BANGLADESH ECONOMIC ZONES AUTHORITY (BEZA)
NATIONAL SPECIAL ECONOMIC ZONE DEVELOPMENT PROJECT
CHIEF ADVISER'S OFFICE

Environmental and Social Impact Assessment (ESIA)
For
Land Development of Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ-BEZA

Volume II: Appendices

Prepared By

August 2025

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APPENDIX-1: ENVIRONMENTAL AND SOCIAL BASELINE CONDITION

A. PHYSICAL ENVIRONMENTAL BASELINE

Climatic factors: Temperature, Wind, humidity, and rainfall

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 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

The average minimum and maximum temperatures in Sitakunda station is 12.28°C & 32.94 °C, respectively. In the Mirsharai area, temperatures vary from 6-9°C in winters and 37-41°C in summers. Details Temperature of the Sitakunda area is recorded from the Sitakunda Meteorological station, which is the closest station to the study area.

The data from one station has been considered for establishing the temperature profile of the project area. The average minimum temperature varies between 12.28 to 25.91 °C, whereas the maximum temperature ranges from 27.16 to 32.94 °C. Monthly minimum and maximum temperatures and average minimum and maximum temperatures for the period 2013-2022 for Sitakunda Station are given in below tables and figures.

Table 1: Monthly average minimum temperature (°c) in Sitakunda Station (2013 to 2022)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2013	8.5	13.9	18.0	21.3	23.9	23.9	26.9	26.2	26.0	22.3	15.1	12.3
2014	***	***	***	***	***	***	***	***	***	***	***	***
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	23.0	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	15.0	21.5	23.8	24.1	25.3	25.3	25.7	25.6	26.0	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
Average of 10 Years	**12.28**	**16.18**	**20.36**	**23.81**	**24.88**	**25.58**	**25.88**	**25.91**	**25.70**	**23.71**	**18.36**	**14.38**

Source: BMD & BBS-Statistical Yearbook 2013 to 2022 (Station: Sitakunda)

(Note: *** means data missing)

Table 2: Monthly average maximum temperature (°c) in sitakunda station (2013 to 2022)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2013	27.0	31.