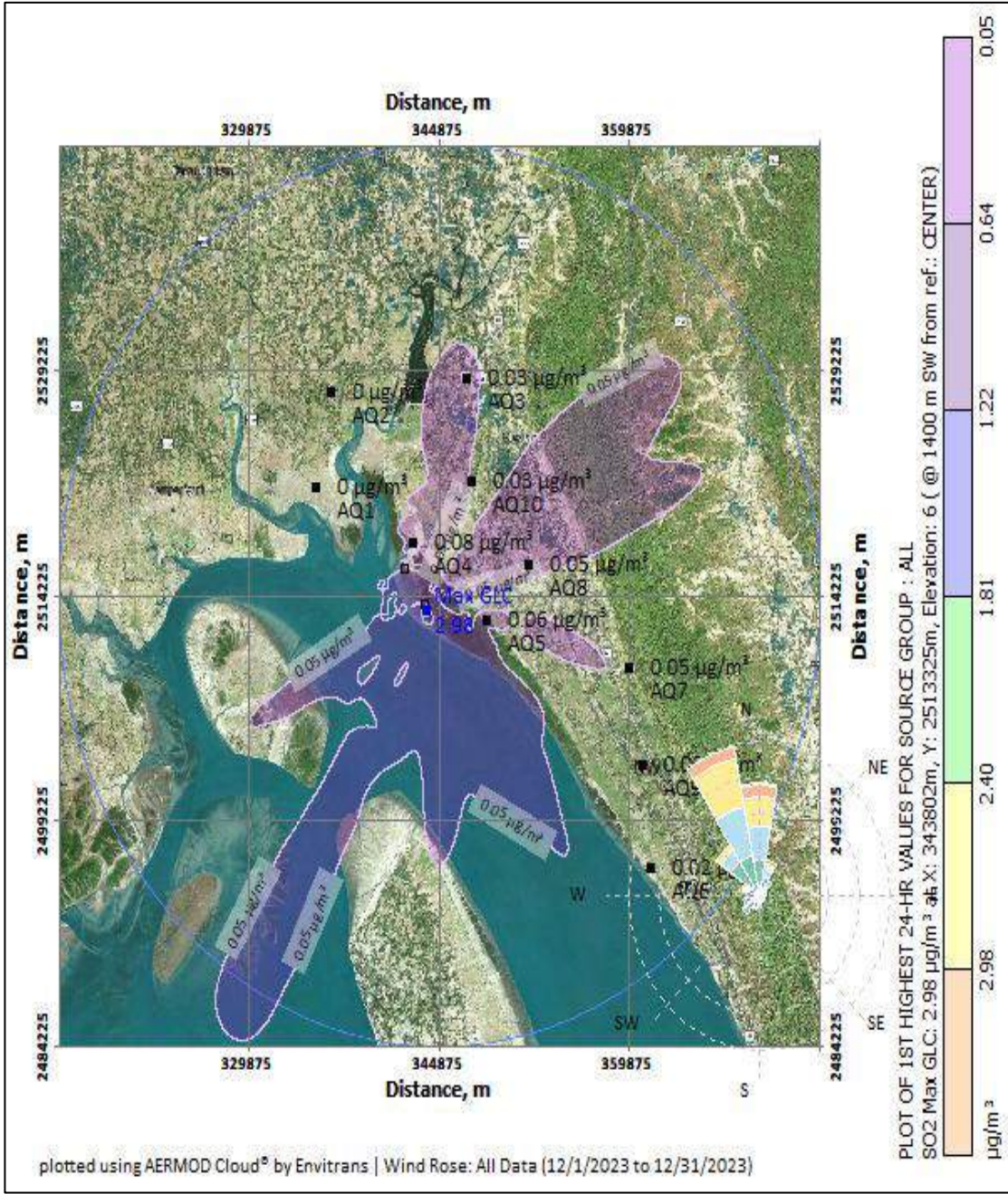
Map 1: Isopleths of 24-hourly Average Maximum PM10 Ground Level Concentrations



Map 2: Spatial Distribution one-month maximum incremental GLC of the PM_{2.5}

Note: The spatial distribution of SO₂

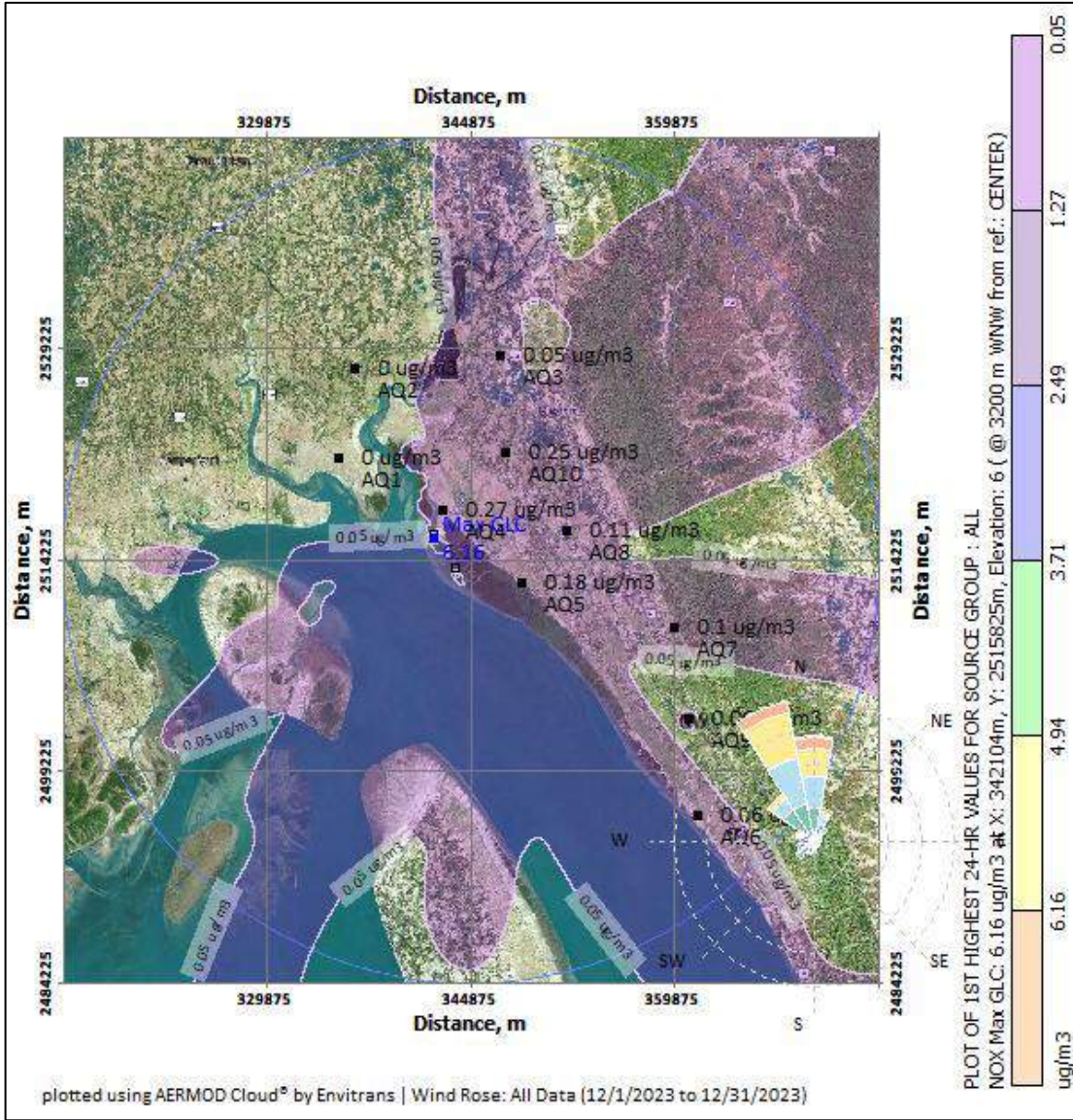
233. The airshed is insignificantly pollute with SO₂ in terms of DOE standard but noticeable in terms of WHO compliance standard for 24hr. Therefore, this project will elevate SO₂ concertation moderately for short term period especially international perspective but insignificant for long term basis. However, the incremental effects of SO₂ would not be any problem in the study area as it will be well below from the standard values of ECR, 2005 and WHO 2021. Figure 4 shows the resultant maximum ground level concentration of SO₂ at the ambient air quality monitoring locations.



Map 3: Isopleths of 24-hourly Average Maximum SO₂ Ground Level Concentrations

Note: The spatial distribution of NO₂

234. The background concentration of NOx is moderate with respect to compliance standard. Considering the maximum emission rate of the NOx during operation, the maximum ground level concentration would be significant for short term period. However, in all cases the maximum level of NO2 and NOx will be within the standard limit both for long term and short-term period. Figure 5 shows the resultant maximum ground level concentration of NOx at the ambient air quality monitoring locations.



Map 4: Isopleths of 24-hourly Average Maximum NO2 Ground Level Concentrations

Inference & observation

235. The main impacted area due to air pollution is under 2 km towards the NW side. Parabolic curves have been observed under 2 km which are reducing gradually leading to the reduction in impacts. Comparing the baseline data with incremental data; it has been observed that the increased Air Quality Index due to the incremental ground level concentration does not have impact on the prescribed color zone of the respective pollutants.

236. The incremental value of PM₁₀ for the ambient air has been found to be 'Moderate' category during the baseline studies as well as after the incremental ground level concentration. Therefore, there is no significant impact on existing air quality owing to the project. It is however to be noted that the air pollution quality in the study area is already Moderate category.

Proposed Air Pollution Control Measure

Mitigation Measures during Operation Phase:

- Stack height shall be maintained as per the guidelines suggested by APCR 2022.
- The emission standard from the stacks should follow EU or USA standard¹⁰ where the national standard yet to be formulated

¹⁰ IFC, ‘Environmental, Health, and Safety Guidelines for Waste Management Facilities’.

- Suppression of dust by sprinkling of water twice or thrice a day depending upon weather conditions.
- Two tier green belt shall be made along the boundary wall to reduce the impact of air pollution from air coming from outside boundary and inside air shall be restricted inside only.
- Landscaping shall be done properly so that no dust emission shall be there. All the pavers shall be surrounded with grass.
- Wheel washing bay shall be provided during construction phase. Extended area RCC shall be provided to prevent mud sticking to tyres.
- Barricading of boundary wall shall be done 1/3rd of building height. As the building height increases, the height of wall shall also be increased up to max of 10m.
- All the DG sets on site shall be centralized and shall be closed acoustic type.
- Stack height of DG sets shall be maintained above the roof top of highest building.
- All the construction material shall be covered with the tarpaulin sheets to avoid fugitive emissions.
- All the trucks/dumpers shall be covered while entering and going out from the site.
- All the buildings shall be covered with suitable envelope to prevent dust emission due to cutting of bricks and tiles during plumbing and other works.
- NOx emission control technology should be adopted like low NOx burner or SCR/SNCR to reduce the NOx emission rate to the ambient environment
- The vehicles used in transportation will comply norms as per the motor vehicle act.
- They should take policy level intervention to reduce the particulate matter over the air shed with the assistance of other authorities and stakeholders.
- Water spraying will be practiced frequently and regular maintenance of valves, pipes etc.
- Providing protective gear, such as shoes, face masks, and gloves to the employees during the working hours
- Restrict access to disposal sites such that only safety trained personnel with protective gear are permitted to high-risk areas;
- Regular periodic monitoring of work area to check the emission level.
- Three tier green belt development surrounding the periphery of the project site

237. Today, more comprehensive abatement techniques have become common as many countries must now apply with to maintain the ambient air pollution in the study areas.

Annex- 9: Noise Level Modelling

Introduction

238. Economic Zone to complete a noise modeling assessment to predict the Sound Pressure Levels (SPLs) expected during the operational phase of the project and to estimate the noise contribution from the facility to the current baseline conditions. The SPLs that would be generated during facility operation were predicted using the DhvaniPro software tool, which is an industry standard. The baseline noise conditions (background noise) were determined in the project area based on the results of ten (10) monitoring campaigns that were conducted in 2022. The SPLs that are predicted to be generated by the proposed complex and the cumulative noise levels with the background SPLs were discussed and compared with the Maximum Permissible Limits for Noise Intensity defined by Bangladesh regulation (ECR, 2023) and the IFC Guidelines. This assessment focused on evaluating the compliance of the noise contributions from the project in the sensitive receptors and industrial areas with national and international ambient noise standards. Based on the Noise Model results; the proposed Economic Zone is complying with the national & International limits presented in the report with applying the required mitigation.

239. However, the cumulative effect of surface excavation activities generates enormous noise in the project area and its surrounding areas. Prolonged exposure to high noise levels over a period of years invariably causes permanent damage to the auditory nerve and/or its sensory components (Banerjee and Chakraborty, 2006). The irreversible damage, commonly referred as noise-induced hearing loss (NIHL), is the commonest occupational diseases among-st the construction workers especially at such sites which have multiple noise sources. Besides this the fauna of surrounding area is also affected by noise as the wildlife is more sensitive to noise than the human beings (Mathur, 2005).

A. Noise due to crushing, Screening and Loading Plan: The average noise levels generated due to proposed crushing activities will be about 88.5 dB(A) which is within the exposure limit of 90 dB(A). The crusher shall be housed in a shed to contain noise. Screening activities shall generate average noise level of about 96.5 dB (A). Workers in the noise generating zone will be provided with earmuffs/earplugs besides dust mask.

B. Noise due to excavation and transportation: In order to predict ambient noise levels due to the construction activities from various sources at different location within the barrage complex the noise dispersion modeling has been done on the assumption that all noise sources are acting as a single source generating approximately 91 dB(A). Noise generated due to deployment of rock breaker, excavators, loaders and dump trucks are shown in **Table 1**.

Table 1. Standard Values of Noise Level

S. N	Machinery/ Activity	Noise Produced in dB(A) at 50 ft from source*
1	Excavator/Shovel	85
2	Front end loader	85
3	Dump Truck/ Tippers (at full throttle)	92
4	Near Haul Road (while dumpers are moving)	88
5	Dozer (when dozing)	102
6	Drill machine (drilling with Jack hammer)	88
7	Aggregate processing unit / Stone Crusher (outside crusher cabin)	100
8	Aggregate processing unit / Stone Crusher (inside crusher cabin)	86

Source: U.S. Department of Transportation (Federal Highway Administration) – Construction Noise Handbook

240. Environmental noise particularly industry/commercial/traffic noise is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of machinery/work/vehicles. The impacts of noise due to the proposed project will be of temporary significance locally in the construction phase and slight increase may occur during the operation stages. **Table 2** presents the source of noise pollution and the impact categorization.

Table 2: Source of the Noise pollution and its impact

S. N	Phase	Source of Noise pollution	Impact categorization
1	Pre-Construction	Man, material & machinery movements Establishment of labor camps, onsite offices, stock yards and construction plants	All activities will last for a short duration and also shall be localized in nature
2	Construction Phase	Plant Site: Stone crushing, asphalt production plant and batching plants, diesel generators etc. Work zones: Community residing near to the work zones	Plant Site: Impact will be significant within 500m. Work zones: Such impacts again will be of temporary nature as the construction site will go on changing with the progress of the works.
3	Operation Phase	Due to increase in traffic (due to improved facility)	Will be compensated with the uninterrupted movement of heavy and light vehicles.

Objective and Scope of Work

241. NSEZ Economic Zone to complete a noise modeling assessment to predict the Sound Pressure Levels (SPLs) expected during the construction phase of the project and to estimate the noise contribution from the facility to the current baseline conditions.

- The SPLs that would be generated during construction were predicted using the DhvaniPro software tool, which is an industry standard. This software incorporates the modelling of point, line and area noise sources with screening effects of barriers and buildings and ground absorption effects to construct an acoustic model. The results are presented in the form of an acoustic map with contour lines of equal noise levels (isophones) at 5 decibel dB (A) intervals.
- The baseline noise conditions (background noise) were determined in the project area based on the results of ten (n=10) monitoring campaigns that were conducted in two seasons in year of 2023-2024.
- The SPLs that are predicted to be generated by the proposed area and the cumulative noise levels with the background SPLs were discussed and compared with the Maximum Permissible Limits for Noise Intensity defined by Bangladesh regulation (ECR 1997) and the IFC Guidelines.
- This assessment focused on evaluating the compliance of the noise contributions from the project in the sensitive receptors and commercial and residential areas with national and international standards.
- This Noise Model report is intended to be used as input to the Environmental and Social Impact Assessment (ESIA) of the project. This noise model is considered a screening approach to evaluate potential environmental noise impacts from the proposed economic zone.
- This model was run based on data, which is a common practice at such early stage of the project. In a later stage after construction and before operation, it is highly recommended to rerun the model should there are any deviations in the current model inputs.

REGULATIONS

242. The following applicable national and international standards have been considered to evaluate the compliance of the project with ambient noise standards. This section presents both the Bangladesh limits and IFC Guidelines for ambient noise. As for the European Union relevant guidelines, Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise, establishes that the concrete figures of any limit values are to be determined by the Member States. Consequently, there are no reference values on ambient noise set by European legislation to be presented in this section.

Bangladesh Legislation

243. The Department of Environment (DoE) has the power to set criteria and conditions, monitor compliance and take action against violators of these criteria and conditions. Maximum noise levels generated by an industrial facility are authorized to mark off the areas under their jurisdiction as silent, residential, mixed, and commercial or industrial zones according to the Noise Pollution (Control) Rules, 2006. The allowable noise

limits, listed in **Table 3**, are determined by zone types and vary with the time of day. They should also put signs to mark those areas. The act also describes the approved standard limit of sound in the added schedule 1 and 2.

Table 3: Noise Standard as per Classification given by Noise Pollution Rule, 2006

Type of area	Acceptable limit of noise level (dB)	
	Day time	Night time
Silent	45	40
Residential	50	45
Mixed	60	50
Commercial	70	60
Industrial	75	70

244. In the schedule 1, silent area means area up-to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/ to be identified by the government. In the silent area it is prohibited to use any kind of horns of vehicles, audio signals and loudspeakers. According to this act, daytime is counted from 6am to 9pm whereas night-time is counted from 9pm to 6am.

International Finance Corporation (IFC) Ambient Noise Guidelines

245. The International Finance Corporation (IFC) has established guidelines for maximum permissible noise levels generated by a facility. The IFC Environmental, Health, and Safety (EHS) Guidelines for Noise Management (April 2007) refer to guidelines for industrial sectors. Noise impacts should not exceed the levels listed in **Table 4**.

Table 4 IFC Maximum Allowable Noise Levels dB(A)

Guideline	Zone	Day, dB	Night, dB
IFC Environmental, Health, and Safety (EHS) Guidelines for Noise Management	Residential, institutional, educational	55	45
	Industrial, commercial	70	70

246. Prior to construction activities, subproject contractors have been conducting noise level measurements as baseline. During construction, contractors will be required to conduct noise level measurements and ensure that the subproject does not cause deterioration of noise level beyond the standards. This is included in the environmental management plan hereof. The principal sources of noise are recognized in the study area which details are given in the **Table 5**.

Table 5: Principal sources of noise in the Study Area

Source	Particulars
General community noise:	Noise from the market area, advertising via rickshaw mounted loud speakers, prayer calls, church bells, etc.
Road traffic:	Noise from the main roads and some secondary roads released from engines and originated from the frequent use of signal-horn
Commercial operations	Noise from minor industries and handicraft business.
Pumps:	Most pumps are housed but often operate during night time, what may result in increased noise levels during the night time.
Noise arising from natural sources:	Insects (in particular various types of crickets) and birds (as observed near forest area), wind and heavy rain may contribute to elevated noise levels.

247. Noise levels are measured in Decibel (dB). The Decibel scale is presented in **Table 6**.

Table 6: Noise characterization

0	Threshold of hearing
20	Background noise in quite countryside or silent study room
40	Noise level in a living room
60	Conversational speech
80	Busy road traffic or freight train
100	Pneumatic hammer, construction site
110	Rock music concert
120	Threshold of discomfort
140	Threshold of pain
Source: compiled from www.osha.gov/SLTC/noisehearingconservation/loud.html , retrieved May 30, 2022 and other sources	

248. Noise levels standards are set by the Environment Conservation Rules 1997 for different types of land use;

249. **Silent Area:** The category “silent area” relates to 100 m zones around hospitals and other sensitive land uses as established by the government. In the absence of any regional planning documents describing the spatial distribution of commercial, residential, and other land uses based on the field observation.

- **Residential Area:** “Residential” zones are assigned to the sampling points located in rural, urban household areas with no business activities.
- **Commercial Area:** The area represents the business complex area.
- **Industrial Area:** The area represents the industrial complex including manufacturing, processing packaging units establish in area like economic zones etc.
- **Mixed area:** the area represents combined residential, commercial as well as industrial area.

250. Both, GoB and IFC guidelines (see provide noise limits for day and night time. While night time in Bangladesh is defined as the time interval between 9 PM and 6 AM, ICF considers night time from 10 PM to 7 AM.

251. In the absence of national standards describing the noise measurement methodology, the IFC guidelines were used as a minimum: “Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.” According to IFC Guidelines noise impacts shall not exceed the levels below or not increase the (background) noise levels more than 3 dB at the nearest receptors.

BASELINE NOISE CONDITIONS

252. The background noise levels measured in the project area were used to determine the baseline noise conditions. These noise levels were used in combination with the predicted noise levels to be contributed from the proposed project based on the model to determine the expected cumulative noise levels. For the purpose of this assessment, two sources of data were available:

- Results of two monitoring campaigns: A monitoring survey was conducted in two seasons in the year of 2023-2024 at ten locations (n=10) along the project boundary Map1 and
- An additional measurement was calculated based the proposed activities during construction and taken as a reference value for noise prediction.



Map 1- Location of Noise Monitoring Measurements

253. Measurements were continuously recorded at all ten locations during a 24-hour period that covered two intervals, 'Day' and 'Night', as per ECR 2023. Measurement locations were chosen to be as relevant as possible to the project design and the locations of predicted noise sources. The 24-hour ambient noise measurements were conducted using a Type I (precision grade) sound level meter, and 1/3 octave band logging was employed. The parameters measured at each location included, equivalent continuous sound pressure level (Leq) Table 7.

Table 7 Measured background data from the receptor of the project area

Sampling Code	Category of Area/Receptor	Parameters					National Standards		IFC Standards	
		Leq _{day}	Leq _{night}	Day-Night	L _{max}	L _{min}	Day	Night	Day	Night
ANL-1	Industrial	48.0	44.0	51.2	66.4	31.6	75	70	70	70
ANL-2	Mixed	62.2	53.5	62.7	83.4	40.4	60	50	55	45
ANL-3	Silent	60.6	48.4	59.9	88.1	34.0	50	40	55	45
ANL-4	Commercial	69.6	58.4	69.2	92.1	43.2	70	60	70	70
ANL-5	Commercial	60.2	39.4	58.4	84.7	30.8	70	60	70	70
ANL-6	Commercial	65.0	51.6	64.1	86.7	40.0	70	60	70	70
ANL-7	Commercial	61.0	51.9	61.3	85.7	30.8	70	60	70	70
ANL-8	Commercial	61.1	57.9	64.9	85.3	32.1	70	60	70	70
ANL-9	Industrial	60.7	46.4	59.5	88.6	31.6	75	70	70	70
ANL-10	Commercial	56.5	47.0	56.7	76.1	31.6	70	60	70	70

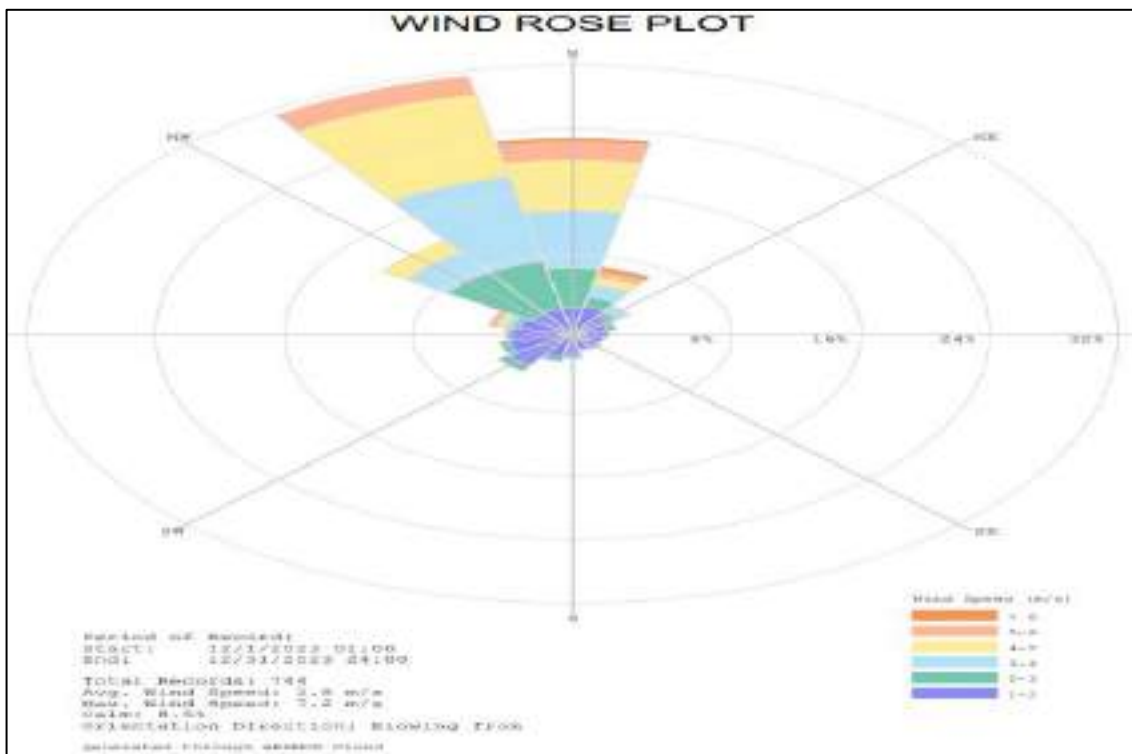


Figure 1: Wind Rose Plot of Economic Zone Area

254. As sound waves travel through the air a small portion of the energy is converted into heat depending upon the atmospheric temperature and humidity, however the amount is only significant with high frequencies and long distances. There are no affecting weather conditions, such as wind or temperature inversion, as these will affect the propagation path of a noise source and diffraction around the barrier. Wind Rose Plot of the study area for last ten-year, wind is blowing from South direction in most of time with 1 to 2 m/s speed **Figure 1**.

METHODOLOGY

Modelling Software

255. The DhvaniPro software was used to predict noise levels that will result from the proposed facility. DhvaniPro is a modeling and presentation tool that helps optimizing the noise control measures and visualizing the effects of noise propagation throughout complex systems, such as the proposed facilities. DhvaniPro is industry-standard noise prediction software used to calculate sound pressure levels and generate noise maps. The maps are a graphical representation of the calculated sound pressure levels, considering reflections and diffractions of sound, and taking into account the geometry of buildings at the site and topography. The pressure level calculated or interpolated for each point within the modelling domain are shown as a grid of sound pressure, from which a contour map is generated showing isophones (lines of equal sound pressure). DhvaniPro generates industrial noise maps using the calculation methods given by standards ISO 8913 for noise emissions and ISO 9613 for noise propagation.

Modelling Approach

256. The program includes a database module that prompts for all input data required for the calculations made by the noise model, including geometrical data of all objects relevant to the investigation. All data entered into the database can be further edited by adding attributes, such as x, y, z coordinates, noise emission levels, noise absorption and reflective properties. The calculation area is also defined. The noise sources can be of four different types: point sources, line sources, area sources and industrial buildings. The two latter sources can be defined by their total acoustic power or by the acoustic power density of the source. Every source is described in terms of its acoustic power, which allows the noise propagation calculation to be based on any of the standards that are included in the software. The calculation module generates a grid of receptors over the calculation area defined in the database. The main calculation module provides the necessary data to calculate or interpolate the noise pressure in the middle of each grid cell from the receptors around it. Grid spacing is chosen to accommodate the model resolution requirements. Additional corrections, such as reflection and absorption coefficients of walls and ground material, can be made. Impulse and tonal sources can be defined; and the

sources can be associated with a radiation pattern. The library module of the software program is used to provide industrial standard noise for each source in the absence of vendor data. The library defines each noise source in terms of central frequency or in terms of frequency spectrum. If spectral data are unknown and the project has an industrial nature, as in this case, the noise pressure in each cell can be calculated using a default central frequency of 500 Hz (typical industrial standard) or a different value, if the choice is supported.

Cumulative Effects

257. Accumulated levels of sound pressure are calculated combining the sound contribution generated during the operation phase and the conditions of existing background noise. The decibels have a logarithmic value. In order to calculate the contribution of several sound sources, it is necessary to use the following formula:

$$L_{pt} = 10 \log \left(\sum_{i=1}^n 10^{L_{pi}/10} \right)$$

Where,

L_{pt} = Total sound pressure

L_{pi} = Partial sound pressure

n = Number of sources of sound

258. An example that illustrates the cumulative effect of adding one sound source B to another sound source A. Based on the calculation above, the effective contribution of a second sound source is dependent on its value relative to the original sound source **Map 2**.



Map 2: Accumulated levels of sound pressure at receptors

Modeling output

Noise Predictions with Project during Day Time

259. In this section, noise model was simulating with noise levels during day time (with project) and shown in **Figure 3**. The sources include noise from receptor area and estimated point sources from industrial machineries, commercial buildings and construction activities. Although the baseline day & night time noise levels monitored at ten locations along the proposed project, in two cases noise level at R_002 and R_004 exceeds 75dB (daytime standard of noise for industrial zone) in day time. The highest Leq noise levels were recorded at R_004 which is 69.6 dB(A) during daytime. The Mathematical equation is used for noise prediction is $L_2 = L_1 - 20 \log D_2/D_1$. Highest predicted value for receptor was observed at R_002 and R_0005 where point source contributes about 12.8 and 13.2 dB(A) respectively without any barrier. The more details of prediction results L_{Aeq} with project in Day Time is given below;

DETAILS OF POINT SOURCES

Title: Sound Propagation Model Run

Subtitle: BEZA

Unit: dB(A)

Source ID	X-Coordinate	Y-Coordinate	Height	SPL
Name	m	m	m	dB(A)
P_001	345156	2514956	0	80
P_002	344346	2516282	0	80

TOTAL POINT SOURCE: 2

Project File: C:\Users\user\Documents\dhwaniprodata\test-beza.dwp

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SUMMARY REPORT FOR DISCRETE RECEPTOR POINTS

Title: Sound Propagation Model Run

Subtitle: BEZA

Unit: dB(A)

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level	Baseline	Resultant^
Name	m	m	dB(A)	dB(A)	dB(A)
R_001	343616	2516542	9	48	57.0
R_002	346473	2514670	12.8	62.2	75.0
R_003	346117	2516966	9.9	60.6	70.5
R_004	347772	2515043	7.4	69.6	77.0
R_005	345431	2513855	13.2	60.2	73.4
R_006	343972	2513613	7.1	65	72.1
R_007	341951	2516334	3	61	63.0
R_008	342433	2517711	3	61.1	64.1
R_009	344320	2518280	6.3	60.7	67.0

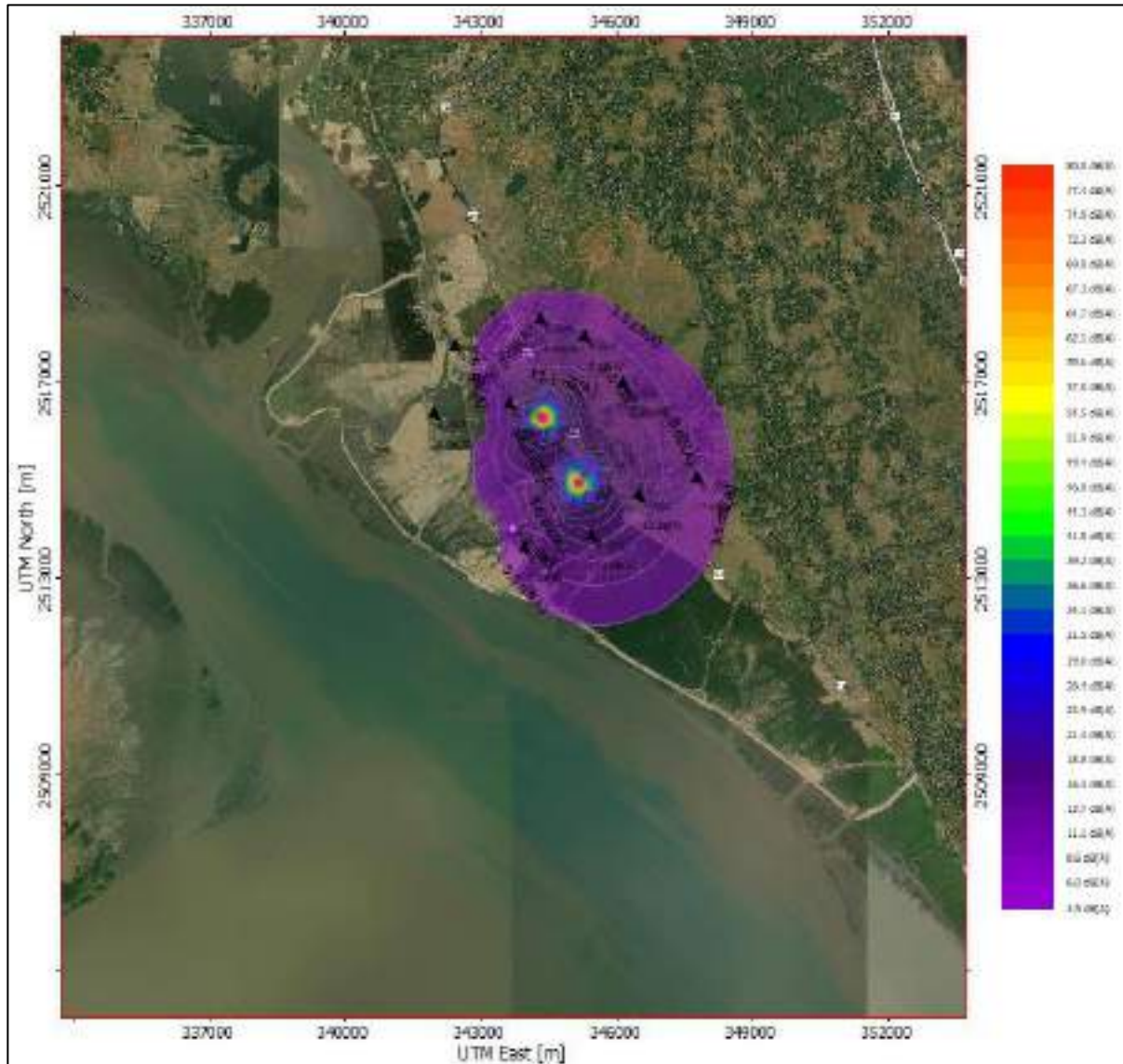
R_010 345284 2517923 8.1 56.5 64.6

Remarks:

1. Summaries of highest values by receptor
2. ^Predicted plus background level

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Map 3: Contour map showing noise levels during day time

Noise Predictions with Project during Night Time

260. In this section, noise model was simulating with noise levels during night time (with project) and shown in **Map 4**. The map shows, new economic zone will create an about 500m radius with 48 dB noise zone around the surrounding areas. The noise level in the receptor points were not exceeds 50 dB(A) in most cases around the newly established areas in the night. However, the predicted value shows that the point source (construction phase) may deviate the noise level from 3.0 to 13.2 dB(A) in the baseline data that exceeds the exceeds 50 dB(A) in most cases around the newly established areas in the night. The highest predicted value for receptor was

observed at R_002 and R_0005 where point source contributes about 12.8 to 13.2 respectively without any barrier. The more details of prediction results L_{Aeq} with project in Day Time is given below;

SUMMARY REPORT FOR DISCRETE RECEPTOR POINTS

Title: Sound Propagation Model Run

Subtitle: BEZA

Unit: dB(A)

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level	Baseline	Resultant^
Name	m	m	dB(A)	dB(A)	dB(A)
R_001	343616	2516542	9	44	53.0
R_002	346473	2514670	12.8	53.5	66.3
R_003	346117	2516966	9.9	48.4	58.3
R_004	347772	2515043	7.4	58.4	65.8
R_005	345431	2513855	13.2	39.4	52.6
R_006	343972	2513613	7.1	51.6	58.7
R_007	341951	2516334	3	51.9	54.9
R_008	342433	2517711	3	57.9	61.9
R_009	344320	2518280	6.3	46.4	52.7
R_010	345284	2517923	8.1	47	55.1

Remarks:

1. Summaries of highest values by receptor
2. ^Predicted plus background level

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1.5.3. Measuring Control through Barrier

261. For controlling measure, we have calculated the Day and Night average value based on the adjusted



Map 4: Contour map showing noise levels during night time

262. weighted Factor and found noise level for R_001 to R_010. These data were simulated in the program (Figure 1.6) and found predicted level 3.0 to 13.2 dB(A) for R_001 to R_010 which details given below;

SUMMARY REPORT FOR DISCRETE RECEPTOR POINTS

Title: Sound Propagation Model Run

Subtitle: BEZA

Unit: dB(A)

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level	Baseline	Resultant [^]
Name	m	m	dB(A)	dB(A)	dB(A)
R_001	343616	2516542	9	51.2	60.2
R_002	346473	2514670	12.8	62.7	75.5
R_003	346117	2516966	9.9	59.9	69.8
R_004	347772	2515043	7.4	69.2	76.6
R_005	345431	2513855	13.2	58.4	71.6
R_006	343972	2513613	7.1	64.1	74.2
R_007	341951	2516334	3	61.3	64.3
R_008	342433	2517711	3	64.9	67.9
R_009	344320	2518280	6.3	59.5	65.8
R_010	345284	2517923	8.1	56.7	64.8

Remarks:

1. Summaries of highest values by receptor
2. [^]Predicted plus background level

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263. For the controlling noise level from the point source, this can be controlled by using general linear wall type sound barrier of 3 to 6m height or by proposed tree and shrub plantations. For this, model has been simulating with 3 to 6m barrier which indicate the significant reduction of noise from sources **Map 5**. The predicted value show that R_002 reduce drastically with barrier whereas R_001 is now 3.0 dB(A) from 9.0 dB(A), R_002 is now 5.7 dB(A) from 12.8, and remaining now 3.0 dB(A) at all locations. The more details of prediction results L_{Aeq} with project with barrier is given below;

DETAILS OF BARRIERS

Title: Sound Propagation Model Run

Subtitle: BEZA

Unit: dB(A)

Source ID	X1-Coordinate	Y1-Coordinate	X2-Coordinate	Y2-Coordinate	Height
Name	m	m	m	m	m

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annexure-9: Noise Level Modelling

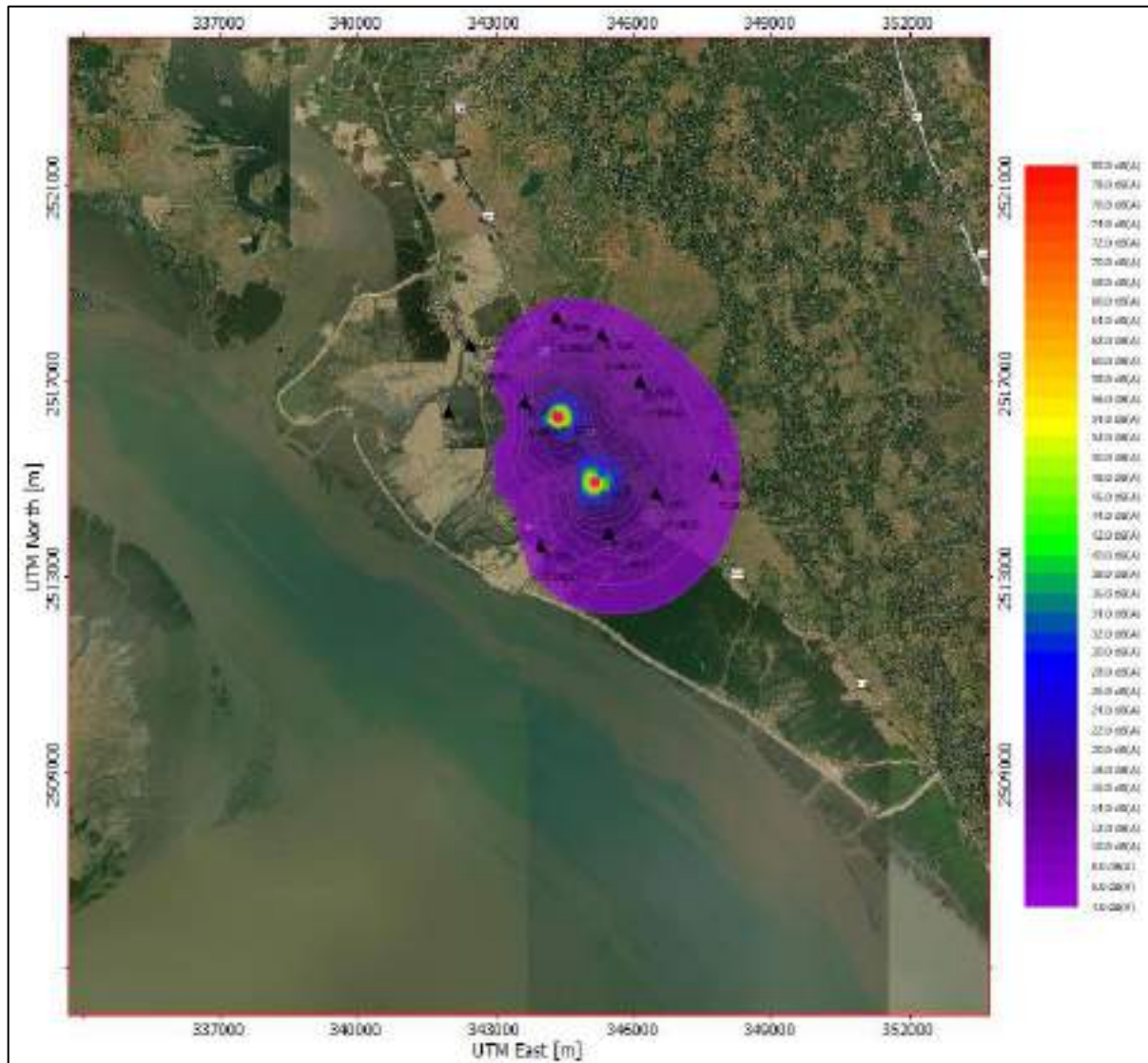
B_001	343687	2516507	344559	2516888	3
B_002	344559	2516888	345244	2515658	3
B_003	345244	2515658	345547	2515259	3
B_004	345547	2515259	346081	2515199	3
B_005	346081	2515199	346419	2514757	3
B_006	346419	2514757	345512	2514549	3
B_007	345512	2514549	344888	2514263	3
B_008	344888	2514263	343767	2516282	3
B_009	343767	2516282	343678	2516507	3
B_010	343678	2516507	343669	2516507	3
B_011	343669	2516507	343669	2516507	3
B_012	343669	2516507	343687	2516507	3

TOTAL BARRIER: 12

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Map 5: Noise Predictions with Project during Day and Night

Summary Report for Discrete Receptor Points

Title: Sound Propagation Model Run

Subtitle: BEZA

Unit: dB (A)

Receptor ID	X-Coordinate	Y-Coordinate	Predicted Level	Baseline	Resultant^
Name	m	m	dB (A)	dB(A)	dB(A)
R_001	343616	2516542	3	51.2	54.2
R_002	346473	2514670	5.7	62.7	68.4
R_003	346117	2516966	3	59.9	62.9
R_004	347772	2515043	3	69.2	72.2
R_005	345431	2513855	6.5	58.4	64.9
R_006	343972	2513613	3	64.1	67.1
R_007	341951	2516334	3	61.3	64.3

EIA of the Development of Sub-zones 5-7, 11-13, 16-19 and 24 Under the NSEZ.
Annexure-9: Noise Level Modelling

R_008	342433	2517711	3	64.9	67.9
R_009	344320	2518280	3	59.5	62.5
R_010	345284	2517923	3	56.7	59.7

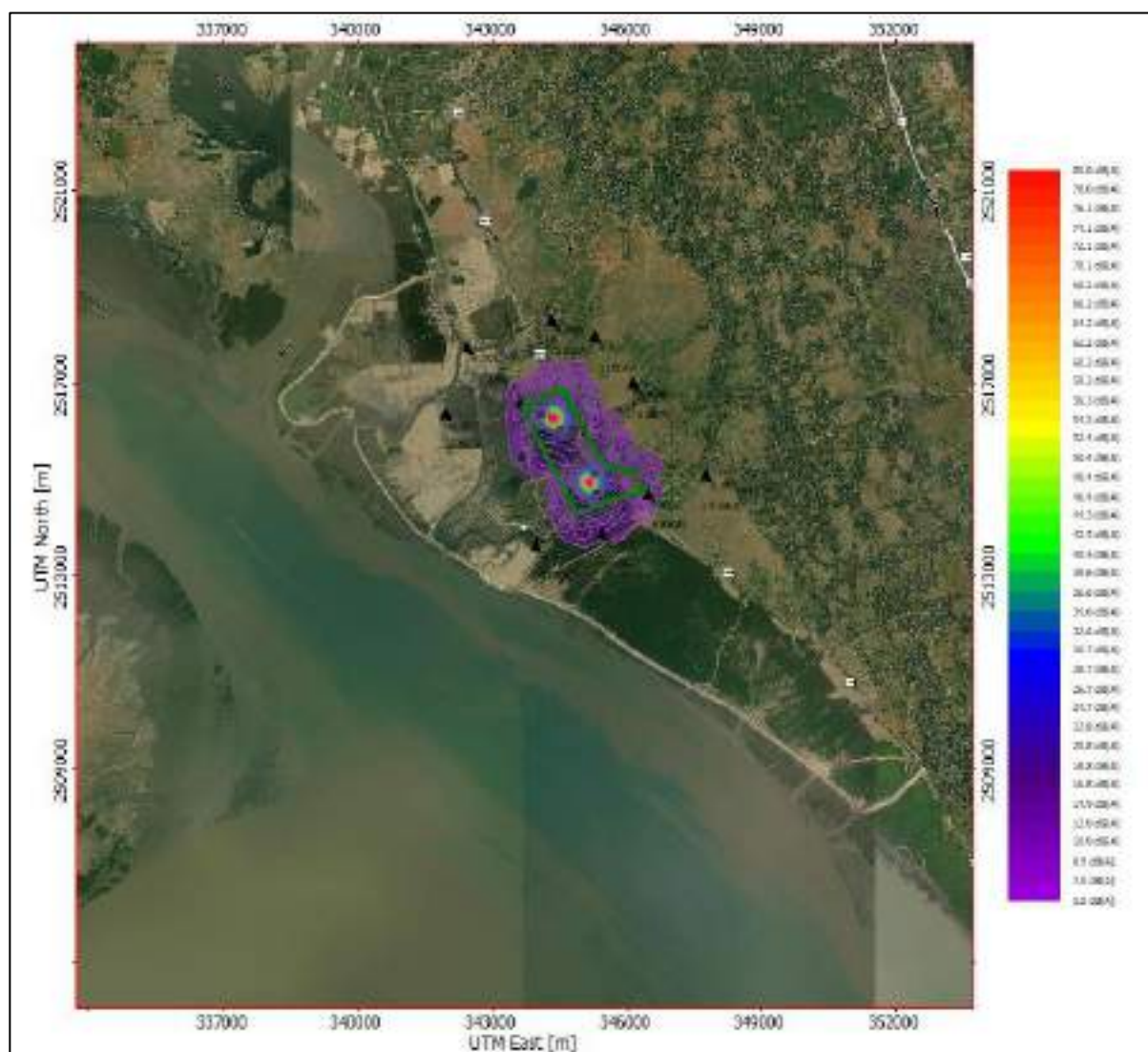
Remarks:

1. Summaries of highest values by receptor
2. ^Predicted plus background level

Project File: C:\Users\user\Documents\dhwaniprodata\test-beza.dwp

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Map 6: Contour map showing noise levels with 3m barrier

Mitigation measures to reduce Noise levels

264. The following are the mitigation measures to reduce noise pollution:

- A. Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB (A).

- B. If required, high noise producing generators such as concrete mixers, generators, graders, etc. must be provided with noise shields.
- C. Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum.
- D. Workers in the vicinity of high noise levels will be provided earplugs, helmets and will be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
- E. During construction vibratory compactors will be used sparingly within the urban areas. In case of complaints from roadside residents, the engineer will ask the site engineer to take suitable steps of restricting the work hours even further or use an alternative roller.
- F. Proposed tree and shrub plantations planned for avenue plantation especially close to settlements, may form an effective sound buffer during the operation stage.
- G. 3-meter boundary with 3 tier plantation surrounding periphery of the project should be proposed as a barrier to reduce the transmission of point source noise towards sensitive receptor.

Annex- 10: Emergency Response and Disaster Management Plan

Pre-emergency Planning

265. During the pre-emergency planning stage, identifying anticipated disaster risks, and how to respond to this odd situation, that could help project people, resources, materials, and as well as nearby communities to respond quickly. The following issues should be addressed or considered during pre-planning stage:

- Hazard Identification or assessment.
- Identifying the emergency resources available at the sites.
- Develop communication strategies during disaster period.
- Administering the plan
- Collecting and available the emergency nos of local fire departments, local police station, and local hospitals at the construction sites.
- Preparing the emergency response procedures
- Communication of the procedures
- Conducting or assessing the capacity needs and development.
- Set up assembly points where everybody gathers during emergency periods.
- Finalizing the debriefing and post-emergency procedures.

Emergency Classification

266. Basically, any emergency can be classified at three stages:

- Minor Emergency: It is easy to control by persons who'll be engaged in the Project operation and facilities which are to be used at the project sites.
- Major or Serious Emergency: This kind of emergency may force the project operation to be suspended or even disrupted entirely, depending on the circumstances.
- Disaster Emergency: During this disaster emergency, the project operation will have to stop right away because the danger of vulnerability is greater. This will result in unsafe working conditions, major injuries, fatalities among employees, contractors, or members of the community, excessive damage to property or equipment, and serious environmental destruction.

Level of Priority

267. The level of priority means to take the steps or initiatives to respond to any odd situation that may cause emergency conditions/situation during dredging and post-dredging periods. To get the priority, three types of level are identified during the project implementation period which are as follows:

- ▶ Level-1 (Minor Emergency): It is easy to tackle or control if some sorts of preventative measures are maintained properly at the sites. To avoid or reduce this situation, any kind of emergency object should be identified and properly mitigated at the early stages of the project implementation. Because a small or minor accident/incident may become a major accident/ incident if proper mitigation is not undertaken at the sites. LEVEL-1 Emergencies may result from equipment or property damage at small scale which are not causing disruptions for operations and do not pose at risk to project personnel or property or the community people in the project areas.
- ▶ Level-2 (Major or serious Emergency): Under this level of circumstance, emergencies are defined as mishaps or incidents that jeopardize or violate the safety protocol of project workers, staff, or the general public outside of the project areas, or that have the potential to jeopardize the safety of personnel involved in the dredging activities, and which necessitate notification to the relevant authority for the necessary support services.
- ▶ Level-3 (Disaster Emergency): This will result in unsafe working conditions, major injuries, fatalities among employees, contractors, or members of the community, excessive damage to property or equipment, and serious environmental destruction. So, during this emergency, dredging and post-dredging should be shut down immediately without notification and alternative arrangement should be there as a contingency plan.

Emergency Notification & Evacuation Process

268. Emergency notification and evacuation process is an important process to reduce the risk and less the degree of impacts that will follow some sorts of steps:

1. Emergency Notification &
2. Evacuation Process

Notification

- The notification will be issued first, notification served to the project sites and its surrounding areas to inform the local people about emergency situations.
- The site manager should be notified immediately, and he will inform BEZA immediately without delay.
- The Maintenance Supervisor and Operations Supervisor should also be notified.
- Use the emergency contact list to notify the relevant parties.

Evacuation

In case of an emergency that requires evacuation, the following procedures should be followed:

- Activate the alarm and alert all employees and visitors.
- Ensure that all employees and visitors are accounted for.
- Assemble at the designated assembly point.
- Wait for further instructions.
- Respond to emergencies using an effective communication network and organized procedures.
- Resume normal activities after emergency situations.

269. Personnel involved in dealing with emergencies shall follow these priorities while making decisions and developing strategies. Contractor's employees should also be instructed in the Emergency Procedures before commencing work on this site. They will report to the emergency assembly point on this site. Construction Manager /EHS expert will guide them in case a major decision like evacuation from the project site is taken. High Disaster or Catastrophic condition, all employees should be evacuated immediately.

Head Count

270. Head count is important to identify the injured, wounded, missing, in field, present and absent persons from the site during emergency situations. The simple format/checklist can be maintained at the assembly point to operate the head count system.

Table1: Head count format at Assembly Point during emergency period

Table 1: Head count format at Assembly Point during emergency period							
Name of the sites:			Assembly point:				
Date and Time:							
Employees / Visitor	Present	Absent	In Field	Injured	Missing	Required Emergency Assistance	Remarks

Re-Entry

Re-entry Planning:

271. Without proper re-entry process, or control over the re-entry issues, new emergencies will occur when workers or residents return to their works or home. This process will cover the following issues:

- Identified the workers or employees of the evacuated areas.
 - Transport them to the evacuated areas.
1. Maintaining order during re-entry etc.

2. The Re-Entry Plan and operation must minimize the danger and properly warn those who may be entering potentially unsafe areas.
3. After the damage information is collected and the decision is made to activate the Re-Entry Plan, construction managers and other community officials will determine what resources are needed and available to devote to the re-entry operation.
4. Some cleanup and repairs may have to be made before it is even possible to get to their property.
5. Traffic control may require substantial manpower resources if transportation routes are damaged and/or detoured.
6. Ongoing security of the evacuated area will require additional law enforcement resources.
7. A successful Re-Entry Plan must be flexible enough to consider post-disaster conditions, size and population of the evacuated area, and availability of resources.
8. Contractors and other repair service providers will be allowed access at this time.
9. If full-scale re-entry is impossible, schedule additional phases of re-entry so that residents or workers in particular areas are allowed in at specified times for a fixed number of hours.
10. Have emergency response personnel and equipment in the re-entered area ready and able to respond even when utilities may not be available.

Public Communication during Emergency

272. A reliable communication system is an important key to make an effective emergency response for disseminating the information on time. To make it successful, reliable communication with procedural development, and personnel training is required.

- Notify the relevant authorities, such as Emergency Services, the Fire Brigade, the Police Stations or other regulatory agencies, as required.
- Develop a media communication plan to keep the public and stakeholders informed.
- Collect the cell phone numbers of nearest medical centers or hospital services.
- Collect the cell phone numbers of the nearest Police stations for emergency help.
- Collect the cell phone numbers of local fire service station locally name as Fire Brigade stations.

Assembly Points

273. The Evacuation Assembly Point (EAP) should be an open area away from the building and out of the way of responding emergency personnel. Establish primary and secondary EAPs in case the primary cannot be occupied during or after an evacuation. A separate EAP may be necessary for earthquake evacuation.

274. Occupants meet after evacuation so that they may be accounted for or lend assistance as needed. There may be more than one assembly point depending on the size of the employees, workers, contractors, and the location of the exits. Some EAPs may be unsuitable for assembly following an earthquake event. However, EAP both primary and secondary locations should be familiar with the project personnel including workers, employees and contractors' representatives during the dredging and post-dredging periods.

275. To activate the assembly point, everyday morning before commencing work, Toolbox talk (TBT) and mock drills for emergency evacuation process should be carried out in these places occasionally. The primary and secondary Evacuation Assembly Points (EAPs):

Primary Assembly Point:	Name of the place
Secondary Assembly Point:	Name of the place

Emergency Response for Typical Emergencies

276. Typical emergency situations at the sites will follow 5 steps such as prevention, mitigation, preparedness, response, and recovery1 etc.,

- ▶ **Prevention:** Preventive measures will prioritize identifying potential dangers at project sites to limit the risk of emergencies. Fire accidents, electrical shocks, slips, and other connected risks, among others, should be inspected before beginning work, and if any possibility is discovered, it should be removed first, followed by the work.
- ▶ **Mitigations:** Refers to efforts taken to either avert an emergency, reduce the risk of an emergency occurring, or ameliorate the harmful effects of unavoidable disasters. To safeguard worker safety, create hard barriers, safety

signage, flag man deployment, warning signs, alternate routes for vehicle movement, and ensure the quality of dredging works. However, wearing PPE is critical for maintaining workplace health and safety. Adopting construction standards and adhering to the World Bank Guidelines for Environmental and Social Protection (ESS standards) are typical mitigation techniques.

- ▶ Preparedness: Activities improve a worker's ability to respond when a crisis strikes. Typical preparedness tactics include increasing understanding, educating both response staff and concerned public, holding catastrophe drills to reinforce training and test capabilities, and presenting all-hazards education campaigns.
- ▶ Response: Actions taken promptly before, during, and after a hazard impact to save lives, reduce economic losses, and alleviate suffering. Response actions may include activating the emergency operations center, evacuating threatened workers, opening alternate shelters, and providing onsite medical treatment facilities, performing emergency rescue and, battling fires, and conducting search and rescue.
- ▶ Recovery: Actions should be taken to restore workers and staff to normal or near-normal conditions. Providing financial assistance for self-recovery, essential medical care, clearing debris or other objects from the sites, and reconstructing roads, pipelines, and other structures.



Figure1: Steps of Typical Emergency Management.

Fuel and Chemicals Spillage

277. Contractors will ensure proper fueling and lubrication of machinery, motors, and vehicles to prevent spillage and evaporation. To protect against spills, gasoline storage locations should be isolated and contained. Access to the storage areas should be restricted, and security personnel should always be present. Different colors should be used to identify different types of fuel, such as diesel, gasoline, and octane. Because petrol and octane have the highest rate of evaporation, they must be used and handled with attention, and special precautions should be taken when receiving and changing oil. Create supplementary containment for oil transfer, as indicated below:

Table -2: Oil storage facilities at dredging working sites

Description	Secondary containment	Type	Location	Purpose of using
Dredging Equipment Diesel Fuel and Gasoline (Temporary)	Double-walled and/or lined berm	Stationary Refueling Tanks	At dredging yard	Refuelling dredging equipment/ vehicle during dredging activities.
Contractor Diesel Fuel (Temporary)	Single-Walled	Mobile Refueler	Construction Facility	Refuelling dredging equipment/ vehicle during dredging activities.

Source: Construction spill prevention, control, and countermeasures (SPCC) plan, Gravel Pit Solar, East Windsor, CT March 18, 2021.

- ▶ Contractor's responsibility: The contractor will notify the site manager / project manager as soon as the spillage is released or occurs on the site, regardless of the amount of oil or chemical leakage that happened. If there is an oil spill, an oil kit (such as a skimmer or sucker) should be utilized to clean up the materials on the construction site.

Medical Emergency

- ▶ First Aid Kit- Every workplace should have a first aid kit with one person in charge and placed in easily accessible locations for everyone to use.
- ▶ Emergency vehicles: An emergency vehicle should be present on-site to transport the wounded or injured person to a hospital or medical facility as soon as possible.
- ▶ Emergency number and information: Emergency numbers for local hospitals, medical facilities, police stations, fire stations, and local volunteer associations/groups should be available at the sites and easily accessible to everybody for emergency response.
- ▶ Takeaway: Dredging activities sites are generally safe places to work, although accidents do occur from time to time. To reduce the danger of an accident, workplace safety laws must be followed. If an accident occurs, the repercussions may be lessened by providing workers with first aid kits, mobile medical units, and adequate information or training.

COVID-19 Situations

278. The Government of Bangladesh (GOB) currently has left the COVID-19 restrictions because to the low frequency of cases and the completion of three rounds of vaccines. However, if a COVID-19 emergency occurs, the following responses will be implemented at the sites to prevent or mitigate the effects.

Table -3: Details Processes of COVID -19 Management

Eliminate	- Workers who don't feel well should not stay or continue their work on the site. - Avoid physical meeting and maintaining 2 meters social distancing while working on the sites.
Reduce	- When social distancing measures (2 meters) are not practical, it is necessary to wear a minimum surgical mask, safety eyewear, and hand gloves. - Temperature screening tests must be performed. - Limit worker proximity to 2 meters and reduce the number of workers involved in tasks. - Encourage workers to work side-by-side or away from each other. - Maintain cleanliness of common touch areas, such as doors, buttons, handles, vehicle cabs, tools, and equipment. - Increase ventilation in enclosed areas. - Employees should wash their hands before and after using any equipment.
Isolate	- Keep groups of workers who need to work within 2 meters. - Work in teams (do not swap workers within teams) - Keep teams small as much as possible. - Work away from other workers as much as feasible.
Control	When working within 2 meters, face-to-face interaction is required to complete a task. - Limit these activities to 15 minutes or less. - Implement an upgraded authorization process. - Increase supervision to ensure compliance.
PPE	- Workers at project sites are required to wear the necessary PPE and maintain a 2-meter social distance. - The necessary PPE will be ensured at the site for each employee, workers, and others.
Behaviors	- The contractor(s) should take the required precautions to reduce the risk of infection transmission and rely on all construction workers to follow their actions and behaviors. - Encourage an open and collaborative approach between workers and employers on-site, so any difficulties can be openly acknowledged and addressed.

Source: Novel Coronavirus (COVID-19) Guidelines, Government of Bangladesh.

<https://old.dghs.gov.bd/index.php/en/home/5376-novel-coronavirus-covid-19-guidelines>.

Emergency Response Equipment

279. Fire extinguishers- Fire extinguishers or fire balls should be placed in strategic positions around the project area to respond to any fire incidents that may arise. Staff and personnel shall be adequately taught to use firefighting equipment during fire emergencies.

Emergency Response Training

- ▶ A necessary training program should be designed to provide 'need to know' knowledge to emergency responders, including information on how to avert a pipeline incident.
- ▶ It should focus on the shared aim of workers and public safety. Emergency responders are trained to safeguard the public from a variety of potential emergencies.
- ▶ The contractor will prepare a detailed 'Emergency Training Plan' in the Construction Environmental and Social Management Plan (CESMP) where frequency of training, no of participants, and trainers' information should be detailed.
- ▶ Every day before work begins, the project manager/HSE officer should conduct a toolbox talk on occupational health and safety and emergency response plans. This should be documented and reported to the project authority in the progress report.

Emergency Drills/Exercises

- ▶ Necessary emergency drills or exercise will be carried out at the sites during the dredging/post-dredging period. It will help enhance the capacity of workers to response to the emergency with the way of interactive, realism and handling the emergency conditions at the site.
- ▶ In emergency drills, workers, staff, and other personnel are directly or indirectly involved in the project activities. Emergency drills should be conducted every quarter.
- ▶ It is critical to communicate with stakeholders before, during, and after the drill or exercise to ensure that they understand the purpose, expectations, and outcomes. It is also critical to seek their opinion, advice, and suggestions to ensure that the drill or exercise is relevant, practical, and courteous.

Emergency Communication

280. A list of emergency communications will be posted in the emergency drill sites and construction areas to respond emergency quickly which is given below:

Table -4: Emergency Contact Number for Communication

Sl #	Name	Emergency no.
1	National emergency cell	999
2	Local police station (Officer in Charge, Mirersharai Thana)	01713373644
3	Mirersharai Fire station	01901021577
4	Local Hospital	01851333111

Risk Assessment and Emergency Response

281. The fundamental risk assessment will be conducted based on the likelihood of major accidents occurring at the working sites and the possible damage to the local community, workers, employees, and others, as well as the destruction of the surrounding natural environment. However, damage assessment clearly identifies the different connected aspects such as chemical leakage, oil spills, confinement of oil storage locations, dispersion distances from oil/chemical substances, noxious materials, and site population, among others.

Introduction Hazard Assessment Process

282. Oil leaks can occur from dredgers, vehicles and other motor engines which will lead to fires and explosions. This type of accident, however, has a negative impact on a country's economic growth and development image around the world, causing property loss, serious health complications, site workers and other lives being jeopardized, and causing serious environmental damage.

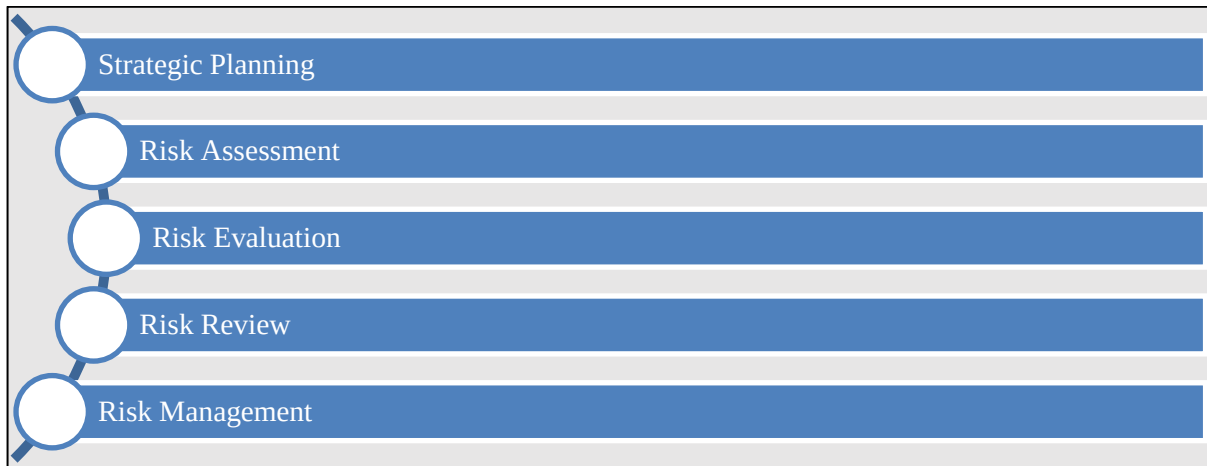


Figure 2: Flow Chart of Risks Management

Identification of Hazards and Cause Analysis

- ▶ Risks/ hazards evaluation criteria will be based on various causes of emergency during dredging and post dredging periods due to inappropriate handling, use, transportation, storage, and disposal of equipment, wastes including hazardous materials, However, the hazardous materials are considered as of:
 - Explosives, toxic and flammable gases, flammable solids, oxidizing substances, toxic and infectious materials, and corrosive substances etc.
- ▶ Causes of hazards mainly occurs from:

Source: Environmental Assessment for Fouzderhat-Sitakunda-Mirsharai Gas Distribution Network Upgradation Project, Chattogram of Karnafuli Gas Distribution Company Limited (KGDCL), March 2023.

Annex- 11: Occupational Health and Safety Plan

Objectives

283. The purpose of occupational health and safety plan is to reduce or lessen the workplace health hazards during working at the sites. The objective of OHS plan is as follows:

- ▶ To prevent accidents during mobilization, dredging and after dredging stages of the proposed sites.
- ▶ Prevention of workplace accidents using the approved work plan/instructions by supervisors.
- ▶ Implementing the recommendations of the Safety plan properly without causing harm to the natural environment.
- ▶ Achieve work towards “INCIDENT FREE” – ZERO accident, ZERO loss, NO harm to people, and NO damage to the environment.
- ▶ Implementing the Emergency Assembly points, evacuation and rescue plant contacts by immediate in-charge of project.
- ▶ Establishing the accident reporting procedures and process which shall be maintained at the sites.
- ▶ Capacity building on OHS issues where staff shall be informed that accidents/incidents investigation are “fact finding” and not “fault finding” exercises and are particularly useful as lessons in preventing re-occurrence.

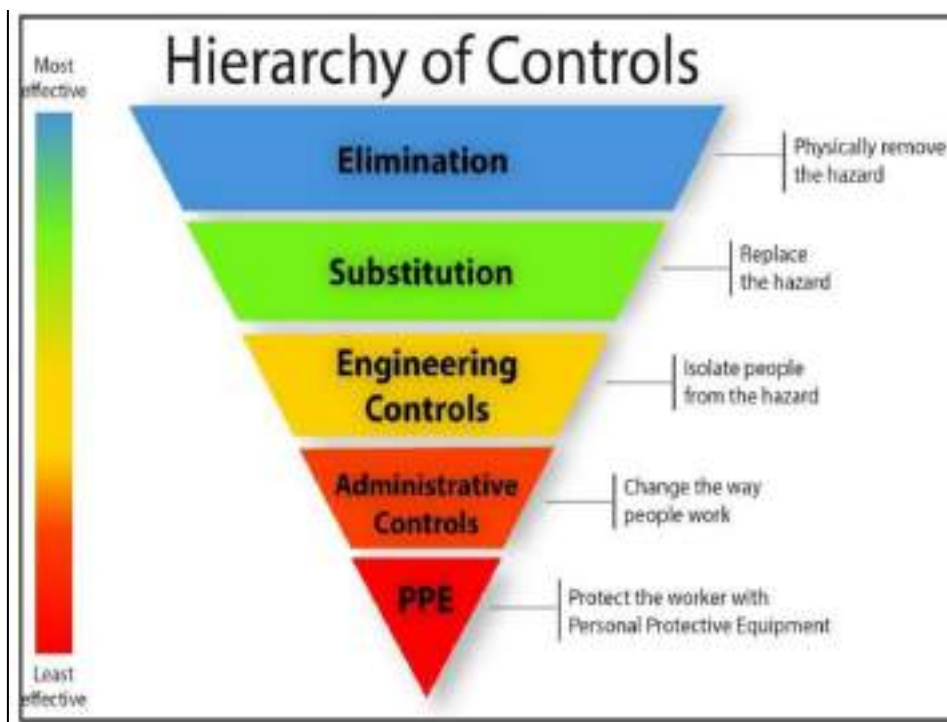


Figure 1: Hierarchy of Controls

Roles and Responsibilities

284. The roles and responsibilities of the responsible parties is as follows:

Table 1: Roles and Responsibilities of the responsible parties

Position/Name of responsible person	Duties
Project Manager	▶ Will be responsible (to be appointed by the contractor) for the organization, planning and execution of assigned tasks at the working sites. ▶ Taking controls to complete the works following the national rules and regulations and WB's E&S standards Guideline. ▶ Ensure zero harm or no accident or incident at the sites.

Position/Name of responsible person	Duties
	▶ Executing the works with quality and deadlines.
Site Supervisor	▶ Employed by the Contractor to manage health and safety protocols at the construction sites and will monitor the quality of works with no harm or zero accident/incident under the project activities. ▶ Regularly hold health and safety training preferably toolbox talk (TBT) before commencing the works at the site. ▶ Record of accident/incident events and inform the relevant agency or authority immediately if any accident/incident occurs at the site.
OHS coordinator	▶ To adapt the OHS Plan at working sites. ▶ To communicate/disseminate the OHS Plan to all all-responsible parties at the working sites. ▶ To foster the coordination with the team timely. ▶ To assess the applicability of the OHS plan at the site, if it's not suitable then revise or adjust the plan immediately based on the field-based requirements. ▶ To arrange formal training sessions quarterly or biyearly. ▶ To check or verify the OHS accident or incident record book at the field sites. ▶ If requires, make necessary corrective action plan (CAP) to lessen the impacts. ▶ To take the necessary procedures to make sure that only the authorised persons will have access on the site or access to be limited for only unauthorized people to avoid community health and safety risks. ▶ Frequently visit the sites and checking the status of OHS issues on the spot etc.
Workers	▶ To comply with the requirements of occupational safety and health plan. ▶ To use the personal protective equipment ▶ To announce the management in the event of danger, accidents, incidents, deficiencies etc. ▶ Everybody should know or personal contact with each other for her/his own safety and the safety of others on the construction site.

Risk Screening, Evaluation, and Impacts Identification

Risks Screening/Identification

285. The contractor(s) will assess the potential OHS risks at the working sites both dredging sites, delivery pipeline, landfill sites and adjacent areas following the hierarchy of initial hazard identification as follows:

- ▶ HIP (Hazard identification plan): Initial hazard identification process will be carried out based on project specific/ activities.
- ▶ HAZID (Hazard identification) study. A competent team will be formed consisting of project manager, site supervisor, OHS officer/specialist, and engineers to conduct Hazard Identification study at the sites.
- ▶ HAZCON (Control of construction hazards): The process of assessing construction hazards via staged risk assessments shall be done following the OHS requirements of Labor Rules 2006, and ESS-2 standards of World Bank.
- ▶ Risk assessment: Conducting risk assessment on the jobsites using subsequent method statements.

286. The designated person assigned by the contractor(s) will conduct the HAZID and HAZCON evaluations to identify potential risks associated with the dredging activities. Whereas the site supervisor will ensure the quality of risks assessment and procedural statements in terms of workplace health and safety issues and quality

of works. The Project Manager ultimately will review the materials to confirm the health and safety of female workers and ensuring gender integration when completing the risk assessment.

Table 2: Degree of Risk Significance

Step 1: SIGNIFICANCES- How severely could it hurt someone? Or How illness could it make someone?	Step 2: POSSIBILITY- How likely is it for an injury to occur?			
Kill or cause permanent disability or ill health.	Very likely, could happen frequently.	Likely, could happen Occasionally	Unlikely, could happen, but rare.	Very unlikely, could happen, probably never will
Long term illness or serious injury	Very high risk (Score 1)	Very high risk (Score 1)	high risk (Score 2)	Substantial Risk (Score 3)
Medical attention and several days off work.	Very high risk (Score 1)	High risk (Score 2)	Moderate risk (4)	Substantial Risk (Score 3)
Medical attention and several days off work	High Risk (Score 2)	Substantial Risk (Score 3)	Moderate Risk (Score 4)	Acceptable Risk (Score 5)
First Aid needed	Substantial Risk (Score 3)	Moderate Risk (Score 4)	Acceptable Risk (Score 5)	Low risk (Score 6)

Note: This risk matrix is prepared based on project activities following the IFC EHS Guideline.

Table 3: Risk Priority Score and its Response

Risks priority scores	Required Actions
1= Very High Risks	Stop the activity—immediate action is required to guarantee safety—before any activity resumes, the Project Manager must approve any safety measures implemented.
2= High Risks	Proceed with caution—immediate reporting of emerging or ongoing risk exposure at this level to the Project Manager for decision is mandatory
3= Substantial Risks	Be aware—immediate action is required to avoid or lessen harm or sickness.
4= Moderate Risks	Reporting to Project Manager or other competent authority is essential.
5= Acceptable Risks	Precaution is important or necessary actions should be undertaken at the site to avoid this risk. Routine monitoring is required to tackle the situation.
6= Low Risks	The responsible/designated person will record the incident/accident, monitoring, and control to prevent the risks.

Risk Evaluation Procedures

287. A simple format will be used to evaluate the occupational health and safety risks at the sites as follows:

Table 4: Risks Evolution Format

Locations:				
Risks assessment conducted by:				
Date of risk assessment:				
S l #	Hazard Identification	Risks Assessment	Risks Control	Review

What types of hazards to be anticipated ?	What injury, illness, or significance could be possibly occurred?	Make a list of any control measures that was applied earlier?	Risk level (Severe, High, Moderate, Low, non-significant)	What steps should be taken to lessen the impact ?	With whom responsible ?	When ?	Are the control measures effective? If not, pls. mention the corrective action plan (CAP)	Date of finalization of risk evaluation
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Sources of Risks

288. The potential source of risks associated with the dredging activities is as follows:

Table-5: Sources of Risks

Anticipated risks zone	Associated risks
Dredging sites	Slips, Trips and Falls, Machineries operation, and oil spillage and Equipment handling etc.
Working sites (landfill sites, delivery pipeline areas, roadsides etc.)	Slips, Trips and Falls etc.
Material storage sites	Materials handling, slips, trips, and falls etc.
Labour Campsites	Health hazards due to improper drinking water, unhygienic sanitary facilities, lack of sunlight and air circulation etc.
Access roads	Road accident, materials handling

Risk Mitigation Measures

289. The possible mitigation measures to reduce, avoid and or lessen the impacts on occupational health and safety is given below:

- ❖ The demarcation of the site and the movement within the site:
 - ▶ The working areas must be contained by warning tapes and signal panels at the access points of the working sites.
 - ▶ It is mandatory to wear personal protective equipment while working at the sites.
 - ▶ The rules and regulations of Government of Bangladesh and World Bank E&S standards (ESS-2) on safety and health at work must be complied with in the premises of the site.
 - ▶ Danger sign should be posted at the sites, and
 - ▶ Flag man should be deployed to limit the access of local people to the sites.
- ❖ The emergency routes and exits:
 - ▶ There will be an alternative route to reduce the traffic load on the roadways and reduce the impact on community health and safety.
 - ▶ Emergency exist plan should be developed to escape from the site during emergency situations.
 - ▶ Assembling points should be fixed on the working sites and drills should be carried out occasionally to train the workers to response during emergency periods.
- ❖ Emergency Contact:
 - ▶ Ensure emergency contact numbers are readily available at the location and maintain close communication with local government offices and emergency responders such as fire stations, red cross society, local police station, and blood donation organizations.
- ❖ Storage site management:
 - ▶ Material storage will take place in purpose-built facilities. The location must be on the site, taking into account the risks associated with material handling and storage, as specified in the accompanying documentation for producers, as well as the environmental impact (e.g. contamination of soil, air, and water).

- ▶ Cover materials with hard polythene or tarpaulin to prevent surface runoff and potential risks for workers at the site.
- ▶ Chemical substances will be stored separately, especially if they are incompatible with other components.
- ▶ Materials posing a risk of explosion or fire, such as fuel like diesel, kerosen, gas cylinder etc., will be stored separately in specially designed premises with proper markings and protection from uncontrolled movements, sunlight, and humidity.
- ❖ Exposure to risks:
 - ▶ Workers should not be exposed to excessive noise or dangerous external factors like fumes, vapors, or dust.
 - ▶ Workers at dredging sites should wear earplugs to prevent noise exposure.
- ❖ Fire detection and firefighting:
 - ▶ Fire extinguishers or fire balls should be supplied at dredgers and labor campsites.
 - ▶ Workers should be educated to use them in case of fire mishaps.
- ❖ Working Environment
 - ▶ Ensure a healthy and sanitary work environment, including access to clean drinking water and bathroom facilities.
 - ▶ During hot days, workers should drink oral saline to prevent dehydration and others necessary preventive measures should be undertaken to avoid health risks at the site, and
 - ▶ Maintain a clean and healthy environment in work areas and labor campgrounds.

Communication and Cooperation

- ▶ Contractors and their subcontractors will have their own safety and health plans, as well as dredging specific requirements.
- ▶ The contractors will receive site rules and must follow them.
- ▶ Special dangers are addressed with appropriate guidelines.
- ▶ Visitors to the site will receive safety equipment, be accompanied, trained, and registered.

290. The contractors, project authority and others will cooperate and communicate about safety and health at work and follow the OHS coordinator's instructions.

Reporting Incidents and Accident

- ▶ The project manager is responsible for reporting and preventing accidents and mishaps.
- ▶ In the event of death, significant injury, or a dangerous scenario, contractors and project authority shall be promptly notified, and written confirmation should be provided.
- ▶ The site manager will provide information from time to time to the project authority and it will be included in the OHS Plan prior to dredging activities.
- ▶ All essential addresses and phone numbers will be displayed at the site's office and on safety and health posters.

Capacity Building of Workers

- ▶ Contractors must train their employees on OHS on a regular basis.
- ▶ Contractors must check their employees' health and safety sheets on site to ensure they are fit for the task.
- ▶ Subcontractors must comply with legal standards for first aid training.
- ▶ The project manager validates the number of qualified first aiders in the monthly safety and health report. If necessary, he can request extra training.
- ▶ If conditions impacting OHS require revisions to the Occupational Health and Safety Plan, training will be provided. These changes will be handled as initial information in accordance with OHS coordination standards.

- ▶ Increased OHS awareness: In addition to training, OHS signage and warning letters will be posted on the landfill sites to alert workers to potential hazards.
- ▶ The project manager and supervisors will periodically discuss site-specific safety and health measures.
- ▶ The Environmental Management Plan contains instructions on safety and health requirements at work etc.

Monitoring Mechanism

- ▶ Weekly safety and health meetings will provide information on unique issues, directions for specific situations, training, and extensive communication about labor protection in daily work.
- ▶ Suggestions/topics for discussion from staff are welcome.
- ▶ The results will be tracked regularly and discussed in the meeting.
- ▶ Participants include the project manager, OHS coordinator, and others as needed.
- ▶ In addition to frequent coordination meetings, monthly health and safety meetings will be held with mandatory attendance.
- ▶ These sessions aim to amend the OHS Plan and analyze workplace safety and health performance.

Annex- 12: Labor Management Plan

Introduction

291. This LMP aids as a comprehensive framework governing labor affairs within the project area of NSEZ, meeting the requirements of Bangladesh Labour Act, 2006; Bangladesh EPZ/EZ Labour Law Ordinance No 01, 2019 as well as the objectives of the World Bank's Environmental and Social Framework, specifically objectives of Environmental and Social Standard 2: Labour and Working Conditions (ESS2) and Standard 4: Community Health and Safety (ESS4). Key components of the LMP detailed below:

Overview of Labor Use in the Project

292. The National Special Economic Zone (NSEZ) is considered as the first multi sector economic zone covering an area of around 30,000 acres, located in Sitakunda & Mirsharai Upazila of Chattogram district and Sonagazi Upazila of Feni district. However, the proposed project activities covering zone 5-7, 11-13, 16-19 and 24 is located in Ichakhali Union of Mirsharai Upazila, Chattogram. The NESZ area is strategically located, making it a focal point for development and investment. Its geographical advantages, coupled with its accessibility, position it as a key player in regional planning and economic growth.

Potential labors to be used in the project

293. Three types of workers will be engaged in the project such as direct workers, migrated workers and community workers. The detail is given below:

294. **Direct Workers:** Direct workers are often those individuals who are directly engaged in the construction activities. They may include skilled and unskilled laborers, operators of machinery/equipment, and other personnel directly involved in the dredging related activities. These workers are usually under the direct supervision and control of the contractors.

295. **Contracted Workers:** Based on the requirements, contractors can directly deploy contracted workers based on their level of skills and project needs. Sub-contracts of the work could be given by the contractors. Sub-contractors thus engaged may supply laborers as per the agreed terms and conditions. Contracted workers are eligible to work for a contract period fixed by the contractor. Their contracts will be renewed, if required, based on satisfactory services.

296. **Primary Supply Workers:** Based on the requirement primary supply workers will be recruited by the suppliers as required. It will ensure that primary supply workers include no children and forced labor. The contractor/PMU will be responsible for ensuring the standards set by LMP are maintained properly. If any deviation is identified PMU will act as prescribed in the contract/ agreement.

297. **Community Workers:** Contractor will employ community workers for the skilled and unskilled works. It will be ensured (and monitored periodically PMU/consultant) that no children are recruited and engaged as a community worker. The contractor will be fully responsible for confirming of standards set by the LMP are pursued strictly.

298. The whole process of hiring and recruitment will be conducted according to the national guidelines as well as World Bank's ESS2. The LMP will be applicable to all project workers whether full-time, part-time, temporary, seasonal, or migrant workers. There will be provisions to avoid the use or employment of children and forced labor at any level of the project.

Recruitment Procedure

299. The major procedure of hiring and recruitment of workers has been depicted here as-

300. **Selection of Workers:** The contractor will adhere to a comprehensive procedure for the selection of skilled, unskilled, semi-skilled, and amateur workers, as well as engineers, staff, consultants, etc., to engage them in various aspects of project activities. This selection process will strictly follow established codes of conduct and industry standards to ensure the competency and suitability of individuals for their assigned roles within the project.

301. **Source of Workers:** The contractor will implement a strategic approach to source workers, tailored to the nature of the work at hand. This may involve procuring direct workers, contract workers, supply workers, and migrant workers as necessary. The sourcing process will strictly adhere to the standards set by the International Labor Organization (ILO), Bangladesh, and the World Bank. It is imperative to note that priority

will be given to recruiting workers from the local community, aligning with the commitment to community engagement and in accordance with relevant standards.

302. **Appointment of Workers:** The contractor retains full autonomy in appointing workers based on the dynamic nature of their workload and project activities. This includes the flexibility to appoint individuals as full-time, part-time, contractual, or intermittent workers, depending on the project's requirements. Worker appointments may occur on a contract basis, probationary period, or as permanent staff, with strict adherence to national labor regulations and compliance with Environmental and Social ESS-2.

Contract Documentation

303. **Probationary Period Inclusion:** A specific and predetermined probationary period will be explicitly incorporated into the contract document. This inclusion will strictly adhere to the guidelines set by appropriate standards, ensuring compliance with labor laws and providing a structured framework for the probationary evaluation of workers.

304. **Services and Facilities:** The contractor will be aware of the prospective workers about their services and facilities before processing any recruitment or hiring and the workers will agree to obey the rules and regulations as well as commit to provide proper services to the project execution.

305. **Wage Adjustment:** After permanent/contractual appointment the contractor will adjust the worker's wages, benefits, services, and facilities as per standard rules, regulations, and laws which adopted for this project.

306. **Project Execution:** The contractor will be the most prominent authenticated body to complete the project work following the supervision of the PMU, lender, and consultation organization. After executing the primary recruitment process, the contractor will properly execute the project work by compiling labor laws, standards, and regulations. The contractor will maintain the workers' profiles to any avoiding unwanted situations.

307. **Local Recruitment:** The preference for project employment will be given to local people, those who have been directly affected by Project Activities, and/ or those who have completed specific skills training under various programs offered and managed. To implement the local recruitment, a local recruitment process will be developed by the contractor including the following activities:

- Collect and finalize the information for recruitment from the contractor and its subcontractors (e.g., type of position, number of positions, job description)
- Conduct public disclosure of a summary of upcoming recruitment (both skilled and unskilled positions) and the process for application at the project area and nearby communes.
- Collect the data of candidates who have applied or registered in seeking employment including personal background, contact information, expected position, training, and update of involvement.
- Communication with the project's stakeholders and beneficiaries shall be clear to manage expectations.

Objective of LMP

308. The aim of this Labor Management Plan (LMP) is to establish effective management procedures for workers, promoting the equitable treatment of workers and fostering safe and healthy working conditions. The overarching goal is to enhance the development benefits of the project and ensure its sustainability. In alignment with the provisions outlined in WB-ESS-2 (Labor and Working Conditions) and the Bangladesh Labor Act of 2006, the following specific objectives have been established:

- ▶ Protecting all project workers, including vulnerable groups such as women, persons with disabilities, migrant workers, contracted workers, and primary supply workers, as applicable.
- ▶ Promoting workplace health and safety.
- ▶ Ensuring safety measures are emphasized for workers involved in the dredging pipelines, dredger and other related activities.
- ▶ Promoting safety protocols during civil works, including activities like dredging pipelines, leakage and repairs.
- ▶ Advocating for fair treatment, non-discrimination, and equal opportunities for all project workers.
- ▶ Preventing the use of forced labor and child labor (under the age of 18).
- ▶ Supporting the principles of freedom of association and collective bargaining for project workers in accordance with national laws.

309. Providing accessible channels for project workers to voice their workplace concerns.

ASSESSMENT OF POTENTIAL LABOR RISKS

310. The potential risks associated with the project activities have been depicted below:

- ▶ Hazardous works: handling heavy equipment, using of hazardous materials like oil, grease, and chemicals etc.
- ▶ Labor influx: migrated workers from other areas/regions/districts will be engaged in dredging activities on the sites.
- ▶ Child labors: risks of child labor engagement
- ▶ GBV: risks of gender-based violence (with the community/ with the project workers)
- ▶ Accidents/ Incidents: Accidents/incidents/emergency to be occurred with the community/ within the project areas.
- ▶ Occupational Health and Safety (OHS): OHS risks anticipated on the sites due to lack of idea and facilities of occupational health and safety.
- ▶ Communicable diseases (COVID-19, Diarrhea, Cholera, Dysentery etc.): risks of transmitting communicable diseases with the community/within the project areas.

Labor influx

311. Due to nature of dredging activities, and its hardship, local people will not be suitable to engage direct dredging related activities that will promote to hire or recruit outside labors at the sites over the dredging and filling activities. However, if skilled labors found at the project sites locally, they will be engaged on priority basis. In most cases, local people will be engaged in unskilled work, either on a contractual or daily basis. Outside labors will require accommodations, access to drinking water and sanitary toilets at the labor campsites, however, it is assumed that the size of the labor influx will be small to medium size, and may create many social and environmental problems such as:

Social problems:

- Communicable diseases will be transmitted to the local community and other laborers.
- Influx of labors will put burden on the local public services.
- Increase of illicit behavior and crimes.
- Increase of gender-based violence, child labors.
- Increase in traffic and road accidents.
- Increase pressure on local products, price, accommodation and rent etc.

Environmental problems:

- ▶ Increase of volume of waste and illegal disposal
- ▶ Increase of volume of wastewater and illegal disposal
- ▶ Increase pressure on fresh water.
- ▶ Labor camp related land use, access road, and noise and lights.
- ▶ Hunting, trapping, and killing of local species.
- ▶ Vegetation/ tree clearing.
- ▶ Increase pressure on natural resources etc.

Gender based violence (GBV)

312. Gender based violence (GBV) will occur due to engagement of outside labors. Usually young people/ laborers are engaged in construction or heavy works, and they stay away from home for long time. This will lead to conduct criminal activities like sexual harassment of women and girls, abusive sexual relations, and unlawful sexual relations with others, even, young male, women, and young girls of local community etc. Sometimes, women workers will be victimized/harassed in the working sites by male laborers. That will be a serious crime, offensive, and punishable! All sorts of GBVs should be recorded and addressed properly and GBV monitoring form as developed and used at the sites to prevent this type of incident/ event at the working areas.

Table 1: GBV records Form

Sl. No.	Types of crimes	Location of crimes	Date of crimes	Details

Occupational Health and Safety

313. Due to the dredging and its associated activities, workers' health and safety will be put in danger. The OHS related hazards are mainly the handling of heavy equipment e.g., bulldozers, excavators, dredgers, motor engines, pipe materials or other heavy machinery, oil and grease and other chemicals etc. However, lacks clean and safe drinking water, access to sanitary toilets, ventilation of lights and air to the labor camps will cause serious health problems of labors at the sites. To reduce these risks, contractors should take necessary preventive measures, and BEZA will provide necessary training/capacity programs to reduce the OHS risks at the sites. Every OHS issue should be recorded and reported properly. Contractors will use the OHS register book at the site and update it regularly.

314. The major potential OHS risks are to be anticipated at the sites as follows:

- ▶ Hazardous works and process: Using heavy equipment/machinery, hazardous materials.
- ▶ Accident/Incidents: Exposure to unsafe handling with equipment/machinery, flammable chemicals, oil, grease, and fuels.
- ▶ Work related hazards: Allergies, respiratory problems, eye irritation, skin diseases, communicable diseases, and sexually transmitted infections (STIs) etc.

Table 2: Accidental Records Form

Sl. No.	Types of accidents/Incidents/ Near miss	Location	Date of the event	Details	Corrective Actions/Counter measures

Child labor and forced labors

315. Due to the low compensation, there is a possibility that underage labor will be recruited for the project sites. The Bangladesh Labor Act, 2006, states in section 34 that no child shall be employed at any job site and in section 44 that any person under the age of 14 will be considered as child labor, and WB'S ESS-2 outlines the age of Child Labor under 18. As a result, child labor is strictly forbidden on the working sites. On the other hand, construction sites frequently employ forced laborers, especially when contractors or labor suppliers compel workers to work longer hours in accordance with their specifications without offering them overtime or additional compensation. Activities of this nature are absolutely prohibited at project sites for humanitarian reasons as well as occupational health and safety reasons. To avoid this event, the working hours should be limited to daytime (07 AM to 06 PM).

Overview of Labor Legislation

Terms and Conditions

316. The "Bangladesh Labor Act, 2006" is the fundamental legislation that outlines the fundamental prerequisites for labor involvement or specifies the particular terms and conditions of employment in Bangladesh. However, Bangladesh EPZ/EZ Labor Law Ordinance No. 01, 2019 is also applicable for labor management and engagement for this project. Furthermore, the Employment Ordinance of 1965 establishes standards for labor management and controlling methods as well as the fundamental needs of hiring or undertaking employment in industries.

- ▶ The provisions of Bangladesh Labor Act 2006 such as:
- ▶ Contracts of employment: Conditions of service and employment include wages and payment, employment of young people, maternity benefits, working hours and leave.
- ▶ Health, safety, hygiene, welfare, and compensation for injury.
- ▶ Leave entitlements, i.e. annual leave, sick leave, maternity leave, and compassionate leave.

- ▶ The protection of wages (prohibition against unlawful deductions).
- ▶ Retrenchment procedures
- ▶ Fair and unfair reasons for termination of employment.
- ▶ Grievance mechanism
- ▶ Trade unions and industrial relations etc.

Occupational Health and Safety Prerequisite

317. The provisions pertaining to health, cleanliness, and safety are included in the Bangladesh EPZ/EZ Labor Law Ordinance No. 01, 2019. This act addresses the health and safety of people at work and in the workplace, as well as the protection of people outside the workplace from risks to their health and safety resulting from or connected to their activities, as well as other incidental matters.

318. This ordinance suggests that routine health and safety inspections be conducted and that employers report any indications of danger or hazard. It also clearly stipulates that any dangerous procedures must be announced in advance and forbids hiring women, children, adolescents, or anybody else who is treated unsuited for such positions. The employer must notify the Safety inspector of any accidents, fatalities, or physical injuries that occur on the project site within two working days.

319. The Bangladesh Labour Act, 2006 has five sections that are specifically related to health, safety, and welfare: Section 208 deals with selling unguarded machinery; Section 290 deals with failing to report an accident; Section 309a deals with breaches causing death; Section 309b deals with breaches causing grievous bodily harm; and Section 309c deals with breaches causing any harm.

320. For instance, this offense would apply to any violation of the duties pertaining to health, safety, and welfare that aren't already addressed by the offenses listed above. According to Section 308, a repeat conviction for the same offense carries a double fine or jail sentence.

World Bank environmental and social framework (ESS-2): Labor and working conditions

321. The ESS-2 primarily addresses issues related to workplace health and safety, treating project workers fairly, preventing discrimination, and providing them with equal opportunities. It also protects workers who are particularly vulnerable, including women, children, migrant workers, community workers, contracted workers, and others. Prohibit the use of child labor and forced labor, safeguard worker rights, ensure workplace health and safety, and provide a suitable grievance resolution process etc., applicable for this project.

Responsible Staff

Responsible Staff

322. The labor management plan (LMP) must be effectively implemented, and the project management unit (PMU) oversees ensuring that contractors comply. Nonetheless, contractors will be closely monitored by BEZA's PMU monthly and at shorter intervals. The contractors bear full responsibility for executing the LMP on the sites in accordance with the contract specifications. The details are illustrated in Table 3.

Table 3: The list of Responsibility and Procedures

Pertinent Issues	Responsibility and Procedures
Occupational Health and Safety:	A minimum of one health and safety representative must be hired by contractors. The health and safety representative keeps track of any occurrences and makes sure that the designated safety precautions are followed daily. Serious occurrences must be reported immediately, while minor incidents must be reported to BEZA once a month. The World Bank will receive quarterly reports that include information on minor events. Significant problems will be reported right once to BEZA and the World Bank.
Labor and Working Conditions:	Contractors shall maintain records in compliance with the guidelines outlined in this LMP. To make sure that labor laws are followed, BEZA has the right to request records at any moment. At the very least, once a month, the Project Management Unit and/or its ES monitoring consultant shall compare records with actual and, if necessary, demand prompt corrective action. Quarterly reports to the World Bank will provide an overview of the problems and corrective measures.

Pertinent Issues	Responsibility and Procedures
Worker Grievances:	▶ Contractors shall provide a worker grievance redress procedure that satisfies this LMP's minimal standards. ▶ Records shall be reviewed by the Project Management Unit or of its consultants once a month. ▶ In cases where worker issues remain unresolved, the national system of Labor Act 2006, will be employed; nevertheless, the Project Management Unit will stay updated on resolutions and incorporate them into its quarterly reports to the World Bank. ▶ Although staff members in the committees (GRC) on both GRMs may have overlapping responsibilities, the labor GRM will be a distinct document from the project level GRM due to the projected number of workers. The GRMs' reporting channels can also be the same.
Additional Training:	▶ It is mandatory for contractors to always have a certified safety officer on board. ▶ Should training be necessary, the contractor will bear the cost of it. ▶ Contractor staff will get instructions from the safety officer. ▶ BEZA will arrange for training to handle the risks related to the influx of labor and will offer a schedule for the necessary trainings. ▶ In accordance with the terms of the contract, the contractor will have to provide staff for this training as well as any additional mandatory trainings mandated by BEZA.

Source: LMP, Pride Project, BEZA, 2019.

Selection of Labor Camp and Required Facilities

Selection of Labor Camp

323. When selecting or designing construction camps for dredging in a specific location, several factors should be considered to optimize productivity, minimize the space required for temporary construction, and maximize utilization. These considerations may include:

- **Proximity to the Worksite:** Ensuring the construction camp is strategically located close to the construction site to minimize commuting time for workers and transportation costs.
- **Safety and Security:** Selecting a location with low safety risks and ensuring that security measures are in place to protect workers and assets. In addition, the selected camp location should be safe from any natural, social, regional, or environmental hazards.
- **Environmental Impact:** Assessing the environmental impact of the construction camp, ensuring compliance with environmental regulations, and minimizing disruption to the surrounding ecosystem.
- **Accessibility:** Ensuring easy access for construction vehicles, materials, and personnel to facilitate efficient construction operations. It shall also be feasible to prevent any emergency easily.
- **Infrastructure Availability:** Checking for the availability of essential infrastructure such as water, electricity, and sanitation facilities to meet the basic needs of the construction camp.
- **Local Regulations and Permits:** Complying with local regulations and obtaining necessary permits for setting up construction camps in the chosen location.
- **Community Impact:** Considering the impact on the local community and obtaining their support or addressing concerns through community engagement initiatives.
- **Site Topography:** Evaluating the topography of the area to ensure that it is suitable for construction activities and can accommodate the necessary infrastructure.
- **Optimal Space Utilization:** Designing the layout of the construction camp to optimize space utilization and minimize the footprint of temporary structures.

324. Considering these factors, Contractor can enhance the efficiency and sustainability of construction camps, fostering a conducive environment for successful project execution.

Facilities at Workers' Camps

325. According to the national and international standards, the contractor will ensure numerous facilities in the labor camps are available. A list of facilities in the worker's camps is listed below-

- **Accommodation Facilities:** For all workers, the contractor will provide an adequate accommodation facility. Separate accommodation needed to be arranged for male and female working groups. A distinct location of the accommodation is required for men and women considering social security. The temporary campsite will not be located at a roadside to avoid/ minimize the danger of road accidents.
- **Potable Water Supply:** The availability and proper storage of potable water is also the responsibility of the contractor. The quality of water must be maintained by proper treatment and testing periodically.
- **Sanitation and Waste Disposal Facilities:** The contractor is responsible for providing adequate sanitary facilities to the workers on site. There must be an adequate number of toilets and bathing facilities for all workers. A separate toilet and bathing facility for the women workers is mandatory. The proper outlet of wastewater is required to maintain the hygiene of the camp as well as workers. The camp should have a treatment facility for the wastewater to maintain public health.
- **Fire Prevention Facilities:** In the camp area, the provision of firefighting equipment, including fire extinguishers, fire blankets, water sprinklers, and other necessary tools, will be ensured in sufficient quantities. This commitment aims to create a safe and secure environment, mitigating the potential risks associated with fire incidents. Adequate availability of firefighting facilities underscores dedication to the well-being and safety of all individuals within the camp premises.
- **Medical Facilities:** The contractor must arrange first aid facilities and primary treatment facilities within the camp premises, with relevant personnel. The contractor will also ensure regular health checkups for the workers.

326. Security: Adequate security initiatives should be confirmed by the contractor for the camp. Security guards, boundary fencing, adequate lighting, CCTV surveillance, entrance etc. need to be confirmed properly. Also, it is necessary to keep track of all visitors to the camp area.

Disciplinary Procedures and Grievance Mechanism

327. The contractor is tasked with facilitating the collection of written complaints on behalf of the Project Management Unit (PMU) and managing the coordination of responses to all complaints. Both verbal and written grievances must be documented in a Grievance Complaint Log. In the event of a complaint, all employees are directed to guide the complainant to either the PMU or the resident engineer, ensuring a well-organized and efficient procedure for addressing and resolving concerns. However, in the workplace, it is imperative that both employers and employees have a thorough understanding of all disciplinary procedures, grievance procedures, and related legal duties and rights. When putting in place a successful conflict resolution system, the following disputes need to be considered:

- ▶ Disciplinary action
- ▶ Individual grievances
- ▶ Collective grievances and negotiation of collective grievances
- ▶ Gender-based violence, sexual exploitation and workplace sexual harassment

Disciplinary action

328. Before taking any disciplinary actions, the employer is required to:

- ▶ Investigation to determine grounds for a hearing.
- ▶ notify the employee of the allegations in the form of local language.
- ▶ give the employee a reasonable amount of time to prepare for the hearing and to be represented by an appropriate representative or fellow employee,
- ▶ provide the employee with an opportunity to address the allegations, cross-examine the employer's witnesses, and call witnesses.
- ▶ If the employee is unable to appear, the employer may conduct the hearing without the employee's presence.
- ▶ An impartial representative must preside over the hearing, which must be convened and completed in a reasonable amount of time.
- ▶ If an employee is fired, they must be provided with the grounds for their termination as well as the opportunity to report any disagreements with the dismissal's fairness.

Individual grievances

- ▶ Every employer, including contractors, is required by Section 33 of the Bangladesh Labour Act, 2006 to have a formal grievance procedure that is known to and explained to the employee.
- ▶ Before laid off, retrenched, discharged, dismissed, removed, or otherwise terminated from their employment. The employer will send the written complaint to their employer via registered mail within 30 (thirty) days of learning about the basis for their complaint.
- ▶ With the requirement that the complaint need not be submitted by registered mail if the appointing authority accepts it immediately and notifies you in writing that it has been received.
- ▶ Following receipt of the complaint, the employer has thirty (30) days to investigate it and, after providing the affected employee with a chance to be heard, to notify him in writing of his decision.
- ▶ Within thirty (30) days of the expiration date, or, if the employer makes a decision that is not acceptable to the worker, within thirty (30) days of the date of the employer's decision, the worker may file a written complaint with the Labour Court.
- ▶ Following receipt of the complaint, the Labour Court will notify both parties, hear their complaints, and, after taking the case's facts into account, make any appropriate orders.
- ▶ The Labour Court may, among other remedies, order the complaint to be reinstated in the workforce, with or without back pay, and may change the order of removal, discharge, or dismissal to any of the lesser penalties listed in section 23(2).
- ▶ There is no fee to the court for filing a complaint or filing an appeal.
- ▶ Under this Act, no complaint will result in a criminal prosecution.
- ▶ Unless the worker in question has been denied the advantages outlined in that section, or the order was purportedly made for his welfare society activities or passed with malice, no complaint may be filed against an order terminating employment.

Collective grievances and negotiation of collective grievances

- ▶ When a worker's welfare society is recognized, the employer is required to negotiate with it and the worker's welfare society has the right to regularly negotiate terms and conditions at work.
- ▶ The collective bargaining agent has the right to engage in collective bargaining with the employer on issues pertaining to employment, terms of employment, and other relevant issues, as specified by the Bangladesh Labour Act, 2006.
- ▶ If a disagreement cannot be settled at work, the parties involved may submit a formal complaint to the labor court.

Gender-based violence, sexual exploitation and workplace sexual harassment

- ▶ Discrimination based on gender will be absolutely forbidden and subject to BEZA oversight.
- ▶ To create a guidebook for potential survivors, BEZA will, with consulting assistance, identify organizations and service providers that actively endeavor to prevent gender-based violence, sexual exploitation, and workplace sexual harassment.
- ▶ The handbook will be updated considering the fast-changing local services and capabilities.
- ▶ The PMU, and the contractor lack the necessary resources to handle complaints or offer survivors pertinent services; however, they will use the information on services that are available to refer survivors to any relevant service providers, such as medical facilities, the gender unit of law enforcement, or other relevant parties.
- ▶ Gender-based violence complaints should be filed through the project/contractor; the complaint's type, the complainant's age, and its connection to the project will all be noted, but the issue will be referred to the appropriate institutions.

CONTRACT MANAGEMENT

329. A comprehensive agreement paper between workers and the contractor will be made, outlining clear guidelines on terms of references, contract duration, probationary period, wage structure, benefits, compensation details, penalties, termination procedures, and project conclusion. Human resource personnel representing the contractor will be responsible for preparing thorough documentation and ensuring it is provided to workers prior to their appointment. This proactive approach aims to foster better understanding and clarity for all parties involved.

330. The contractor should follow the below-explained code of conduct or term of reference for hiring or recruiting the workforce into the project complying with Bangladesh Labor Act 2006 and ESS-2 of World Bank.

- **Child Labor:** The project is committed to upholding internationally recognized standards regarding child labor and young workers. A clear distinction will be made between child labor and young workers. The project strictly prohibits the use of child labor under any circumstances.
- **Young Labor:** For the employment of young workers, defined as minors aged from a full 15 years to under 18 years who have reached the minimum age of employment and completed compulsory schooling, it will be allowed only under stringent conditions. This practice will strictly adhere to the requirements of internationally recognized standards and comply with local relevant laws and regulations.
- **Forced Labor:** The Project defines forced labor in line with the ILO Convention as any work or service extracted from a person under threat or penalty, which includes penal sanctions and the loss of rights and privileges, that the person has not offered him or herself voluntarily. It includes slavery and abduction, misuse of public and prison works, forced recruitment, debt bondage, domestic workers under forced labor situations, and internal or international human trafficking.
- **Probation:** The probation period shall be negotiated by the contractor and candidates based on the candidates' jobs. Only one probation period is applied for a job. A copy of the probation contract will be provided to the candidate which outlines the working conditions and term of employment of the candidate during the probation period.
- **Health and Safety:** Contractors are responsible for providing a safe and healthy working environment for their employees. This includes compliance with occupational health and safety regulations, ensuring proper safety measures at the worksite, and providing necessary training and protective equipment.
- **Labor Contract:** The labor contract is an agreement between the contractor and an employee on a paid job, salary, working conditions, rights, and obligations of each party in the labor relations. The labor contract is also a legally binding agreement between the contractor and an employee, which is the first basis to resolve conflicts and disputes arising in labor relations.
- **Termination of Labor Contract:** An employee and the Project shall have the right to unilaterally terminate the labor contract, however, notification shall be given to each other in advance.
- **Harassment:** The Project prohibits harassment of any kind, including sexual harassment, and will take all appropriate measures to promote a harmonious work environment and to protect personnel from exposure to any form of prohibited conduct through preventive measures and the provision of effective remedies when prevention has failed. During the recruitment process, the PMU must undertake diligent reference checks of candidates to ensure that individuals who have a documented history of prohibited conduct are not hired.
- **Non-Discrimination and Equal Opportunity:** Employees must be treated equally regarding gender, age, race, religion, disability, nationality, political beliefs, membership in unions, ethnic origin, religious beliefs, as well as sexual orientation. Equality in employment shall mean the absence of any form of discrimination, direct or indirect, for reasons specified as mentioned above. The Project builds its equal opportunity policy to ensure fairness in all aspects of employment, including hiring, training, evaluation performance, compensation, and benefits, as well as the termination of employment.
- **Compensation for Damage:** An employee who causes damage to equipment or otherwise damages the employer's assets shall have to pay compensation by enabling the laws. The contractor has the right to conduct a wage deduction from the employee's salary every month to make up for the loss. An investigation shall be conducted when an employee causes damage to the company equipment or assets.
- **Wage:** Employees will be paid based on their performance and skills regardless of employees' characteristics such as gender, age, race, religion, disability, nationality, political beliefs, membership in unions, ethnic origin, religious beliefs, as well as sexual orientation. The base monthly salary shall be determined according to the wage scale and shall not be lower than the regional minimum wage.
- **Benefits:** The contractor is committed to ensuring statutory benefits for employees, including but not limited to: Medical facilities, Social Security & Childcare Assistance.

- **Hours of Work and Breaks:** The regular working hours of all employees at the Project are 8 hours per day and/or 48 hours per week. Employees are entitled to have at least four (4) days off per month. Female employees who are in their 7th-month of pregnancy and who are nursing a child under 12 months of age will only work 7 hours per day but will be compensated for 8 hours.
- **Overtime Arrangements and Overtime Compensation:** The legal requirement on maximum overtime allowed shall be followed as not to exceed 4 hours per day, 40 hours per month, and 300 hours per year. The overtime premium shall be paid following the local regulatory requirements of Bangladesh.
- **Leaves:** The breaks and leave include statutory holiday, public leave, marriage leave, maternity leave, sick leave, work injuries leave, personal leave, bereavement leave, and annual leave
- **Retrenchment:** Retrenchment means the elimination of several positions or the dismissal or layoff of several workers by an employer, generally because of a plant closing or for cost savings. In the Project, retrenchment refers to a consequence of adverse economic circumstances or because of a reorganization or restructuring, it does not cover isolated cases of termination of employment for cause or voluntary departure.

Community Workers

331. The project will involve workers from the local community. By including them, it may encourage the locals to contribute to the implementation of the project without hindrance, it will reduce the social conflict also as it may provide them working opportunity and new source of earnings. Participating in the initiative will benefit the locals' social growth as well.

Community Health and Safety

332. Community health and safety is important; it will help reduce social conflict and increase the engagement of community people for supporting the project. Any hazardous materials that are utilized in the project area need to be handled and moved carefully. Throughout the project period, the PMU of BEZA will monitor the associated risks and take appropriate mitigation actions. Hazardous materials management should be carried out to outline the organizational arrangements and responsibilities for hazardous material identification, storage, handling, use, and disposal. To protect the community health and safety, the following issues should be considered:

- ▶ Inform the community people about the project activities, schedule, and nature of work.
- ▶ Put the danger sign and safety barricades at working sites.
- ▶ Flag man should be engaged to aware the community people and limit to access to the working sites.
- ▶ Lighting should be ensured in road-crossing sections during the night-time.
- ▶ Night guards will patrol to protect the safety of the local people living close to the landfilling sites and its adjacent areas.

Record Keeping and Maintenance

333. Labor related details information needs to be kept in proper way for each labor and preserve the record for future. The project owner, the contractor, and subcontractors shall retain the following documents and records-

- ▶ Employees' personal details
- ▶ Contract details.
- ▶ Internal Labor Regulation.
- ▶ Wage scale and pay slip.
- ▶ Documents on occupational accidents and diseases.
- ▶ Grievance documents.
- ▶ Training records.
- ▶ Discipline records.
- ▶ Monthly/Quarterly/Semi-Annual self-audit report of contractors, their subcontractors, and primary suppliers' performance
- ▶ Monthly performance report of subcontractors/ primary suppliers
- ▶ Quarterly/Semi-Annual report of the Project' Labor and Working Conditions Management and

- Annual Labor Compliance Self-Assessment Report.

334. All documents and records are required to be filed for specific time periods as per regulatory requirements, whichever is more stringent and kept in safe storage accessible only to authorized personnel. Records shall be made available for inspection and audit by the contractor and the project owner or its agents upon request.

Monitoring, Auditing, and Inspections

335. Inspection, monitoring, and auditing are the important components of LMP. Inspections shall be conducted on a regular basis by relevant personnel of the contractor. Proper implementation of LMP significantly depends on regular monitoring programs. The monitoring program related to the LMP is presented in Table 4. Any major non-compliance (e.g., issues that could lead to a significant failure of structures, fatal accident, major injuries, authorities' notice/prosecution, or delay in project schedule) shall be corrected within one working day. Minor non-compliance issues (e.g., issues that do not lead to a breach of statutory requirements, bodily injuries/damage to properties, the environment, and surrounding communities) shall be corrected within a specific time frame depending on its extent.

Table 4: Monitoring Program

Action	Performance Indicators	Monitoring Protocol	Responsibilities	Monitoring Records
Internal Monitoring	The number of child labour; Number of forced labours. Number of Trade Union/Workers' Organization members and activities; Number of Trade Union/Workers' Organization dialogues and number of issues raised. Number of employees who sign the labour contract. Number of employees paid under regional minimum wage. Number of employees registered with social, health, and unemployment insurance, Type, number, and compensation of occupational accidents and diseases. Type and number of grievances; and Type and number of instances of disciplinary actions.	Quarterly	Contractor's representatives,	Employees' information. Internal Labour Regulation. Labour Contracts. Wage scale and pay slip, Documents on social, health, and unemployment insurance payments. Documents on occupational accidents and diseases. Grievance documents; and Discipline documents.
	Number of local people (separated by gender) working at the Projects	Quarterly	Contractor's representatives.	List of local workers with address verified by national ID (separated by gender)
External monitoring	Performance indicators listed above; and Labour Audit Report; Other indicators upon request by Lender.	Quarterly	Third Party/Audit Firm	Upon request by the PMU of BEZA

Internal Audit

336. In addition to regular daily inspection and periodic monitoring, need to arrange internal audits at scheduled intervals. These audits aim to verify the implementation of planned preventive actions and ensure that corrective measures are promptly executed as needed. The internal auditing program is shown in.

337. The contractor's personnel are required to perform internal audits on labor and working conditions quarterly throughout the construction phase and semi-annually during the operational phase. These audits are essential to verify that the project's performance aligns with the relevant laws and regulations. The template of the audit checklist is presented in Table 5.

Table 5: Internal Auditing Program

Sl. No.	Audit/Inspection	Responsibilities	
		The PMU of BEZA	The Contractor/Subcontractor/Primary Supplier
1.	Monthly inspection		x
2.	Quarterly self-audit		x
3.	Quarterly audit of Subcontractor/Supplier Management (during the construction phase)	x	
4.	Semi-annual Labor Compliance Self-Assessment (during construction and operation phases)	x	

Reporting

Internal reporting

338. Internal reporting involves communication among the project owner, contractors, subcontractors, and primary suppliers. Throughout the dredging activities, internal reporting will be submitted to the PMU on Monthly basis.

Quarterly self-audit reports assessing the performance of contractors, primary suppliers, and subcontractors.

- ▶ Quarterly report on the management of contractors and primary suppliers.
- ▶ Quarterly report on the management of labor and working conditions within the project.

339. The responsibility for implementing corrective actions stemming from audits and assessments lies with contractors, and primary suppliers. A status report detailing the implementation of corrective actions is to be prepared and submitted to the contractor's personnel during subsequent audits. This process ensures ongoing monitoring and improvement in response to identified issues.

Annex- 13: Traffic Management Plan

Introduction

340. Before work begins, the Contractor will create and carry out a traffic management plan to control construction-related traffic. This will be necessary to stop local traffic jams, avoid rush hour traffic, and stop accidents. The contractor will prepare traffic management plan following Master Plan of NSEZ.

An indication of traffic management plan is given as below:

Road Networks of NSEZ

341. The roadways that will transport and transmit passenger and goods traffic into and out of the NSEZ are the local and regional road networks, which are of utmost importance. Given the functional attributes of the NSEZ and the projected passenger and freight movement pattern, the Dhaka – Chattogram Highway (N1) and Feni – Sonagazi Road are expected to be of utmost importance, particularly for north-south main travel. Most of the connected roads originate from Dhaka Chattogram Road.

- ▶ Muhuri Project Road (Zorarganj to Muhuri Project)
- ▶ Bamonsundar Road
- ▶ Sheikh Hasina Sarani
- ▶ Mohan Nagar Barodarogarhat Road
- ▶ On-Site Road Network within NSEZ

Table 1: Hierarchy of Roads and Cross Sections in NSEZ:

An Emergency Road: Super Dyke (100m ROW).	Road is a high embankment road next to the sea that provides restricted access and, in case of emergency, serves as an escape from NSEZ.
Arterial Roads- Type A (100m ROW).	For vehicles traveling throughout the NSEZ to reach Precincts more quickly.
Arterial Roads – Type B (60m ROW)	For through traffic on an uninterrupted path inside the NSEZ.
Sub Arterial Roads – Type A (40m ROW)	For collecting and distributing traffic in order to link with the network of arterial roads, while providing a worse quality of service than an arterial route.
Sub Arterial Roads – Type B (30m ROW)	For gathering and distributing traffic in order to link with the network of arterial roads, while providing a worse quality of service than an arterial route.
Collector Street – (20m ROW)	For the purpose of gathering and allocating local traffic as well as granting access to major and minor thoroughfares.

Source: Master Plan of NSEZ, BEZA.

342. Intersection and Interchanges: The following intersections and interchanges should be considered during preparation of traffic management plan.

- Intersection of Sheikh Hasina Avenue with Dhaka Chattogram Road (3 arm)
- Intersection of Port connector with Dhaka Chattogram Road (3 arm)
- Intersection of Sheikh Hasina Avenue at CP More (4 arm)
- Intersection of roads at On-Site Road Network within NSEZ, particularly within the selected zones that covers through this EIA.

General Responsibility of Contractors for Movement of Vehicles during dredging activities including and land preparation

- ▶ Whenever possible, dredging pipelines should be placed in such a way that those are not creates any hazard to heavy vehicle movement and light vehicles
- ▶ To guide people and vehicles, clear and visible traffic signs on caution of dredging pipelines and related activities should be installed.
- ▶ The adjacent Ring Roads should be free from project vehicles movement that will help neighbourhoods experience low traffic congestion and improved traffic flows and avoiding passing' where dredging activities and land reclamation are carried out.

- ▶ Raising driver awareness on dredging activities, hazard from pipeline installation amongst the people who are moving within BWZA premises. Providing training to promote safe parking practices, observing traffic laws, avoiding needless stops, and overtaking.
- ▶ Employees will be tasked with upholding traffic laws, facilitating traffic flow, and preventing collisions.
- ▶ To protect the safety of the local population, a program of awareness will be held for the staff participating in dredging activities from the channel and/or Feni River and land preparation connected to the movement of heavy equipment and vehicles.
- ▶ Determining rights-of-way, speed restrictions (max. 30 km/hr.) for the site, requirements for vehicle inspections, operating guidelines and managing traffic patterns or directions.
- ▶ No child driver or child helper would be employed at the project sites for transportation of materials and goods to the sites.
- ▶ Drivers must have a valid driving license to carry goods and materials to the sites.
- ▶ To produce low noise, good engines should be ensured for the vehicles.
- ▶ To help lower the number of traffic accidents at the project sites, one-way traffic should be implemented as much as practicable.

Reporting and Monitoring

343. A regularly monitoring should be carried out during the dredging activities and land preparation with dewatering dredged spoil water should be included in the Quarterly Environmental and Social Monitoring Report. A sample format will be used to keep the record of traffic flow, accident or incident related to project's vehicle movement and necessary corrective action plan (CAP) will be preassembled accordingly.

Table2: Monitoring, CAP and Reporting

Types of traffic flow with specific locations:	Accident/Incident types	Date of occurrence	Place of occurrence	Corrective Action Plan (CAP)

Conclusion

344. The traffic management plan shall be prepared, approved by BEZA, and shared with the NSEZ to advise them of the movement, routes, and schedules of project vehicles.

Annex- 14: Waste Management Plan

Objectives of waste management:

345. The main objective of Waste Management Plan (WMP) is to organize the disposal of all wastes generated during the dredging activities in an environmentally friendly manner especially considering the following points and principles of SWMP as summarized in Table 1.

Table 1: Summary of Waste Management Principles

Principles	Application in the project
Prevent	The products and services to be employed for this project will be assessed for their potential to generate waste. Those with a lower potential will be favored.
Minimize	If a product or service produces more waste than the desirable limit, it must be used for reasons, then the use of that product or service will be minimized.
Reuse	No project materials with the potential to be reused will be disposed of after only single use.
Recycle	Where facilities are available, all recyclable domestic and kitchen waste generated by this project will be recycled.
Recover	The generation of facilities for energy recovery from waste products including that for waste gas now being flared must be encouraged. All other items that may be reused for energy or other purposes will be employed wherever possible. It's not applicable for this project.
Dispose	As a final resort, waste will be disposed of. All waste disposed of will be done responsibly in approved landfills/ due treatment and disposal sinks/sumps.

Source: National 3R strategy for Waste Management, Bangladesh

Types of Wastes

346. In addition to bulk materials and debris, based on the Solid Waste Management Rules, 2021, the potential construction wastes generated during construction period can be summarized below:

Table 2: Category of Waste

Waste category	Waste description	Reusable/Recyclable
Solid waste	Air freshener, Aerosol cane	No
	Mobile battery and other batteries	Yes
	Oil filter, motor parts	Yes
	Light, bulb	Yes
	Paints, lubricants	No
	Metals, glass, plastic	Yes
	Hand gloves, mask, goggles, face shield	No
	Toothpaste, saving cream, antiseptic container	No
	Torch light, syringe, needle etc.	No
	Clean wood and stumps	Yes
	Organic waste/kitchen waste	No
	Use tyres	Yes

Source: Solid Waste Management Rule 2021, Article 7(2), 10(4)

Hazardous waste:

347. Hazardous waste management is outlined below in accordance with relevant waste legislation and the Bangladesh E-waste Management Guidelines (2012).

Source of wastes including hazardous wastes:

348. The probable sources of various types of waste throughout the dredging and post-dredging phase will be as follows:

349. Dredging and labor camps will generate a variety of trash, including food waste, lubricating oil, waste oil, and others.

General Procedures for Collection, Storage and Handling Procedures:

350. All waste generated during and after dredging works is processed and disposed of by the contractor(s) in line with Bangladeshi laws and regulations, such as the Solid Wastes Management Rules 2021 and World

Bank's ESS standards like ESS-4. The contractor(s) will be responsible for collecting, sorting, and disposing of waste generated by dredging operations at the site as follows:

Waste Collection:

- o Waste generated during dredging works must be stored and disposed of in approved areas selected by BEZA.
- o Waste bins should be freely accessible at the working sites for workers, vendors, and other parties involved in dredging activities, such as suppliers and subcontractors.
- o Use color-coded containers (solid, hazardous and organic) at dredging sites, storage areas, and camp-sites to distinguish waste kinds, such as food, light, bulbs, needles, dry batteries, health-care waste from labor camps, lubricant oil, and oil wastes.

Waste Storage:

- To conserve soil, garbage should be stored on-site using color-coated waste bins.
- If discharged at disposal sites, the storage space should be paved and covered with soil. No open areas should be left without vegetation.

Waste Segregation and Handling:

- At the source, waste will be separated into hazardous and non-hazardous categories, taking into account recyclable and non-recyclable materials.
- Recyclable hazardous trash, such as dry batteries, should be given to authorized vendors for recycling. Non-recyclable hazardous garbage, such as healthcare waste, food waste, will be disposed of at specified sites.
- The vendor (either selected by the contractor(s) or by BEZA) will take overall responsibility for collecting, storing, and handling hazardous waste to remove from the sites and dispose of them in a safe disposal point (the location of the disposal site will be decided by BEZA with the collaboration of local government agencies, e.g., Union Parishad).

351. Contractors and vendors must maintain appropriate Personal Protective Equipment (PPE) when collecting and handling hazardous waste from working sites to ultimate disposal points.

Table 3: Draft Monitoring Form on Waste during Dredging and Post-dredging Activities

Locations	Kinds of waste	Quantity (kg)	Disposal method
Landfill sites			
Dredging sites			
Labor campsites			
Storage sites			

Annex- 15: Stakeholder Engagement Plan

Introduction

352. Stakeholder communication and engagement is an important process to ensure the effectiveness, accountability and transparency of any development program. Through the process of consultation and participation, people can participate in project activities, raise their voice and give their opinion in project design, planning and implementation. This consultation, public participation and information disclosure has been prepared and proposed guideline for implementing the consultation process and stakeholders' engagement throughout the life cycle of the project, started from preparation to implementation. The E&S consultant hold fresh consultations and incorporated their suggestions and recommendations in the project design.

353. This section describes the different methods of the consultations, issues discussed with the stakeholders, outcome of the exercise. The consultant used the methods for consultations,

- Public participation and information disclosure include stakeholder's consultation meetings;
- Key Informant Interviews (KIIs),
- Focus Group Discussions (FGDs); individual contact etc.

354. Total from December 2023 to February 2024 for the preparation of the ESIA and disseminating relevant information of the PAPS of the Project numerous KII, FGD and one public consultation was conducted.

Objectives

355. Consultation is a process through which stakeholders can participate in project planning and implementation. Public consultation and disclosure are crucial to the success of any development project. Through the consultation process, affected communities can raise their voices about the project, its impacts, compensation policy and participate in project design and impact mitigation planning. Basically, the suggestion is to review the impact of the project. Many kinds of problems arise while implementing a project. These problems can be tackled if the affected communities are properly informed and consulted about the project. Consultation ensures community participation and allows affected communities to make appropriate choices and choices. Public or community participation through the consultation process will establish transparency in project planning and implementation. Consultation is a two-way process where implementing agencies, policy makers, beneficiaries and affected individuals discuss and share their concerns in a project process.

356. World Bank (WB) safeguards policies place a high priority on public consultation and participation to enhance community voice and ensure inclusion of community views in social design and implementation.

Purpose of Stakeholder Engagement Plan

357. The purpose of this SEP is to define a program for stakeholder engagement, including public information disclosure and consultation, throughout project lifecycle. The SEP outlines the ways in which various stakeholders will be identified and includes a mechanism by which they can raise concerns, provide positive or negative feedback, or make complaints about the project activities. This will begin very early in the project cycle and will be based on the prior disclosure and dissemination of relevant, transparent, objective, meaningful and easily accessible information in a timeframe that enables meaningful consultation with stakeholders in a culturally appropriate format, in relevant local languages and is understandable to stakeholders. The SEP will endeavor to disclose information that will allow stakeholders to understand the risks and impacts of the project as well as potential opportunities. It will also provide stakeholders with access to information, as early as possible before the Bank proceeds to project appraisal, and in a timeframe that enables meaningful consultations with stakeholders on project design. The SEP is a living document and will be updated throughout project implementation based on the feedback and information received through continued consultation conducted throughout the life of the project.

Legal Regulation and Requirement

358. Bangladesh has relevant and adequate law/regulation on the right to information, information disclosure and transparency during decision making/public hearing etc. Relevant laws and regulations pertaining to these issues are given below:

Constitution of the People's Republic of Bangladesh

359. **Article 36. Freedom of movement.** Subject to any reasonable restrictions imposed by law in the public interest, every citizen shall have the right to move freely throughout Bangladesh, to reside and settle in any place therein and to leave and re-enter Bangladesh.

360. **Article 37. Freedom of assembly.** Every citizen shall have the right to assemble and to participate in public meetings and processions peacefully and without arms, subject to any reasonable restrictions imposed by law in the interests of public order health.

361. **Article 38. Freedom of association.** Every citizen shall have the right to form associations or unions, subject to any reasonable restrictions imposed by law in the interests of morality or public order;

362. **Article 39. Freedom of thought and conscience, and of speech.** Citizen's freedom of thought and conscience is guaranteed; subject to any reasonable restrictions imposed by law in the interests of the security of the State, friendly relations with foreign states, public order, decency or morality, or in relation to contempt of court, defamation or incitement to an offence the right of every citizen of freedom of speech and expression; and freedom of the press, are guaranteed.

363. **Article 59. Local Government.** Local Government in every administrative unit of the Republic shall be entrusted to bodies, composed of persons elected in accordance with law; everybody shall, subject to this Constitution and any other law, perform within the appropriate administrative unit such functions as shall be prescribed by Act of Parliament, which may include functions relating to administration and the work of public officers and the maintenance of public order; the preparation and implementation of plans relating to public services and economic development.

364. **Article 60. Powers of local government bodies.** For the purpose of giving full effect to the provisions of article 59 Parliament shall, by law, confer powers on the local government bodies referred to in that article, including power to impose taxes for local purposes, to prepare their budgets and to maintain funds.

The Consumers' Right Protection Act, 2009

365. This Act aims at protection of the rights of the consumers, prevention of anti-consumer right practices and related matters connected therewith.

Right to Information Act (RTIA) 2009

366. The Act makes provisions for ensuring free flow of information and people's right to information. The freedom of thought, conscience and speech is recognized in the Constitution as a fundamental right and the right to information is an alienable part of it. The right to information shall ensure that transparency and accountability in all public, autonomous and statutory organizations and in private organizations run on government or foreign funding shall increase, corruption shall decrease and good governance shall be established.

Law on Local Government

367. Bangladesh is a democratic republic with two spheres of government: national and local. Local government is enshrined in the constitution (Chapter IV Articles 59 and 60) and the main legislative texts include the Acts covering zila parishads (2000), upazila parishads (1998, amended 2009), union parishads (2009), operatives (2009), city corporations (2009) and hill district councils (1989). The local government division within the Ministry of Local Government, Rural Development and Cooperatives is responsible for local government, with the exception of the hill district councils, which are under the Ministry of Hill Tract Affairs.

Bangladesh Labor Law, 2006 (Amended in 2013) and Labor Code 2015

368. This Law pertains to the occupational rights and safety of workers and the provision of a comfortable work environment and reasonable working conditions. The Labor Law of Bangladesh 2006 bans children under the age of 14 from working. Chapter III of the Act under "EMPLOYMENT OF ADOLESCENT WORKER" puts restrictions on employment of children and adolescents as follows:

(1) No child shall be employed or permitted to work in any occupation or establishment.

(2) No adolescent shall be employed or permitted to work in any occupation or establishment, unless:

(a) A certificate of fitness in the form prescribed by rules, and granted to him by a registered medical practitioner is in the custody of the employer; and

(b) He/She carries, while at work, a token containing a reference to such certificate.

World Bank Requirement

369. As defined by the ESF and ESS10, stakeholder engagement is an inclusive process conducted throughout the project life cycle. Where properly designed and implemented, it supports the development of strong, constructive and responsive relationships that are important for successful management of a project's environmental and social risks. As per ESS10 the process of stakeholder engagement will involve the following, as set out in further detail in this ESS: (i) stakeholder identification and analysis; (ii) planning how the engagement with stakeholders will take place; (iii) disclosure of information; (iv) consultation with stakeholders; (v) addressing and responding to grievances; and (vi) reporting to stakeholders. ESS10 also requires the development and implementation of a grievance redress mechanism that allows project-affected parties and others to raise concerns and provide feedback related to the environmental and social performance of the project and to have those concerns addressed in a timely manner.

Approach and Methodology for Stakeholder Mapping and Analysis

Identification of Stakeholders:

370. During the preparation of the SIA study, all stakeholders are initially synthesized into two categories which are identified as:

- Project-affected parties: those who will be or are likely to be affected by the project, and zones 12 and 13 and Precinct B and part of Precinct F of NSEZ are fully occupied by BEZA, but some squatters and peoples from the outside are grazing their cattle and fishing there.
- Other interested parties: those who may be interested in the project and who may positively or negatively influence the views of the affected parties or affect the sustainability of the implementation process or project outcomes.

371. Project stakeholders such as local people, land owners, house owners, civil society organizations, locally active NGOs, government officials, farmers, transport owners, women and vulnerable groups, fishermen etc. will be affected directly or indirectly during project construction due to labor flow and project construction activities

- A combination of mixed methods of information disclosure and consultation process was adopted at this stage of ESIA preparation. The method selected for consultation was basically designed keeping in mind the profile of the stakeholders, type of information desired and level of engagement required. In each consultation session the consultant introduced themselves, introduced the project and the purpose of engagement with the respective stakeholder. The primary methods followed in the consultation process are:
- Public Consultation meeting (PCM)
- Key Informant Interview (KII) and
- Focus group discussion (FGD)

Stakeholder Identification and Analysis

372. The first step in preparing a SEP is mapping the Project stakeholders. This analysis is central to the designing of the SEP, particularly in developing the Project's approach to consultation and communication. This involves identifying relevant Project stakeholders or groups of stakeholders, characterizing the key stakeholder issues and concerns, and mapping the Project stakeholders to determine the appropriate level of engagement for each stakeholder or stakeholder group. This section describes the outputs from the stakeholder mapping process.

373. The stakeholders of a project vary depending on the details of the project. They may include local communities, national and local authorities, neighboring projects and nongovernmental organizations.¹Stakeholders refer to project-affected parties and other interested parties:²Project-affected parties: those who are or are likely to be affected by the project, and Other interested parties: those who may have an interest in the project and who could, for example:

- Influence the opinions of affected parties either positively or negatively, or
- Affect the implementation process or the sustainability of the project's outcomes

374. Where possible, stakeholder engagement will utilize engagement structures within the national system, e.g., community meetings, supplemented as needed with project-specific arrangements.³

375. Community representatives may provide helpful insight into the local settings and act as main conduits for dissemination of the Project-related information and as a primary communication/liaison link between the Project and targeted communities and their established networks. The legitimacy of such representatives may stem both from their official elected status and their informal and widely supported standing within the community that allows them to act as focal points of contact in Project's interaction with its stakeholders. Examples of legitimate stakeholder representatives include and are not limited to:

- elected officials of regional, local, and village councils and self-governance bodies;
- leaders of informal or traditional community institutions such as ward member or UP chairman;
- non-elected leaders that have wide recognition within their community, such as chairpersons of local initiative groups, committees, local cooperatives etc.;
- leaders of community-based organizations, local NGOs and women's groups;
- the elders and veterans within the affected community;
- religious leaders, including those representing traditional faiths;
- Teachers and other respected persons in the local communities, etc.

376. Verification of stakeholder representatives (i.e. the process of confirming that they are legitimate and genuine advocates of the community they represent) remains an important task in establishing contact with the community stakeholders.

Project-affected parties

377. Affected Parties include local communities, community members and other parties that may be subject to direct impacts from the project during development phase. Specifically, the following individuals and groups fall within this category:

- Affected Persons who are living in or beside the project area;
- Communities in the vicinity of the project's planned activities;
- The local population and local communities including the vulnerable group that include the elderly, physically and mentally disabled persons, single mothers, adolescent girls, minority transgender community and the children;
- Local health, education and like services that would have to provide basic support to the NSEZ/EZ staffs, workers and their families including school going children like basic healthcare, schooling etc.
- Residents, business entities, and individual entrepreneurs in the area of the project who are adversely affected owing to the project activities, and others that can benefit from the employment, training and business opportunities offered due to implementation of the project;
- During the operation phase, when the factories are in place and functioning, staffs and workers of the factories, buyers of the product, suppliers of raw material, vendors, utility service providers and local community who would be affected by the factory generated pollutants of all forms
- During operation phase the Entrepreneurs/Businessmen investing in the project could also be adversely affected by staffs/workers who may adopt illegitimate means like arson, workers agitation, destruction of machineries etc. to coerce the authority to meet their ends etc.
- At times unilaterally adopted BEZA policies may also go against the interest of the entrepreneurs investing in the EZ/PEZ including NSEZ.

378. Local NGOs and initiative/advocacy groups represent the considerable capacity that the project(s) may tap for disseminating the information and raising awareness of the planned activities among the potentially affected communities in the project area. NGOs typically have well established interaction with the local communities, are able to propose the most effective and culturally appropriate methods of liaising based on the local customary norms and prevailing means of communication, and possess the facilitation skills that may be utilized as part of the project's consultations. In addition, NGOs may lend assistance in disseminating information about the proposed project(s) to the local communities, including in the remote areas (e.g. by placing information materials about the project in their offices, distributing the project information lists during events that they are organizing), and provide venues for the engagement activities such as focus-group discussions.

Other interested parties

379. The projects' stakeholders also include parties other than the directly affected communities, including:

- Civil society groups and NGOs on the regional, national and local levels, which pursue environmental and socio-economic interests and may become partners of the project.
- Organizations within this group are likely to be located outside the project's Direct Area of Influence;
- Community-based groups and non-governmental organizations (NGOs) working on Labor, or Gender issues including GBV and Human Rights in the locality that work for and represent local residents and other local interested groups, and act on their behalf;
- GoB officials, permitting and regulatory agencies at the national and regional levels, including environmental, technical, social protection and labor authorities.
- GoB officials at the district level and below including DoE: local Union Parisad, Upazila Parisad in the project area, village administrations; local MP etc.
- Business owners and providers of services, goods and materials that will be involved in the project's wider supply chain and transportation business or may be considered for the role of project's suppliers in the future;
- Residents of the other rural settlements within the project area that can benefit from employment and training opportunities stemming from the project;
- Mass media and associated interested groups including District and local Press Club, local, regional and national print and broadcasting media, digital/web-based entities, and their associations.
- Foreign investors & companies, Development Partners (at National and International levels) etc.

Table 1: A general list of stakeholder groups identified below

Other interested parties	Interest in the project
International Level	
Environmental and societal NGOs (including those working on Labor, Human rights, environment and Gender and GBV matters)	Understanding of the range of problems and opportunities associated with the project(s).
Foreign Investors	The NSEZ has all the potentials to attract FDI as the most attractive destination for investment in Bangladesh.
Multinational or foreign companies	Interested in operating or partnering with companies in the area.
Donor agency	This zone is environmentally and socially sustainable and the lesson and learned may share for international community
Academics and researchers	They may involve with various research work at the project site to provide scientific knowledge of the impacts of the project.
National Level	
Bangladesh Garment Manufacturers and Exporters Association	They have shown interest to establish one garments park at NSEZ complying with required potential environmental and social issues including setting up ETPs
Bangladesh Export Processing Zones Authority	They will establish BEPZA Economic Zone in this city and complying with required potential environmental and social issues including setting up ETPs
59 foreign and local investors	They will establish their industries and complying with required potential environmental and social issues including setting up ETPs
Chattogram Port Authority	Plan to construct a sea port under PPP within NSEZ complying with potential environmental and social issues
Business and workers' organizations	Interest in procurement and supply chain, potential environmental and social as well as community health and safety, including occupational health and safety of the Labor force
Academic institutions (e.g. universities, think tanks, schools)	There would be a large influx of migrant workers/Managers/staffs with family in the project area. Students from this group would

Other interested parties	Interest in the project
	Need schooling and healthcare facilities in situ. This demands the establishment of educational institutions within and near the project area. In addition, academic institutions and think tanks would be interested in the project due to its large development impacts (economic growth, social impacts, etc.)
Training service providers	They would be providing the training and skill development programs for workers
Urban Development Department	They are working for preparing a comprehensive Master Plan for influence area of NSEZ and would need help from the local government to implement the plan
Roads and Highways Department	The approach road will play vital role to ensure efficient transportation links with NSEZ, they may help BEZA and local community through ensuring its proper maintenance
Environmental and societal NGOs	Understanding of the range or problems associated with the project(s)
Other NGOs (HR, Gender, Labor Issues)	Represents the interests of different interested parties and vulnerable groups
Mass media	They are intermediaries for informing the general public about the planned activities of the project developer(s) and for information disclosure in connection with the proposed project(s)
Business community	Economically interested business entities (conclusion of contracts, economic damage due to competition, etc.); they can be also be potential customers of the project developer
Project employees and Project's sub-contractors	Technical understanding of the range or problems associated with the proposed project(s) including Health and Safety issues
Regional and District Level	
Administration of Chattogram Region	Legislative and executive authorities. Functions of supervision and monitoring
Administrations of Chattogram and Feni districts (for WB financed projects)	Legislative and executive authorities. Functions of supervision and monitoring
Local NGOs (HR, Gender, Labor Issues)	Represents interests of different interested parties and vulnerable groups
Mass media	They are intermediaries for informing the general public about the planned activities of the project developer and for information disclosure in connection with the proposed project.
Business community	Economically interested business entities (conclusion of contracts, economic damage due to competition, etc.);
Local communities	Interested parties living in regions of NSEZ that could be indirectly affected by the realization of the projects
Local small business man	Small scale businessmen in the project vicinity would benefit from the project related workers/staff and managers and the raised purchasing power of the local populace getting jobs in the project through selling daily necessities
Mirsharai, Sitakunda and Sonagazi Upazila Administration	The influence area of this city will be busier. The administration of these Upazillas may help to BEZA to control the unplanned development
Union Level	
UP Chairman	Elected Union Porisad Chairman would be interested to have influence over resettlement, compensation and providing jobs to

Other interested parties	Interest in the project
Ward Members	Represent interests of the affected communities (land users) and vulnerable groups
Local land users and other local population	Potential vulnerable groups, affected communities and other interested parties living in the close proximity of the project area

380. In the process of project implementation and operation phase when goods would be produced at the factories at NSEZ/EZ/PEZs and, whenever certain 'Interested Party/Parties' are identified, they would be included, and the SEP would be updated.

Disadvantaged/vulnerable individuals or groups

381. BEZA will take special measures to ensure that disadvantaged and vulnerable groups have equal opportunity to access of information, participate in the engagement activities, provide feedback, and submit grievances. The deployment of the Social Development Officers will help to ensure proactive outreach to all population groups, and they will make a special effort to engage with those identified as vulnerable or disadvantaged. If necessary, BEZA will provide transport to public meetings for vulnerable people, and will also deliver brochures and informational material to such households in the language appropriate. To reach the elderly and the disabled in the community and the single mothers and the transgender community, dedicated efforts would be undertaken to reach them at their convenience by the social development Officer. BEZA will take necessary supportive measures for the vulnerable groups within the overall process. The vulnerable groups may include and are not limited to the following:

- Elderly people, especially if they are living alone;
- Persons with physical and mental disabilities and their care givers;
- Low-income families dependent on state support;
- Women-headed households or single mothers with underage children, adolescent girls;
- Children and adolescent girls
- The unemployed persons (men and women).
- Squatters
- Poor farmer and fishermen
- Minority Transgender community within the area of influence of the project area

382. It is anticipated that, among the above vulnerable groups, working age group who will be getting jobs in construction activities and suppliers of goods and services will be benefitted. Preferential employment of vulnerable people from the zone of influence should be ensured. Equal remuneration for the male and female workers for similar types of assignment will encourage the female to do job. Social security and protection against gender-based violence can benefit the poor women particularly adolescent girls.

383. As the SEP is a living document, vulnerable groups within the community affected by the project will be further confirmed, included and consulted with, as appropriate. Description of the methods of engagement that will be undertaken by the project will be provided in the upcoming Regional Environmental and Social Assessment of NSEZ. In future, BEZA will take following steps to provide support vulnerable peoples in collaboration with developers and unit investors:

- BEZA will give priority to vulnerable family members to provide skills development training and on successful completion would provide jobs on priority basis.
- BEZA will create and ensure jobs for women-headed households as well as low-income families and persons with disabilities
- BEZA will ensure active participation of all stakeholders including the vulnerable groups in the project-related decision-making consultation meetings.

Stakeholder Engagement Program

Purpose and timing of stakeholder engagement program

384. The main goal of the Stakeholder engagement program is (i) building and maintaining a constructive relationship with various stakeholders that have been identified; (ii) to assess the level of stakeholder interest and support for the project and to enable stakeholders' views to be taken into account in project design and environmental and social performance; (iii) to inform stakeholders of the project related information especially issues that could potentially affect them in a timely, understandable, accessible and appropriate manner and format; (iv) to provide them with accessible and inclusive means to raise issues and grievances, and allow IA to respond to and manage such grievance.

385. For the sake of the identification, the following criteria, adjusted to take account of local specific conditions, are proposed to be used for the identification of stakeholders:

- Liability: project implementation or on-going operations may result in legal, financial or other liabilities of the proponent to a social group;
- Influence: a social group may be able to substantially influence project implementation or on-going operations;
- Partnership: there are opportunities for building partnership relations between the project developer and a given social group in the framework of the project implementation or on-going operations;
- Dependency: project implementation may significantly affect a given social group, in particular, it may affect vital interests of its representatives if they are dependent on the project on-going operations in economic or financial terms;
- Representation: a social group may have a right to represent interests with regard to a project or on-going operations, and this right is legitimated through legislation, custom and and/or cultural specifics;
- Expressed interest: a social group and/or individual may express interest to a project or on-going operations, and this group is not necessarily directly affected by the planned or current activities

Information disclosure

386. As a standard practice, the Project materials (PAD, Implementation progress reports, monitoring reports, on-site construction specific information and E&S reports/documents including ESMF, ESMP, ESCP, SEP, LMP, RFP or RAP) released for disclosure are accompanied by making available the registers of comments and suggestions from the public that are subsequently documented by BEZA in a formal manner.

387. The project director will continue applying the similar approach to disclosure for any additional appraisal materials that will be prepared as part of the project development.

388. The ESMF report (together with the associated environmental and social management plan – ESMP) in Bangla, and English will be made available for public review in accordance with the international requirements. The SEP will be released in the public domain and will be available for stakeholder review during the same period of time.

389. Distributions of the disclosure materials will be through making them available at venues and locations frequented by the community and places to which public have unhindered access. Free printed copies of the SEP in Bangla and English will be made accessible for the general public at the following locations:

- The Headquarters of BEZA
- The District Administration office of Chattogram
- The Project office in Mirsharai;
- Upazila Headquarters of Mirsharai
- Union Parisad Office
- Local NGO offices Mirsharai; and
- Other designated public locations to ensure wide dissemination of the materials.
- Newspapers, posters, radio, television;
- Information centers and exhibitions or other visual displays;

- Brochures, leaflets, posters, nontechnical summary documents and reports;
- Official correspondence, meetings

390. Electronic copy of the SEP will be placed on the project web-site <http://www.beza.gov.bd>. This will allow stakeholders with access to Internet to view information about the planned development and to initiate their involvement in the public consultation process. The web-site will be equipped with an on-line feedback feature that will enable readers to leave their comments in relation to the disclosed materials.

391. The mechanisms which will be used for facilitating input from stakeholders will include further in the report and will disclose materials to local, regional and national NGOs as well as other interested parties.

Proposed strategy for stakeholder engagement

392. Stakeholder engagement activities will provide stakeholder groups with relevant information and opportunities to voice their views on issues that matter to them/affect them. Table (Planned stakeholder engagement activities) presents the stakeholder engagement activities that NSEZ authority will undertake for their project(s) which also includes how people would be made aware and opportunities for participation including location and frequency. The activity types and their frequency are adapted to the three main project stages: project preparation (including design, procurement of contractors and supplies), construction, and operation and maintenance.

393. The methods used would vary according to the target audience and would include:

- Public/community meetings, separate meetings for women and vulnerable
- Face-to-face meetings
- Focus Group Discussions
- Workshop with the Experts
- Surveys, polls etc.
- Interviewing stakeholders and relevant organizations
- Mass/social media communication (as needed)
- Disclosure of written information: brochures, posters, flyers, website Information boards or desks at various sites where project work is ongoing - In Mirsharai, Sitakunda and Sonagazi area
- Grievance mechanism
- NSEZ/EZ/PEZ newsletter and website
- BEZA newsletter and website.

Table 2: Planned stakeholder engagement activities

Stage	Target stakeholders	Topic(s) of engagement	Method(s) used	Location/frequency	Responsibilities
STAGE 1: PROJECT PREPARATION (PROJECT DESIGN, SCOPING, RESETTLEMENT PLANNING, ESMF/RPF/SEP DISCLOSURE)	Project Affected People: - People potentially affected by land acquisition - People residing in project area - Vulnerable households - Squatters and petty businessmen around the Approach Road - Local administration and local leadership - Benefited Group - Local laborer's to be engaged in the project work - Suppliers and service providers - Contractors, sub-contractors - Transport owners & workers	- Project scope and rationale - ESMF, ESMP, RPF, SEP, RAP (if triggered) disclosures - Land acquisition process and compensation - Assistance in gathering official documents for authorized land uses - Project E&S principles - Resettlement and livelihood restoration options - Grievance mechanism process	- Public meetings, separate meetings for women and vulnerable - Face-to-face meetings - Mass/social media communication (as needed) - Disclosure of written information: brochures, posters, flyers, website Information boards or desks - In Mirsharai, Sitakunda and Sonagazi area - Grievance mechanism - BEZA newsletter and website	- In Mirsharai, Sitakunda and Sonagazi for disclosure of Drafts ESMF, RPF, SEP, RAP (if relevant) - In Mirsharai, Sitakunda and Sonagazi at beginning of construction that would affect the area - Continuous communication through mass/social media and routine interactions - Throughout SEP development as needed - At a central place along the Approach Road	- BEZA Pride Team - PD and NSEZ point of Contact - Social Specialists
	Other Interested Parties (External) - Mirsharai, Sonagazi and Sitakunda Upazila - Representatives in villages	- Project scope, rationale and E&S principles - ESMF, ESMP, RPF, SEP, RAP disclosures - Land acquisition process - Identification of land plots and uses	- Face-to-face meetings - Joint public/community meetings with PAPs - Public Disclosure	- Throughout SEP development as needed - Project launch meetings in Mirsharai, Sitakunda and Sonagazi - Quarterly meetings in affected villages and	- BEZA E&S Team & management - PD and NSEZ point of Contact - Social Specialists

Stage	Target stakeholders	Topic(s) of engagement	Method(s) used	Location/frequency	Responsibilities
		- Resettlement and livelihood restoration options (if needed) - Grievance mechanism process	-	Mirsharai, Sitakunda and Sonagazi or as an when demanded by the affected community - Disclosure meetings in nearby NSEZ	-
	Other Interested Parties (External) - Press and media - NGOs - Businesses and business organizations - Workers' organizations - Academic institutions - National Government Ministries - Mirsharai, Sitakunda and Sonagazi Government Departments - General public, tourists, jobseekers	- Project scope, rationale and E&S principles - ESMF, ESMP, RPF, SEP, RAP disclosures - Grievance mechanism	- Public meetings, trainings/workshops (separate meetings specifically for women and vulnerable as needed) - Mass/social media communication - Disclosure of written information: Brochures, posters, flyers, website - Information boards or desks in Mirsharai, Sitakunda and Sonagazi - Grievance mechanism - Notice board for employment recruitment	- Project launch meetings in Mirsharai - Meetings in affected Mirsharai, Sitakunda and Sonagazi Upazilla as needed - Communication through mass/social media (as needed) - Information desks with brochures/posters in affected villages (continuous) - Public forums in Dhaka	- BEZA Pride team - PD and NSEZ - authority through their point of Contact
	Other Interested Parties (External) - Other Government Departments including DoE from which permissions/clearances are required; - Other project developers, donors	- Legal compliance issues - Project information scope and rationale and E&S principles - Coordination activities - Land acquisition process - Grievance mechanism process - ESMF/ESMP/RPF/SEP disclosures	- Face-to-face meetings - Invitations to public/community meetings - Submission of required reports	- Disclosure meetings - Reports as required	- BEZA PRIDE team - PD and NSEZ point of Contact

Stage	Target stakeholders	Topic(s) of engagement	Method(s) used	Location/frequency	Responsibilities
	Other Interested Parties (Internal) - Other NSEZ staff - Supervision Consultants - Supervision contractors, sub-contractors, service providers, suppliers, and their workers	- Project information: scope and rationale and E&S principles - Training ESMF/ESMP requirements and other management plans - Grievance mechanism process - E&S requirements - Feedback on consultant/contractor reports	- Face-to-face meetings - Trainings/workshops - Invitations to public/community meetings	- As needed	- BEZA PRIDE team - PD and project management team
STAGE 2: CONSTRUCTION AND MOBILIZATION ACTIVITIES	Project Affected People - People potentially affected by land acquisition - People residing in project area - Vulnerable households Benefited Group - Local laborer to be engaged in the project work - Suppliers and service providers - Contractors, sub-contractors - Transport owners & workers	- Grievance mechanism - Health and safety impacts (EMF, community H&S, community concerns) - Employment opportunities - Project status	- Public meetings, open houses, trainings/workshops - Separate meetings as needed for women and vulnerable - Individual outreach to PAPs as needed - Disclosure of written information: brochures, posters, flyers, website - Information boards in Mirsharai, Sitakunda and Sonagazi - Notice board(s) at construction sites - Grievance mechanism - NSEZ Quarterly newsletter	- Quarterly meetings during construction stage - Communication through mass/social media as needed - Notice boards updated weekly - Routine interactions - Brochures in local offices	- BEZA PRIDE team and project management team along with NSEZ point of Contact - Social Specialist - Supervision consultants - Contractor/sub-contractors
	Other Interested Parties (External) - Governmental committees for land use and compensation (MBC) - Mirsharai, Sitakunda and Sonagazi and representatives in	- Project scope, rationale and E&S principles - Grievance mechanism - Project status - World Bank compensation requirements	- Face-to-face meetings - Joint public/community meetings with PAPs	- As needed (monthly during construction stage)	- BEZA PRIDE team and project management team - Social Specialist - NSEZ point of Contact

Stage	Target stakeholders	Topic(s) of engagement	Method(s) used	Location/frequency	Responsibilities
	villages				- Supervision and RAP consultants - Contractor/sub-contractors
	Other Interested Parties (External) - Press and media - NGOs - Businesses and business organizations - Workers' organizations - Academic institutions - National Government Ministries - Mirsharai, Sitakunda and Sonagazi Government Departments - General public, tourists, jobseekers	- Project information - scope and rationale and E&S principles - Project status - Health and safety impacts - Employment opportunities - Environmental concerns - Grievance mechanism process	- Public meetings, open houses, trainings/workshops - Disclosure of written information: brochures, posters, flyers, website, Information boards in BEZA - Notice board(s) at construction sites - Grievance mechanism	- Quarterly meetings during construction stage - Communication through mass/social media as needed - Notice boards updated weekly - Routine interactions - Brochures in local offices	- BEZA PRIDE team and project management team - Social Specialist - NSEZ point of Contact
	Other Interested Parties (Internal) - Other NSEZ staff - Supervision Consultants - Contractor, sub-contractors, service providers, suppliers and their workers	- Project information: scope and rationale and E&S principles - Training on ESMF/ESMP requirements and other sub-management plans - Worker grievance mechanism	- Face-to-face meetings - Trainings/workshops - Invitations to public/community meetings	- Daily, as needed	- BEZA PRIDE team and project management team - Social Specialist - NSEZ point of Contact

Stage	Target stakeholders	Topic(s) of engagement	Method(s) used	Location/frequency	Responsibilities
STAGE 3: OPERATION AND MAINTENANCE	Project Affected People: - People residing in project area - Vulnerable households	- Satisfaction with engagement activities and GRM - Grievance mechanism process - Damage claim process	- Outreach to individual PAPs - BEZA website - Grievance mechanism - BEZA newsletter	- Outreach as needed - Meetings in affected Mirsharai, Sitakunda and Sonagazi and villages (as needed/requested) - Monthly (newsletter)	- BEZA PRIDE team and project management team - Social Specialist - NSEZ point of Contact
	Other Interested Parties (External) - Press and media - NGOs - Businesses and business organizations - Workers' organizations - Academic institutions - Local Government Departments (Mirsharai, Sonagazi and Sitakunda) - General public, tourists	- Grievance mechanism process - Issues of concern - Status and compliance reports	- Grievance mechanism - BEZA website - Face-to-face meetings - Submission of reports as required	As needed	- BEZA PRIDE team and project management team - Social Specialist - NSEZ point of Contact

Stakeholder Mapping

394. Stakeholder-mapping, illustrated in the figure below was undertaken to identify the level of engagement required for each group of stakeholders based on their level of interest and level of impact. The mapping description is as follows:

395. The stakeholders that appear in the top right quadrant are those that need to be managed closely (i.e. the stakeholders that need to be proactively engaged on a regular basis and engagement efforts should be focused on this group). This is because these are the stakeholders that are most interested in the Project and have the potential to impact its outcome (i.e. the ability of the Project to go ahead).

396. The stakeholders that appear in next quadrants (i.e. in Q2 and Q3) need to be kept informed

- I.e. provided information and consulted on issues of interest to the stakeholders.
- The final stakeholders (i.e. in Q4) need to be monitored – i.e. informed of key Project aspects. It is important to track if their level of interest or impact changes.

397. The stakeholder list as well as stakeholder analysis and mapping will continue to be revised and updated during the consultation during the planning phase, based on the ongoing receipt of comments and input from local, national and international stakeholders directed to the Project.

High Influence-Low Interest (Q2 – Keep Satisfied) Media	High Influence-High Interest (Q1- Manage Closely) FinancierIA Government Agencies Local Business Association Potential Entrepreneurs
Low Influence - Low Interest (Q4- Monitor) General Public	Low Influence - High Interest (Q3- Keep Informed) Project affected communities Vulnerable Groups

Annex- 16: Drainage Management Plan

Introduction

Background of the Study

398. The proposed IMD zone part of precinct F, would be reclaimed/filled up by dredged material sourced at least 2.5 km offshore. During the land development activities, an adequate temporary drainage system to manage the spill runoff will be required by the contractor. The original area of the landfill was 1200 acres. The landfill has an average depth of 3.5m. Upon closing, the dredge materials in place were estimated to be 16,000,000 cubic meters. For instance, about 30% of the sand will be dumped in landfills, and the remaining 70% will spoil runoff to the adjacent surface water sources after settlement. However, the working sites typically get enormous amounts of rainwater during the monsoon season's severe downpour, this plan will also take management of or removal of the rainwater during that time into consideration.

Objectives

399. The drainage management plan has a primary objective to prevent runoff from landfill sites. This runoff will then be diverted into nearby canals or surface water sources located within the designated sections of Precincts F. As part of the data collection process for the ESIA study, community interviews, secondary data sources, and primary or baseline data were used to prepare this drainage management plan.

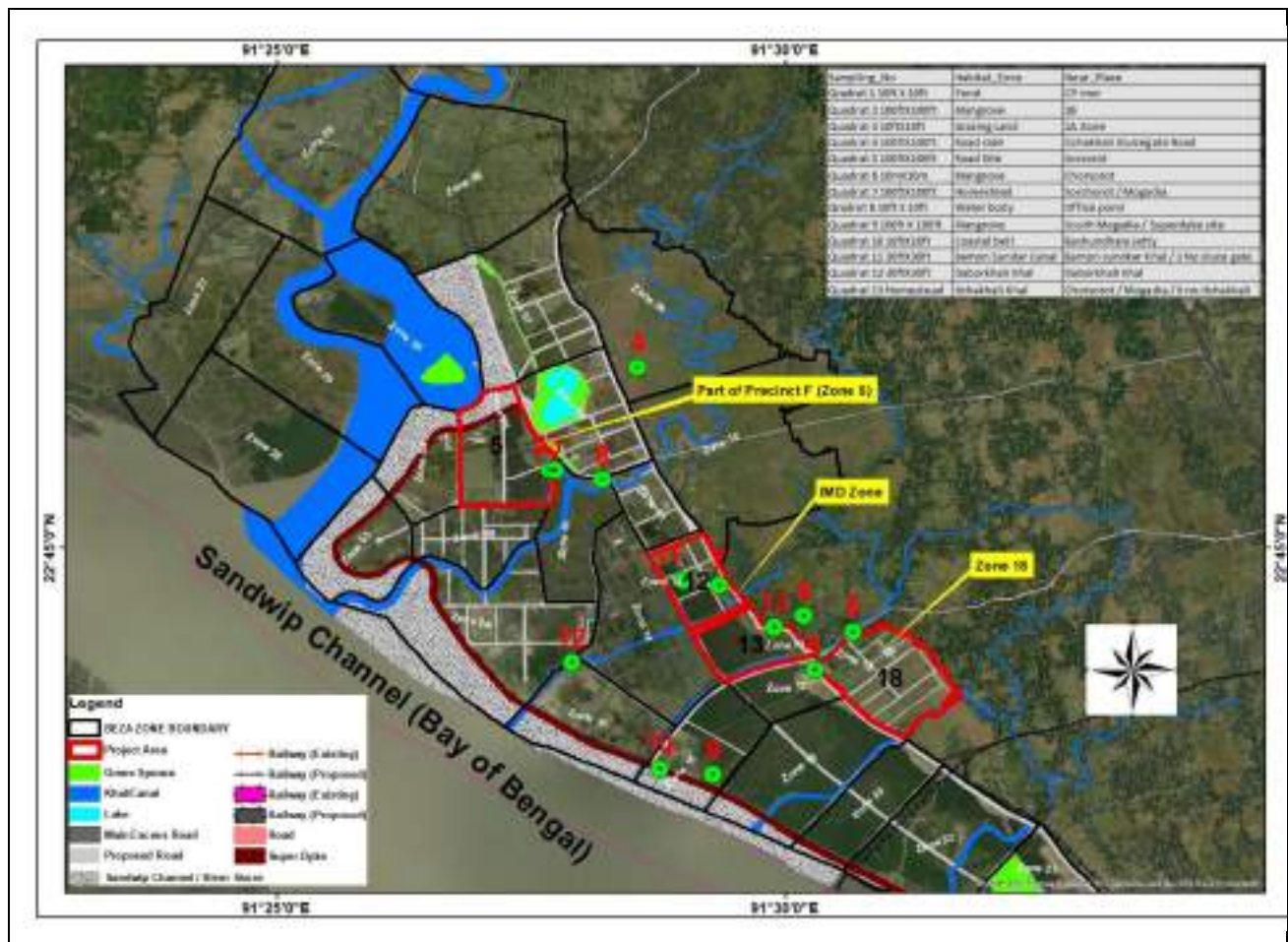
Existing drainage conditions

400. There is no man-made drainage system at the project site, all the drainage is naturally occurring, such as Bamansundar, Daborkhali, Ichakhali canal, and Shaherkhali khal. The water in the Ichakhali canal is controlled by a sluice gate, located at the entry point of the channel on SW side of the project site. The upstream area of the Ichakhali Canal is crisscrossed by natural drains. Existing surface water sources in the project area are shown in Figure 1. The flow direction is towards the Ichakhali channel and the water from the Ichakhali channel eventually flows into the sea.

Table 1: Major surface water sources in the project areas.

Sl. No.	Sampling Location	Geographical Location
5.	Bamonsundor Canal	22°43'36.06"N 91°29'14.67"E
6.	Daborkhali Canal	22°44'30.96"N 91°28'9.60"E
7.	Ichakhali Canal	22°44'41.63"N 91°27'11.03"E
8.	Shaherkhali Khal	22°71'55.11"N 91°51'40.32"E

Source: Baseline survey, BCL, 2023.

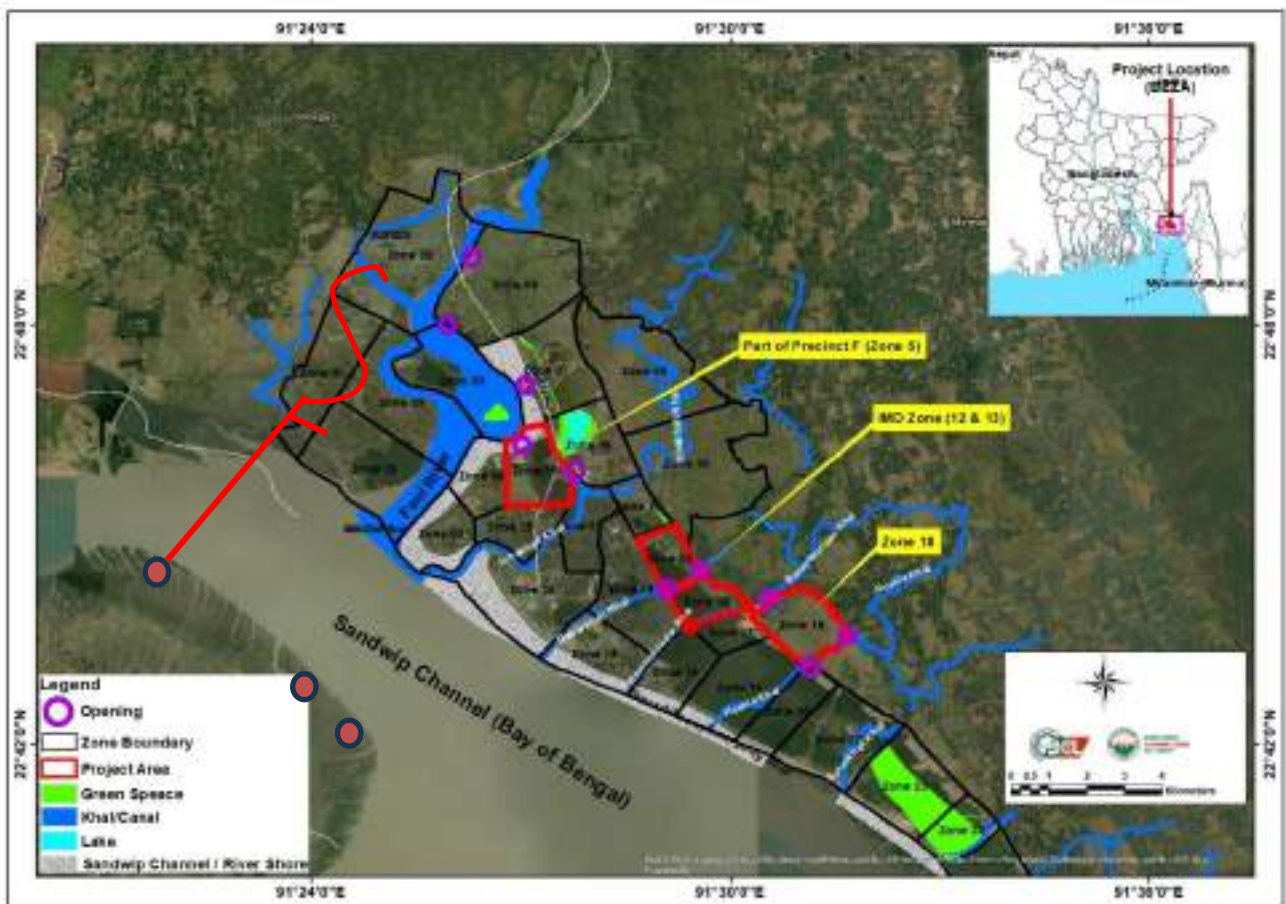


Map 1: Drainage system of the project areas.

Drainage Management System

401. Sustainable drainage management is required to the project areas to release rainwater and the spoil runoff from the landfilling sites to the surface water sources in terms of managing erosion, soakage, and settling of silt before discharging to the natural water courses, sensitivity of aquatic ecosystems, and other engineering controls etc. However, to catch the silt before release, temporary settling ponds are needed.

402. To provide sufficient silt removal during the dredging phase, temporary settling ponds could be required to reduce the amount of contaminated water left over during landfilling. It must be considered for spoil outflow from both permanent and transient spoil deposits. The cover may be taken into consideration to stop fine particles from washing off. Preventing the placement of either temporary or permanent spoil stacks near drains or watercourses is imperative. Before beginning the dredging activities, a temporary drainage system should be ensured.



Map 2: Drainage Planning in the project areas.

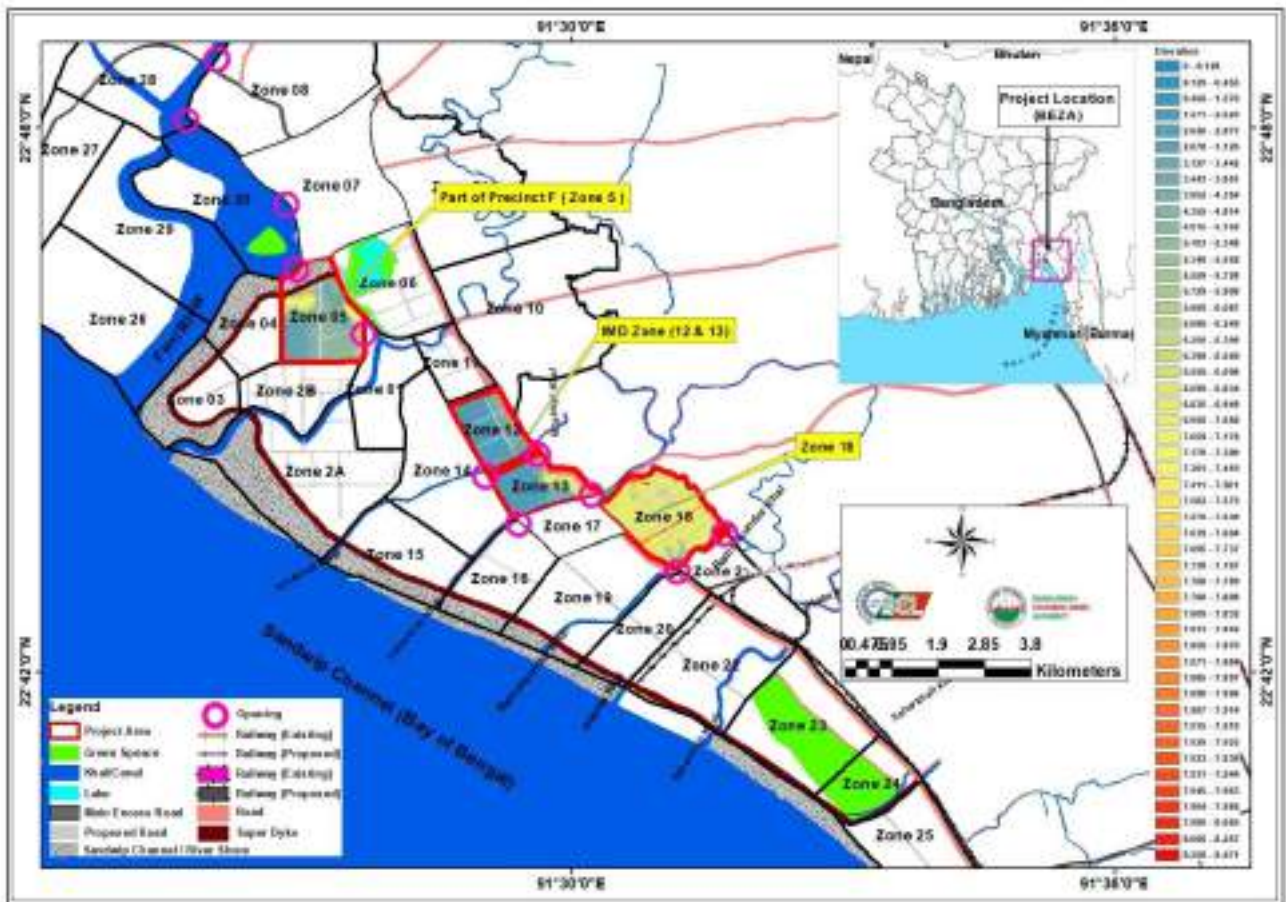
Proposed Drainage System under the project

403. To manage the dredge spoil runoff, and as well as huge rainwaters is mainly considered the four options such as

- Construction of new embankment or ring dike,
- Diversion canal,
- Cross-drainage structures, and
- Side drains, etc.

Construction of new embankment or ring dike (Option-1):

404. Since the discharge of sand and water is the main result of the dredging operations, precautions must be taken to avoid damaging the aquatic habitat. Thus, enclosing the dredging areas by an embankment or ring dike will protect the spoil flow, and rainwater straight to the nearby surface water sources, and maintain acceptable surface water quality, thereby lowering the quantity of dredged silt that settles there. The ring dike considers factors like crest width, base value, height, and slope features, etc. (Table-2), and this type of construction can be constructed in and around dredging sites to temporarily settle sediment.



Map 3: Elevation Map of the project areas.

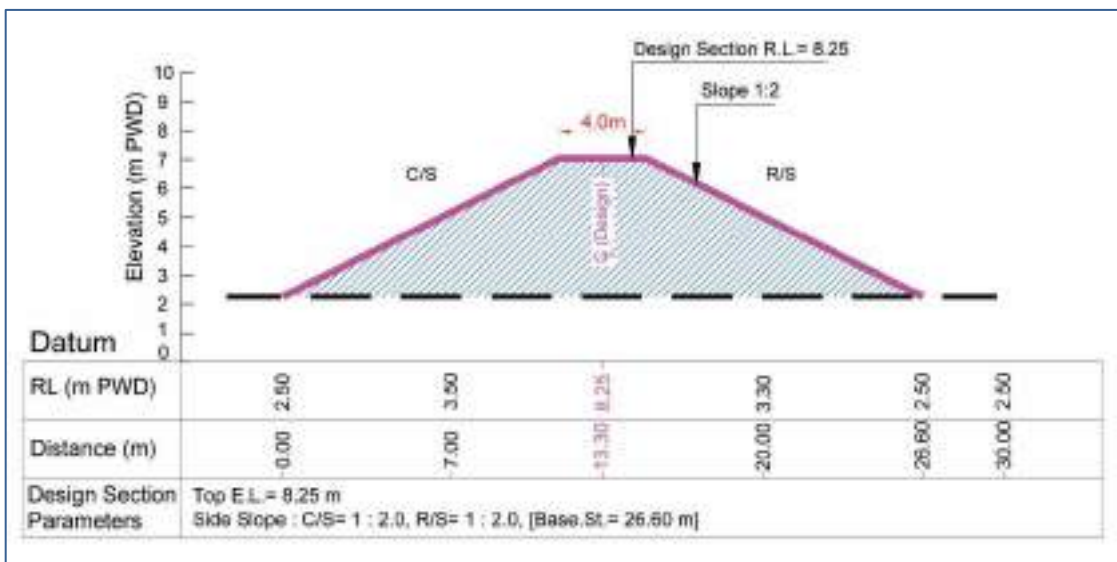


Figure 1: A Typical Embankment Section.

Table 2: Existing features of crest width, base height, and slope features.

Parameters	Zone-5	Zone-7	Zone-8	Zone-12	Zone-13	Zone-18
Ground Level (mPWD)	5	6.5	5.5	2.5	2.5	7
Design Top Elevation (mPWD)	8.25	8.25	8.25	8.25	8.25	8.25

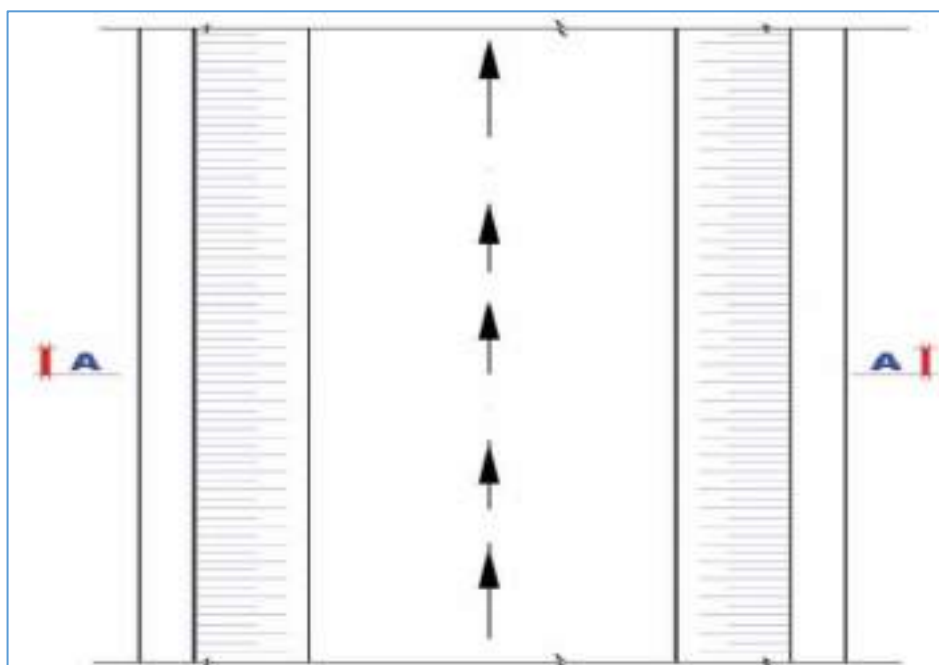
Parameters	Zone-5	Zone-7	Zone-8	Zone-12	Zone-13	Zone-18
Design Height (meter)	3.25	1.75	2.75	5.75	5.75	1.25
Top Width (meter)	4	4	4	4	4	4
Side Slope	1: 2	1: 2	1: 2	1: 2	1: 2	1: 2
Base Width (meter)	17	11	15	27	27	9

Source: Digital Elevation Model

Construction of Diversion Canal

405. There are a number of existing canals situated in the project areas. The rainwater as well as dredging water, is planned to be discharged to the adjacent canals in those areas. The planning of discharge to the Canal has been easily is charged by a diversion canal in Zone-7, and Zone-8 of the project (Figure-2). A typical Diversion Canal has been presented below:

Details Of Canal (Section A-A)



Typical Plan Of Canal

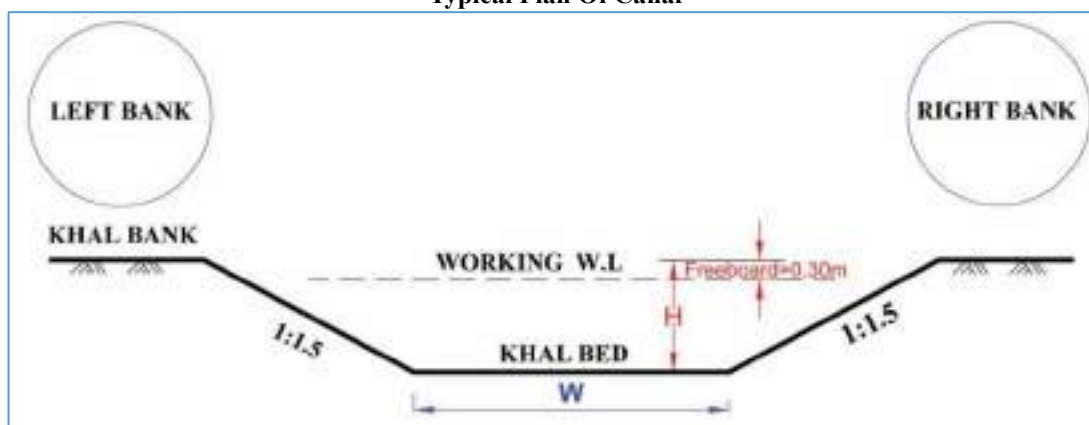


Figure 2: Typical Plan and Section of Diversion Canal

Table 3: The configuration of diversion canal in Zone-07 and Zone-08

Sl. No	Parameters	Measurement
01.	Existing Ground Level (mPWD)	5
02.	Canal Design Bed Level (mPWD)	1.5
03.	Height of Canal (m)	3.5
04.	Canal Bottom Width (m)	10
05.	Top Width (m)	20.5
06.	Side Slope	1: 1.5

Construction of Side Drains

406. Side drains construction may possibly be one of the other options to discharge dredged spoil runoff and heavy rainwater from the landfill sites to the nearby surface water sources. It is generally a structure of culvert, discharging spoil runoff immediately to the desired destinations of surface water sources. It's a RCC Pre-cast or cast-in-situ type structure commonly used in different parts of the country. If U-drains can be constructed in Zone-12, Zone-13, Zone-18, and Zone-6, it can easily discharge or drain out the rainwater and spoil runoff from the dredging sites. Normally, U drains are made by cast-in-situ Concrete and Pipe Drain made by Pre-Cast Concrete. A typical cross-section of drains has been presented in the following Figures-5 and 6.

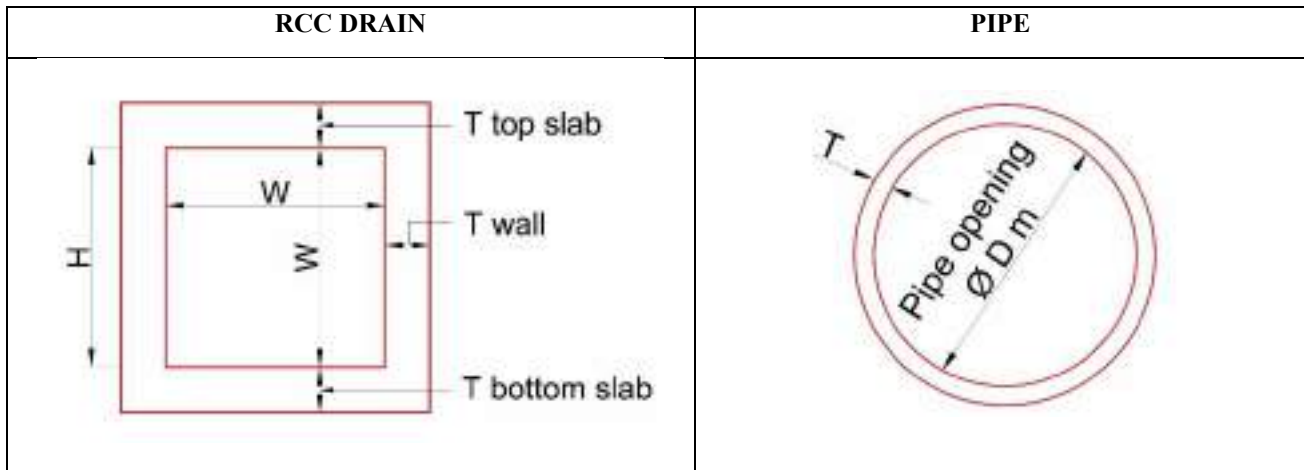


Figure 3: Typical Section of Drain

Cross-Drainage

407. If a Cross-drainage structure is made adjacent to the project areas (Zone-5, Zone-7, Zone-8, Zone-12, Zone-13, and Zone-18) that could easily drain out the dredged spoil runoff and rainwater from the landfilling sites to the nearby surface water sources, it is generally a structure of culverts, or regulators, etc. The typical section of Culvert is given below:

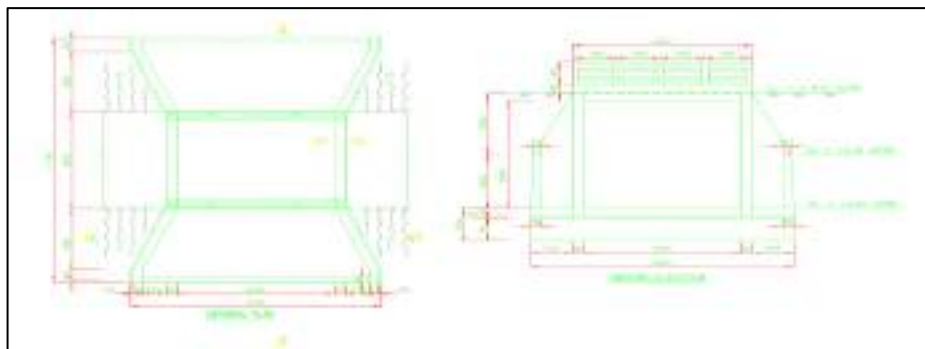


Figure 4: Typical Plan and Section of Culvert

Drainage Management Plan

Table-4: Drainage Management Plan for land development IMD Zone including part of Precinct F.

Project activity/ Impact source	Environmental Impact	Mitigation Measures/ Management Guidelines
Earth filling	Lack of proper drainage for dredge spoil runoff or rainwater can harm the natural environment in terms of water and soil contamination,	- Dredging activities and sand pipeline layout/networks should not impact any natural drainage courses in the project area. - A temporary storm water drainage system should be developed at site to channelize the storm water away from the excavation/filling area. - Provision of cross drainage structures, like balancing, for maintaining the drainage pattern. - Provision of cross drainage structures to prevent waterlogging and soil erosion.

Project activity/ Impact source	Environmental Impact	Mitigation Measures/ Management Guidelines
	and siltation of canal bed.	• The selection of the type of temporary drains (open or closed) shall be based on the magnitude and duration of flow and design requirements in accordance with the regulatory/best practice guidelines. • The storm water drains shall not pose any danger/hamper to traffic, slopes of cuttings, embankment, road, pavement, or structures. • Proper access should be provided with covering to every plot/ property nearby to the site. • The pipeline can pass alongside the existing canal, along the road, and along the fellow land. • The Developer will always clear all the cross-drainage structures and natural drainage before the onset of monsoon to keep all drainage unblocked. Stones, wastes, and spoils will be properly disposed of, to avoid blockage of any drainage channel. • The construction /setting up of the pipeline should not affect the BWDB dam, the contractor should take prior NOC/permission from the BWDB • All necessary precautions will be taken to construct a temporary/permanent device to prevent inundation. • Regular monitoring of the ground/surface water quality (according to ECR'2023 Standards) during the dredging/land filling operation. If monitoring of the water quality of the Ichakhali canal and adjacent water bodies indicates any adverse impact on the surface water, the contractor shall check whether this impact is due to any project activities and take appropriate mitigation measures to prevent such adverse impact from project activities. • The Ichakhali canal at site has been retained, and no waste is disposed of in the canal. • Temporary storm water drains will be provided for the whole site. These drains will be connected to the Ichakhali canal. These drains have been provided with a silt trap to arrest sediments from run-off before discharging into the canal. • Usage of silt or air bubble screens/curtains should be explored to minimize the sediment release during dredging operations; Ensuring that silts are removed periodically from these silt traps to avoid choking and overflowing. • Contractor should prepare and follow the contingency plans and emergency response procedures following the approved ESMP to address any unexpected releases or spills of contaminants that may occur during the filling process and after the filling process.

Annex- 17: Dredging Management/Land Development Plan

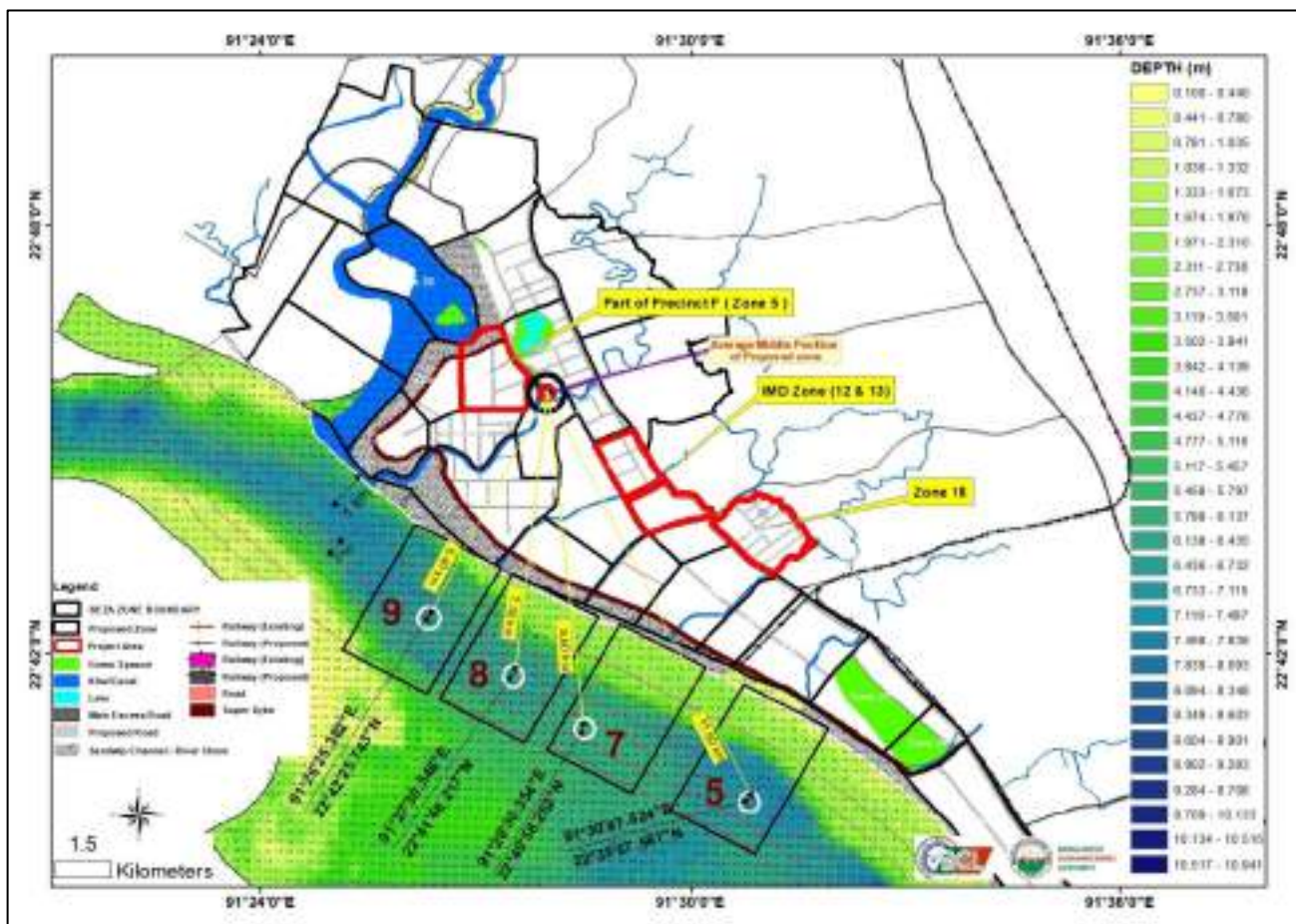
Land Development Plan

408. The study area is considered within a 34.534 km stretch from 3 km up of Muhuri Reservoir to the Confluence of the Sandwip channel and its downstream up to 1 (one) km of the NSEZ Project site, which is about 26 km away from the Bay of Bengal at the downstream, and identified 13 locations.

Source of Soil

409. Based on the Digital Elevation Models, 4 dredging locations have been selected. Out of 12 proposed locations, 11, 12, 10, are at the Sandwip Channel confluence, and the locations numbers 9, 8, 7, 6, 5, 4, 3, 2, and 1 are located at the Sandwip Channel downstream.

410. Based on the Contour Map and DEM (Digital Elevation Model) from this bathymetric survey data for four locations are presented. In addition, the morphological changes of the Sandwip Channel have been studied to know the stability of the channel bank, erosion, and accretion-prone areas.



Map 1: Four suitable dredging locations

Present Scenarios of the Sandwip Channel

411. The project location is close to the estuary of the Meghna River and receives a large quantity of sediment every year. The area was formed through deposition of a large quantity of sediments that builds up over the years through the process of erosion and accretion of land due to the influence of the upstream river system and tidal effects.

Dredging Activities

412. The proposed dredging materials pipelines will be constructed to collect the material from the channel/river to the part of Precinct F (IMD Zone and Housing Facilities) of NSEZ. A total 16,000,000 cum needs to be landfilled in the said areas.

Dredging Technology

413. Dredging is the process of dislodging, raising, handling, and transporting mainly soil underwater from layers of the earth surface in order to create/maintain artificial depth. The dredging process, when applied to the construction of harbours and trenches for foundations/pipelines, is called 'Capital Dredging'. However, when applied for the removal of siltation in existing harbours, rivers, and clearance of lakes is termed as 'Maintenance Dredging'.

Dredging Process

414. The following four sub-systems can be classified as dredging process:

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

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

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

Dredger Types

418. The dredgers are classified into the following categories:

- Mechanical dredgers
- Hydraulic dredgers
- Pneumatic dredgers
- Special dredging equipment

Mechanical Dredger

419. The mechanical dredgers use mechanical means for dislodging the soil., Examples of this type of dredger are grab dredgers, dipper dredgers, bucket dredgers, rock breakers, and backhoe dredgers. The salient features of these types of dredgers are as under:

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

Table 1: Operational Limit of Grab Type Pontoon/Hopper

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

421. **Dipper Dredger:** The dipper dredger is basically a power shovel operating from a pontoon/barge. The bucket is attached to the extremity of a hinged right arm, and a forward leading hoist wire supplies the digging power. Since large horizontal forces have to be applied to the ground by the bucket, the pontoon must have positioning spuds to prevent the transfer of force to the anchor wires. Dipper dredgers are ideal for dredging of

hard material such as blasted rock, weak rocks, stiff clays, boulder clays, etc. The output of dipper dredgers is about 200 cum per hour. The limiting operational conditions for this type of dredger are as follows;

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

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

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

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

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

Minimum water depth to operate	=	2 m
Maximum water depth to operate	=	24 m
Maximum width of cut	=	25 m
Minimum width of cut	=	Bucket width
Maximum wave height	=	1.5 m
Maximum swell height	=	1.0 m
Maximum cross current	=	2.0 knots

Maximum compressive strength (intact rock) = 10 Mpa

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

Hydraulic Dredgers

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

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

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

Plain Suction Dredger

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

Trailing Hopper Suction Dredgers

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

430. The main advantages and disadvantages of the trailing suction dredger are as under:

Advantages

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

Disadvantages

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

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

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

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

434. When the hopper is loaded, the suction pipes are returned and dredger sails for dumping. The dumping of dredged spoil is accomplished by different methods depending upon the soil type and sea conditions, as shown in the table below:

Table 2: Dumping Method of Dredge Spoil According to Soil Type

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

Cutter Suction Dredger

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

Advantages

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

Disadvantages

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

436. The cutter suction dredger is usually rated according to either diameter of the discharge pipe, which may range from 150 mm to 1,100 mm or by the power driving the cutter head, which may range from 15 KW to 4,500 KW. Most of the cutter suction dredging fleet available have installed power from 2,000 to 10,000 HP; though the cutter suction dredgers with higher installed power also exist which are used for dredging of hard soil, soft rock etc. The limiting operational conditions for cutter suction dredgers are as under:

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

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

Selection of Dredgers

438. The selection of dredgers based on few factors those have implications on the selection of the plant and equipment for dredging has been discussed. The key factors of selection of a dredger are:

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

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

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

Potential Types of Dredgers

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

Hydraulic type dredgers mainly of two types:

- i) Trailing suction hopper dredger and
- ii) Cutter suction dredger.

Trailing Suction Hopper Dredger

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

Cutter Suction Dredger

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

444. Dredging operation involves a number sites located part of Precinct F and most of the locations of dredging will be well inside the coastline. Therefore, cutter suction type dredger would be the feasible option from both technical and financial point of view.



Figure 1: Cutter Suction Dredger

445. Cutter suction dredger (32 inch) with a capacity of 5000 cubic meter per hour would be used for the purpose which lifts the dredged material through a suction pipe. This would not increase the turbidity of the water column at the dredging location significantly. For the land filling in NSEZ a 32-inch cutter section dredger can be considered that can carry 2500 cum per day which is approximate 9,00,000 cubic meters of soil each year (this amount of output of working 8 hours a day). Dimensions and instruction for the cutter suction dredger and production capacity is given in the below **Table-3**:

Table 3: Dredger specification

Sl. No.	Dredger specification	Dimension
1.	Dredger Type	32" (8 lac cum/year) ¹¹
2.	Length overall	90 m
3.	Beam	19 m
4.	Depth	5 m
5.	Draft (max)	4 m
6.	Suction pipe	900 mm
7.	Discharge pipe	750 mm
8.	Dredging depths	6.5 m min to 27.5m max

Capacity of a Cutter Suction Dredger

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

¹¹ <https://www.vlmaritime.com/product/a0410-cutter-suction-dredger/>



Figure 2: Photographs of Dredger

446. The rotating cutter excavates the soil during their movement, generated by the side winches, from port side to starboard and vice-a-versa. The necessary side winch force depends not only on the type of soil but also on:

- The rotation direction of the cutter head; (over cutting) rotation in the direction of the swing movement or (under cutting) opposite to that.

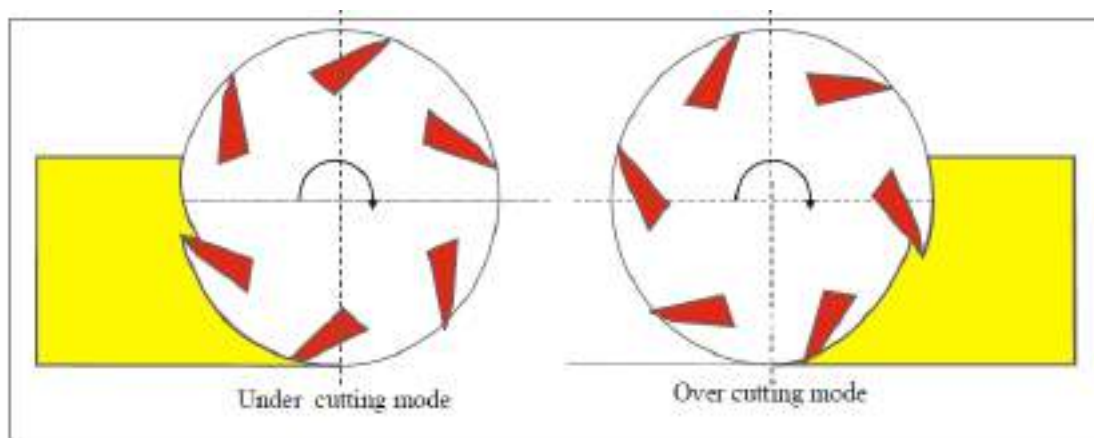


Figure 3: The rotating cutter

- In the over cutting mode, the cutter head tries to drag the cutter dredger in the direction of the pulling winch. Braking with the opposite winch may be necessary.
- The position of the anchors to the path of the cutter head. The more the anchor lies in the direction of the moving cutter head the less the required side winch force will be.
- External forces, such as wind, current and waves.

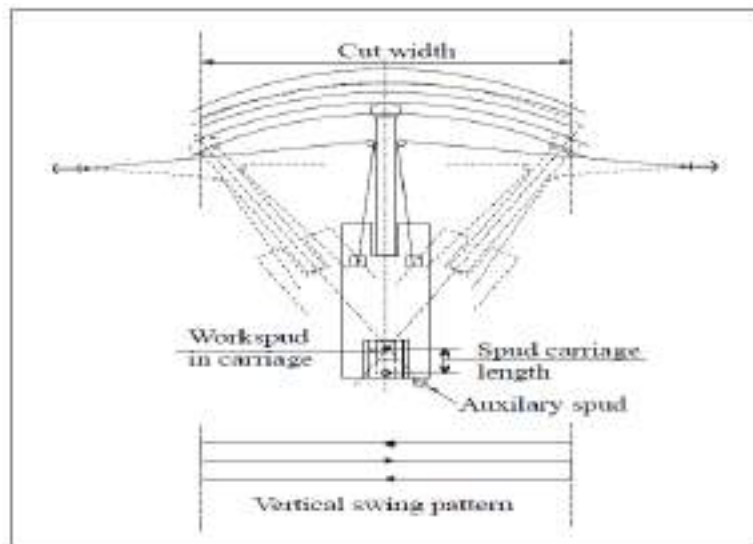


Figure 4: Swing Pattern for A Cutter Suction Dredger

Calculation of Dredging Material:

447. A dredger (CSD) sized 32" cutter can dredge about 5000 cubic metres of sand per hour. Considering an 8-hours operation per day, the CSD able to carry 40,000 cum per day. Since the carrying materials are semi-solid or semi-liquid, there will be 30% solid (sand or soil) material and 70% liquid material. Therefore, each day the dredger can fill approximately 12,000 cum (40,000 cum x 30%) of sand.

Transportation of Dredged materials

448. Dredged materials would not be possible to transport through local barge. Cutter Suction Dredgers (CSD) discharge its dredged materials with a higher pressure. Local barges are not capable to bear such pressure. So, it is better to consider another option like temporal dykes. The dykes will be filled with dredged material through discharge pipe and then those could be transported through trucks or dumb trucks. A truck (5 ton) is capable to carry 5 m³ or 170 cubic feet of sand/soil at a time. So, several lacs of Trucks are required to engage for filling the area of the zone.



Temporary Drainage Management

449. The management of dredging related soil and spoil should be well maintained by the contractor. A separate dredging related land use and drainage management plan should be prepared by the contractor and that has to be approved by the PIU. The following measures should be taken by the contractor in order to maintain drainage during the construction period:

- Prepare a program for prevent/avoid standing waters, which PMU will verify in advance and confirm during implementation.
- Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line.

- Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there
- Rehabilitate road drainage structures immediately if damaged by contractors' road transports.
- Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to the relevant standards provided by DoE, before it being discharged into the recipient water bodies.
- Ensure the internal roads/hard surfaces in the construction yards/construction camps that generate storm water drainage to accommodate high runoff during downpour and that there is no stagnant water in the area at the end of the downpour.
- Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning.
- Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion.
- Protect natural slopes of drainage channels to ensure adequate storm water drains.
- Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem.
- Reduce infiltration of contaminated drainage through storm water management design.

Annex- 18: Environmental and Social Code of Practices

Environmental And Social Code of Practices (ESCOPS):

Table 1: Environmental and Social Code of Practices (ESCoPs)

Activity	Impacts	Mitigation Measures/ Management Guidelines
Waste Management		
Waste Management	Soil contamination, water pollution and drainage congestion from the improper management of wastes. Storage, and burn/burial of waste at work sites may damage the topsoil	The Contractor shall: • Prepare a proper waste management plan with a program/mechanism for various specific waste streams (e.g., reusable waste, flammable waste, debris, food waste etc.). • Minimize the waste following 3R (Reduce, Recycle, and Reuse) approach. Segregate and reuse or recycle all the wastes, wherever practical. • Provide dedicated covered waste collection bins at appropriate locations to ensure safe storage. • Remove collected wastes for disposal in approved waste disposal sites. • Prohibit burning of solid waste at the enterprise. • Waste mapping and inventory should be conducted by the enterprise submitted to the PIU in every quarter. • Ensure environmentally sound disposal of all waste, including fecal sludge. • Set up a prearranged mechanism for post-disaster-related waste. • Use appropriate PPEs before handling wastes (gloves, mask, apron, and safety boots). • Execute waste management program and trainings on safe handling, collecting, storing and safe disposal.
Hazardous Waste	Pose health hazards and cause soil contamination due to improper waste management practice	The Contractor shall: • Provide sufficient numbers of containers for collecting chemical wastes, appropriately labelled for safe transport to an approved chemical waste depot. • Store, transport, and handle all chemicals, avoiding potential spillage. • Ensure availability of Material Safety Data Sheets (MSDS) for all materials (chemicals). • Provide secondary container/construct concrete or other impermeable flooring to prevent seepage/spills of lube oil, machine oil, and lubricants. Store at approved locations before safe transportation for off-site recycle, reuse or treatment via approved vendors. • Provide appropriate PPEs during handling wastes (gloves, mask, apron, and safety boots).
Water Resource Management		
Water resource management	Scarcity of water may be arising due to unplanned water consumption. Salinity intrusion may disrupt availability of fresh water supply. Seasonality affect may differ water available in different location of the subprojects.	The Contractor shall: • Track baseline of available water resources in the case of business as usual. • Set up targets (reasonable percentage) for water saving percentage. • Establish a monitoring system to track water quantity (water efficiency and rainwater harvesting) and circularity of water (wastewater recycling and reuse). • Get advice from PIU/NSEZ to monitor and suggest water efficiency, recycling, reuse and rainwater harvesting. • Conduct and execute capacity development/ technical sessions for related members of staff.

Activity	Impacts	Mitigation Measures/ Management Guidelines
Discharges from camp house and office	Water resource- surface and groundwater quality may be deteriorated due to generated wastewater	The Contractor shall: • Install/construct drainage system in the enterprise that required for sediment and erosion control. • Collect sewerage related waste to manage through pit. • Check and test managed waste water to ensure quality as per standard. • Manage generated solid wastes (sludge) from pit into reusable products (for example fire briquettes from sludge cakes).
Hazardous Material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste and accidental spillage.	The Contractor shall: • Follow the wastes management guidelines. • Minimize the generation of sediment, slurry, oil and grease, organic matter, litter, debris and any form of waste. • These substances must not enter into waterways, storm water systems or underground water table.
Groundwater Extraction	Excessive pumping from groundwater wells can decrease the amount of groundwater that would flow naturally into water bodies, such as wetlands, streams, rivers and lakes	The Contractor shall: • Enhance infiltration by green vegetation or green infrastructure. • Conservation and efficiency are key components of sustainable water management. • Awareness & Education
Noise and Vibration		
Noise and vibration can be caused by machinery and vehicles movement	Noise and vibration may have an impact on people, property, and the natural environment	The Contractor shall: • Ensure Noise levels of all machineries, or vehicles are within the standard limits (ECR, 1997/2017 or WHO Guidelines). • Maintain all equipment's in order to keep it in good working order in accordance with manufactures maintenance procedures. • Modify equipment to reduce noise (for example, noise control kits, use rubber etc.). • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Avoid the unnecessary use of alarms, horns and sirens. • Employ best available work practices on-site to minimize occupational noise levels. • Provide trainings on noise limits, use of horns and sirens. Insert signage to aware on noise pollution. • Ensure use of protective gears (ear mufflers/ earplugs to protect from noise).
Air Quality Management		
Air, dust or fugitive flumes may generate due to improper management of generator exhausts	Working area air quality can be adversely affect to the ecosystem, surrounding environment and human health	The Contractor shall: • Fit equipment's with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Procure safe and clean fuel to reduce air pollution from emissions. • Recover waste heats from hot flue gas (exhausts) from power station or generators. • Set up standard air emission (partials, aerosols, gases, and odor) guidelines (WHO, ECR 1997/ 2017) both for indoor and outdoor. • Monitor and measure air quality by internal laboratory, external independent firms sporadically, at regular intervals, or continuously.

Activity	Impacts	Mitigation Measures/ Management Guidelines
GHG emission gas	Contribute in the global warming and induce disasters related to climate change	The Contractor/ NSEZ entity shall: Source primary electricity/energy from renewable resources.
Occupational Health and Safety		
Occupational Health and Safety (OHS) Best practices	ME operational activity may pose health and safety risks to the workers and site visitors leading to severe injuries and deaths. The population in the proximity of the subprojects site and the workers will be exposed to a number of (i) biophysical health risk factors, (e.g., noise, dust, fumes, chemicals, construction material, solid waste, wastewater, vector transmitted diseases etc.), and (ii) road accidents from traffic	The Contractor and PIU shall: - Implement suitable safety standards for all workers and site visitors which should not be less than those laid down on the international standards (e.g. International Labor Office guideline on ‘Safety and Health in Construction; BEZA Act, 2010, Bangladesh Labor Law 2018/06, BSCI or SA8000) - Execute risk and hazard assessment on materials, process and equipment. - Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas. - Provide personal protective equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. - Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. - Ensure trainings on PPE with records. - Safety procedures include provision of information, training for workers those are involved in hazardous operations and proper performance of their job. - Light, air, noise, temperature assessment records. - Ensure sufficient toilets with manpower ration and clean frequently. - Appoint an environment, health and safety manager to look after the health and safety of the workers.
Injuries due to major or minor accidents	Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victims	The Contractor shall: - Ensure health care facilities and first aid facilities are readily available. - Ensure first aid boxes at first-aid stations and should be easily accessible throughout the place of work. - Arrange training for first aider and equipped with proper first aid facilities. - Prepare document and reports accidents, injuries, diseases, and incidents. - Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, in a manner consistent with good international industry best practice. - Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. - Provide safe machine, tools, equipment and ensure safe working area for workers and labors.
Water and sanitation facilities at the workplace	Lack of Water sanitation facilities at workplace cause inconvenience to the workers and affect their personal hygiene.	The Contractor shall - Provide portable toilets at the construction sites, if about 25 people are working the whole day for a month. - Ensure the location of portable facilities at least 6m away from storm drain system and surface waters. These portable toilets should be cleaned once a day and all the sewerage should be

Activity	Impacts	Mitigation Measures/ Management Guidelines
		pumped from the collection tank once a day and should be brought to the common septic tank for further treatment. • Provide filtered/bottled drinking water facilities to the workers at all the workplace.
Road Transport and Road Traffic Management		
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the Safety of the road users.	The Contractor shall • Prepare a traffic management plan and submit the plan for supervision consultant approval. • Strictly follow the Project's 'Traffic Management Plan' and work with close coordination with the Traffic Management Unit. • Prepare and submit additional traffic plan, if any of this traffic route is not covered in the Project's Traffic Management Plan, and requires traffic diversion and management. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the National Traffic Regulations
Physical damage or death toll	Accidents and spillage of fuels and chemicals	The Contractor shall • Restrict truck deliveries, where practicable, to day time working hours. • Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc. • Restrict the transport of oversize loads.
Construction Camp Management		
Siting and Location of camps	Campsites for workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Prepare a camp management plan and submit the plan to supervision consultant for approval. • Locate the camps within the designated sites or at areas which are acceptable from environmental, cultural or social point of view and approved by the supervision consultant or the PIU/NSEZ. • Conduct consultation with communities including local government institutes (Local member of Union Parishad), PIU, NSEZ prior to set-up the camp. • Consider the location of camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities.
Facility of camps	Lack of proper infrastructure facilities, such as housing, water supply, and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers and ensure reliable water supply, which should meet national/WHO standards. • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes. • Storm water drainage facilities. • Paved internal roads. • Provide child cares for women working at construction site. The crèche should have facilities for dormitory, kitchen, indoor and outdoor play area. Schools should be attached to these crèches so that children are not deprived of education whose mothers are construction workers.

Activity	Impacts	Mitigation Measures/ Management Guidelines
		Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The contractor shall - Ensure proper collection and disposal of solid wastes within the camp - Insist waste separation at source (organic, hazardous and inorganic waste collect separate container/bin) - Do not establish site specific landfill areas. All solid waste will be collected and removed from the worker camps and disposed of in an approved designated waste disposal site through approved vendor. - Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed.
Safety and security	Inadequate security and safety provision in construction camps may create security and safety problems of workforces and assets and fire hazards	The Contractor shall - Provide appropriate security personnel (police or private security guards) and enclosures to prevent unauthorized entry in to the camp area. - Maintain register to keep a track on a head count of persons present in the camp at any given time. - Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. - Provide appropriate type of firefighting equipment suitable for the camps. - All construction material storage should be sitting a visible location secured with fence or solid walls with locks to avoid theft and vandalism. - Display emergency contact numbers clearly and prominently at strategic places in camps. - Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Health and hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of worker spreading sexually transmitted infections and HIV/AIDS	The contractor shall - Provide adequate health care facilities within construction sites. - Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. - Provide ambulance facility for the labours during emergency to be transported to nearest hospitals. - Initial health screening of the labours coming from outside areas. - Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. - Provide HIV awareness programming, including - STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis. - Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. - Regular mosquito repellent sprays during rainy season in offices and construction camps and yards. - Not dispose food waste openly as that will attract rats and stray dogs.

Activity	Impacts	Mitigation Measures/ Management Guidelines
		Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing
Social Accountability Guidelines		
Implementation of social accountability	Labor unrest, dissatisfaction, turmoil, vandalism even ratios can be arisen due to lack of social accountability	The Contractor shall: - Ensure social management policy and procedures are available as per the Labor Law, 2016/08 - Ensure child labor is not used directly or sourced - Ensure that young workers (15-18) are not employed in dangerous work - Check the ages of all employees - Ensure that forced labor is not used directly, or through contractors or the supply chain. - Implement equal opportunity and no discrimination - Maintain equal opportunity for male and female workers including pregnant women - Ensure all the entities have grievance mechanism policy and procedure with responsible person - Grievance committee established for the workers - Grievance mechanism established and operating smoothly
Emergency Response		
Implement Emergency Response procedure	Asset loss, manpower loss, accident, injury, productivity loss	The Contractor shall: - Prepare an Emergency Response Plan to mitigate any kind of prevailing risk and hazards - Ensure responsibility of the team to deal with catastrophic accidents, natural calamities, breakout/ spread of diseases, accidental release of hazardous chemical or manmade unrest (student agitation). - Ensure the emergency response team's responsibilities are to immediately meet when an emergency situation is reported and to determine the course of action. - Ensure the emergency response team is preparing for any kind of emergency situation arise - Develop a list of contact information for all internal and external resource. The list should include name, description, location, and contact details (phone number, email) for each of the resources and be maintained annually. - Communicated with relevant organizations (Fire service, Hospital, Police station, Ambulance, Suppliers, Mechanics or others) in any emergency. - Prepare emergency response plan for each type of emergency (fire, natural calamity, cyclone, tidal surge, earthquake, accidental release of chemicals, or turmoil/agitation). - Identify training needs based on roles and responsibilities, capabilities, and requirements of personnel in an emergency. - Impart refresher training on hazard and risk identification, risk assessment and mitigation, rescue & recovery, etc. - Develop and update training plans to address needs, particularly for firefighting, spill response, and evacuation. - Record keeping on training activities and the outcomes.
Fire Safety Management System		

Activity	Impacts	Mitigation Measures/ Management Guidelines
Implement Fire Safety Management System	May cause economic loss, loss of human life as well as property	The Contractor shall: • Ensure the regular inspection is conducted by the contractor. • Firefighting equipment is updated and well-maintained; emergency telephone numbers are available. • Impart firefighting training and fire drills regularly and maintain records. • Conduct emergency evacuation drills and alarm testing to evaluate the effectiveness. • Train all workers and staff on how to operate the fire alarm systems with clear instructions. • Develop training plans to address needs, particularly for firefighting, spill response, and evacuation. • Ensure that the escape routes are easily identifiable and free from obstructions. • Ensure that the exit doors are labelled, unlocked, and designed to open outwards. • Ensure that the fire extinguishers are fully charged and inspected monthly.
Chemical Management System		
Chemical Storage	Unsafe chemical storage or store in an open area may affect the physical environment and harmful for human health	The Contractor shall: • Store required amounts in order to reduce waste. • Safe storage (in dry, cool temperature) with sufficient air circulation at the chemical store. Ensure temperature and humidity records to store at a suitable condition. • Ensure proper ventilation/ air circulation in the store. • Use proper PPE (gloves, mask, goggles, safety shoe) before handling chemicals. • Ensure Material Safety Data Sheet (MSDS) and labelling for all chemicals. • Provide absorbent materials to control accidental release of chemicals. • Ensure secondary containments for all chemicals. • Ensure an eyewash station for accidental spillage or contact with workers. • Provide training to related staffs on safe chemical storage.
Transport and disposal	Unsafe disposal may pollute surface and ground water. Uncontrolled disposal causes soil contamination	• Disposal of chemicals as per given instructions (on the MSDS). • Dilute chemicals and dispose into the treatment plant if available; otherwise, dispose into the soak-well. Do not dispose of chemicals into surface water. • Provide training to related staff on the safe transportation and disposal of chemicals.

Annex- 19: Environmental Enhancement Measures and Greenery Plan

Introduction

Bangladesh Economic Zone Authority (BEZA) is developing large industrial city National Special Economic Zone (NSEZ) to be set up on 330,000 acres of land located in Mirsharai, Sonagazi and Sitakunda Upazilla of Chattogram and Feni Districts. A master plan of NSEZ has been prepared under the current PSDS project financed by the World Bank. The World Bank's Private Investment & Digital Entrepreneurship (PRIDE) project is supporting for the development of NSEZ. Government of Bangladesh encourages tree plantation to improve the environment. Trees take carbon dioxide and discharge oxygen for their photosynthesis, which helps clean the air. In addition, the wood, fruit, fuel and medicinal value of trees are considerable. Roadside trees intercept the dust on their leaves and keep the ambient air dust free. In general, plantation of trees has advantages with respect to environment and economy. Therefore, environmental enhancement will be done through plantation on the slopes of embankment, road side and elsewhere where free spaces are available.

In total 33,805 acres of land for NSEZ in different zones, out of these 15,781 acres for industrial activities and 18,024 acres of land for non-industry

Project Area

- Zone-12=307 acres of land, Zone-13=368 acres of land and
- Zone-18
- Precinct F is for Light/Medium Industrial area 10,043.12 acres of land (29.71%)¹².

As enhancement plan, it is proposed that BEZA should develop a thick green belt all around the EZ site. Thick green buffer of 30m will be developed all along the EZ site and along the Ichakhali Channel. A zone of 1km between the EZ site and sea will be maintained as mangrove zone. Also, a lake of will be developed at site measuring 100 acres green buffer and lake site will act as landing site for water birds and habitat for mud crabs and other species¹³.

Developing a greener and resilient NSEZ: This component will support phased development of the NSEZ Green Industrial City based on the recently approved Master Plan for NSEZ. It will finance works, goods and technical assistance for three areas: NSEZ-2A (380ha), NSEZ-2B (192 ha) and NSEZ-IMD (100-200 ha) to help catalyze the development of state-of-the-art green economic zones and set an example for sustainable, resilient and environmentally sound industrial development in Bangladesh¹⁴.

Positive Impact of Plantation

- To create new habitat for both flora and fauna
- To augment in maintaining biodiversity with restore birds, and other animal habitat on trees
- To reduce the impact of ever-increasing noise pollution caused due to increase in number of vehicles
- To reduce the impacts of air pollution and dust as trees and shrubs are known to be natural sink for air pollutants
- To provide much needed shade on glaring hot roads during summer
- To arrest soil erosion at the embankment slopes
- To prevent of glare from the headlight of incoming vehicles
- To moderating the effect of wind and incoming radiation
- To mitigate climate change scenarios of the region
- To generate of employment opportunity to local people

Principles of Plantation

¹² NSEZ-Master Plan report, 2020

¹³ (Ref. EIA report Mirsarai EZ-11)

¹⁴ (Ref. ESA Final report,2020)

Large seedlings should be planted, i.e., man height or above 1 m height seedlings should be planted. Seedlings will be planted at road embankment slopes and in vacant land within RoW in plan way. Ornamental and flower plants will be planted in front areas for enhancing beauty at the median of road. Timber and fruit trees should be planted on embankment of Road and Rest areas Variety species may be planted for light and fresh air circulation.

Methods Of Plantation

May – June is the best season for plantation. The tree seedlings are planted in row with a spacing of 2.5 m x 2.5 m. The fruit trees are planted with 3.5 m spacing.

- The first row, seedling-to-seedling distance will be 1.5m, ornamental and beatification flower trees.
- The second-row tree seedlings will be 1.5 – 2.5m below from the first row and 3 apart each other according to width of the road slope and seedlings will be planted in 2m apart and triangular way, fast growing timber, medicinal and fruit trees.
- In this way 3-4 rows of seedlings may be planted if the slope is more broaden/width
- Seedlings will be planted in such a way that do not obstruct vision of the driving
- No trees will be planted in the inner curve of the road.
- It should not be planted large and deep – rooted plants at the edge of road.
- Water logging tolerable species should be planted in the last row of the slope at toe. Palm tree is preferable in flood prone area.

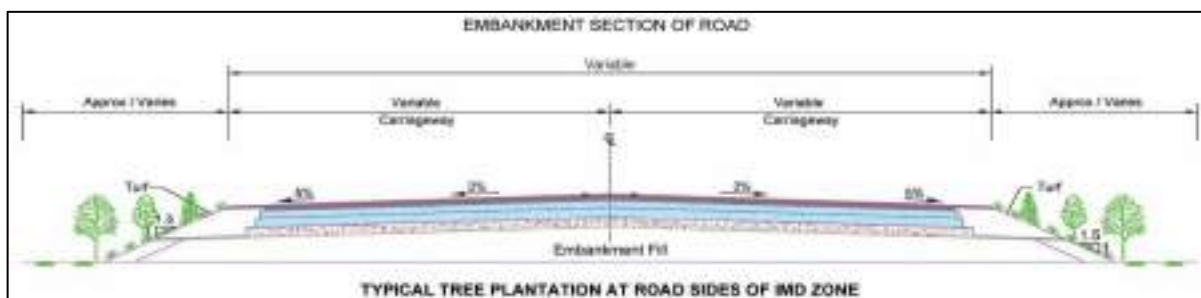


Figure 1: Typical road site plantation design

In case of slope of embankment of Ichakhali, Dabor khali, and Shaerkhali canal two rows plantation with zigzag pattern and slope to be protected from erosion by planting vetivar/nepiar/ barmuda grasses.

- In case of roadside to be planted and number of rows depend of width of the road.
- Line trees Plantation: Two meters' distance between two saplings per kilometer around 501 species, 2.5 m distances per kilometer around 400 saplings and 1-meter distance per kilometer 1000 saplings to be planted.
- In case of Block plantation per decimal 10 species of saplings to be planted, per acre 1000 and per hectare 2560 saplings to be planted.

Selection of Species

The project involves movement of vehicle for transportation of material, causing emissions of particulate matter, and SO₂, NO_x & CO will be generated at site. Also, there is potential of generation of dust while unloading the materials at stockpiles. Hence the plant species chosen for along the roadside should be tolerant to these pollutants and be moderately able to mitigate these from air.

Native plant species to be planted for functional reasons, not only aesthetic, because they are durable, long-lived perennials, ecologically suitable, best adapted to Bangladesh climate and growing conditions and able to survive the stresses of road right-of-ways. It is necessary to select species, which have air-filtering properties. The species will also be evergreen, having dense branching, thick leaves and rough surface, which have capacity to absorb air contaminating dust particles. The composition of tree species under the social forestry will be selected after the consultation with the local communities.

- Timber tree species will cover 30% of the total area
- Fruit tree species will cover 30% of the total area;
- Medicinal tree species will cover 15% of the total area
- Fuel tree species will cover the rest 20% of the total area.

- Ornamental and beatification flower trees 5% on road median and available spaces.

Species selecting criteria is given below:

- Native species including herbs, shrubs, and trees of different
- Tolerant to expected pollutants at project site
- Longer duration of foliage
- Freely exposed foliage (adequate height of crown, openness of foliage, small stomata apertures, stomata well exposed)
- Broad leaf plants should be taken in consideration as this kind of plant helps to reduce different air pollutants by absorbing through stomata.
- Leaves supported on firm petioles

The proposed following trees for plantation plan include different categories of trees with distance to each other are given in **Table 1:**

Table 1: Based on nature of pollutants following tree species are recommended to be planted

Sl. No.	Local Name	English name	Species Name	Family	Uses	Distance (m) between each sapling
1	Mangiam	Austrilian Teak Plant	<i>Acacia mangium</i>	Fabaceae	Timber	2.5m
2	Akashmoni	Akashmoni	<i>Acacia moniliformes</i>	Fabaceae	Timber	2.5m
3	Siris	Raintree	<i>Albizia lebbbeck</i>	Fabaceae	Timber	2.5m
4	Kathal	Jack fruit	<i>Artocarpus heterophyllus</i>	Moraceae	Fruit Bearing/ Timber	3.5m
5	Bean	black mangrove	<i>Avecenia alba</i>	Aviceniaceae	Timber	2.5m
6	Neem	Neem	<i>Azadirachta indica</i>	Meliaceae	Medicinal	2.5m
7	Shimul	Red silk cotton tree	<i>Bombax ceiba</i>	Malvaceae	Flower	2.5m
8	Tal	Palm	<i>Borassus flabellifer</i>	Arecaceae	Fruit Bearing	2.5m
9	Radachura	Peacock	<i>Caesalpinia pulcherrima</i>	Fabaceae	Ornamental flower	2.5m
10	Pepey	Papaw	<i>Carica papaya</i>	Caricaceae	Fruit Bearing	2m
11	Karamcha tree	Karamcha tree	<i>Carissa carandas</i>	Apocynaceae	Fruit bearing	2m
12	Sonalu	Golden shower tree	<i>Cassia fistula</i>	Fabaceae	Fuel	2.5m
13	Jhao Ghas	Beach She-oak	<i>Casuarina equisetifolia</i>	Casuarinaceae	Timber	2.5m
14	Jambura	Jambura	<i>Citrus grandis</i>	Rutaceae	Fruit Bearing	3.5m
15	Narikel	Narikel	<i>Cocos nucifera</i>	Palmae	Fruit Bearing	3.5m
16	Krichnachura	Royal poinciana	<i>Delonix regia</i>	Fabaceae	Ornamental flower	2.5m
17	Gewa	Milky mangrove	<i>Excoecaria agallocha</i>	Euphorbiaceae	Timber	2.5m
18	Bot	Banyan	<i>Ficus benghalensis</i>	Moraceae	Aesthetic	2.5m
19	Dumur	Ficus tree	<i>Ficus benamina</i>	Moraceae	Fruit bearing	2.5m
20	Gamari	Gamari	<i>Gmelina arborea</i>	Verbenaceae	Timber	2.5m
21	Rongon	Jungle geranium	<i>Ixora coccinea</i>	Rubiaceae	Ornamental flower	2m
22	Ipil Ipil	Lead Tree	<i>Leucaena leucocephala</i>	Fabaceae	Fuel	2m
23	Litchi	Litchi	<i>Litchi chinensis</i>	Sapindaceae	Fruit Bearing	3.5m
24	Aam	Mango	<i>Mangifera indica</i>	Anacardiaceae	Fruit Bearing	3.5m
25	Safeda	Safeda	<i>Manilkara zapota</i>	Zapotaceae	Fruit Bearing	3.5m
26	Bokul	Bokul	<i>Mimusops elengi</i>	Sapotaceae	Ornamental flower	2m

Sl. No.	Local Name	English name	Species Name	Family	Uses	Distance (m) between each sapling
27	Kadam	Burflower	<i>Neolamarckia cadamba</i>	Rubiaceae	Ornamental flower/Fuel	2.5m
28	Olives	Olives	<i>Olea europaea</i>	Oleaceae	Fruit Bearing	3.5m
29	Khejur	Date	<i>Phoenix sylvestris</i>	Palmae	Juice	2.5m
30	Debdaru	Pseudo Ashoka	<i>Polyalthia longifolia</i>	Annonaceae	Timber	2.5m
31	Peyara	Guava	<i>Psidium guajava</i>	Myrtaceae	Fruit Bearing	2m
32	Ashoka	Ashoka tree	<i>Saraca asoca</i>	Fabaceae	Ornamental flower	2.5m
33	Amra	Hog Plum	<i>Spondius pinnata</i>	Anacardiaceae	Fruit Bearing	3.5m
34	Mahagony	Mahagony	<i>Swietenia mahagony</i>	Meliaceae	Timber	3.5m
35	Jaam	Black Berry	<i>Syzygium cumini</i>	Myrtaceae	Fruit Bearing	3.5m
36	Jamrul	Jamrul	<i>Syzygium samarengense</i>	Myrtaceae	Fruit bearing	3.5m
37	Tentul	Tentul	<i>Tamarindus indica</i>	Leguminosae	Fruit Bearing	2.5m
38	Segun	Teak	<i>Tectonia grandis</i>	Lamiaceae	Timber	2.5m
39	Arjun	Arjun tree	<i>Terminalia arjuna</i>	Combretaceae	Medicinal	2.5m
40	Bohera	Bohera	<i>Terminalia bellirica</i>	Combretaceae	Medicinal	2.5m
41	Kathbadam	Kathbadam	<i>Terminalia catapa</i>	Combrataceae	Timber/Shed	2.5m
42	Horitoki	Horitoki	<i>Terminalia chebula</i>	Combretaceae	Medicinal	2.5m
43	Boroi	Jujube	<i>Zizyphus mauritiana</i>	Rhamnaceae	Fruit Bearing	3.5m

Coastal Afforestation

For Coastal afforestation specially the super dyke embankment side. This area has been reserved for forest of mangroves. This area will act as a prime barrier to any future cyclonic storms and will keep NSEZ resilient and protected from climate change calamities. This site should be planted according to the coastal afforestation guidelines. According to FAO's 'Coastal Forest Rehabilitation Manual', the number of trees per hectare can vary greatly between different planting densities. For example, planting trees at 0.5 x 0.5 m spacing requires 40,000 trees per hectare, while at 1 x 1 m spacing 10,000 trees are required and at 1 x 2 m only 5,000 trees are required. The spacing of trees has been determined by the typology of mangrove trees. Choice of spacing of trees has been determined by the canopy coverage of mangrove trees. Tree having larger canopy coverage requires more spacing. Different layer of trees to be planted like tall trees, medium trees with shrubs and shrub layer.

This plantation will provide multiple climatic advantages for the project, such as:

- Conservation of mangrove forest
- Minimize effect of climate change
- Protect NSEZ site from cyclonic storm
- Protect the site from erosion
- Biodiversity restoration and conservation specially Wildlife protection

Table 2: Following list plants to be selected for coastal afforestation

Sl No	Local Name	English name	Species Name	Family	Uses	Distance (m) between each sapling
1	Sundari	Sundari	<i>Heritiera fomes</i>	<i>Malvaceae</i>	Timber	2m
2	Gewa	Milky mangrove	<i>Excoecaria agallocha</i>	Euphorbiaceae	Timber	2m
3	Passur	Passur	<i>Xylocarpus mekongensis</i>	<i>Meliaceae</i>	Timber	2m
4	Dhundul	Dhundul	<i>Xylocarpus granatum</i>	<i>Meliaceae</i>	Timber	2m
5	Kankra	Upriver Orange Mangrove	<i>Bruguiera sexanula</i>	<i>Rhizophoraceae</i>	Timber	2m

Sl No	Local Name	English name	Species Name	Family	Uses	Distance between sapling (m) each
6	Khalshi	Black mangrove	<i>Aegiceras corniculatum</i>	<i>Primulaceae</i>	Timber	2m
7	Shingra	Sialang tree	<i>Cynometra ramiflora</i>	<i>Fabaceae</i>	Timber	2m
8	Goran	Goran	<i>Ceriops decandra</i>	<i>Rhizophoraceae</i>	Timber	2m
9	Baen	Indian mangrove	<i>Avecennia officinalis</i>	<i>Aveciniaceae</i>	Timber	2m

Tree removal from Zone 12 and Zone 13

In the Zone- 12 around 401 species and Zone -13 around 442 Trees to be removed for the project. Trees are timber, fruit bearing, fuel and medicinal. Most of the trees are medium sizes but have economic value. According to IUCN red list of vascular plants of Bangladesh National Herbarium 2015, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention, Wildlife (Conservation and Security) Act, 2012, no one species of plant is under threatened category.

Compensatory Plantation

About 843 trees will fell from Zone 12 and Zone 13. For enhancement of environmental condition road site, slope of embankment, will be afforested by a total of 2529 saplings of trees and around 100,000 vetiver roots (soil erosion protection). This is the compensatory afforestation. Classification of tress for plantation has been planned as - fruit trees will be 40%, timber / fuel wood trees will be 40% and 10% will be medicinal trees. Grassing (Vetiver/ Nepiar/ Barmuda) will be provided on the slope of the embankment to protect slope erosion. In order to compensate for the loss of trees, the project provides opportunities for new plantation.

Protection of Tree Saplings

Circular tree guard should be placed after the plantation of the saplings for the protection of these youngplants from the ravages. If tree saplings died or damage occur after placing the circular tree guard, timely replacements of damaged plant and thereafter care is important.

Saplings require support throughout the first few months to avoid drooping or bending. Support sticks should be inserted into the soil near the plant's roots without hurting the plant's roots. For plants shorter than 1 meter, 1-metre-long bamboo sticks and for taller plants, slightly thicker 2-2.5-metre-long bamboo sticks should be used. The sticks should be tied to the plant stems using thin jute strings. Support sticks will be needed for at least every alternate plant.

Maintenance

The plantation should be monitored once in 1-2 months, to check if the targets have been achieved and if any changes should be made to improve results. This should be done the first 8-12 months. Count the number of saplings that have survived, and record the data. Growth of selected species should also be monitored. Mulching should be maintained for at least one year. The soil should be re-mulched with time, since dry soil is detrimental to plant health. As the tree grows taller, longer support sticks may be needed so that the tree shoot does not bend and become weak. Water the forest with hose pipe once a day. Keep the forest weed-free for the first 2-3 years. Once the forest starts growing, weed growth will stop. Mortality rate of plants is usually 2-5 percent. Mortality is to be checked after 3-4 months of planting; minimum 70% survival rate shall be achieved. Keep the forest clean, and free of plastic, paper etc. Re-plantation after one year from Planting and pruning and thinning after 4 years.

Records Keeping & Reporting

The following records shall be maintained:

- Record of Tree plantation
- Record of Survivability rate

Inspection shall be carried out at site to know the survival rate of the plantation. The tree plantation and survivability report shall be prepared every six monthly.

Responsibility

Compensatory plantation shall be carried out by forest department. Survival rate of plantation shall be inspected of the by NSEZ.
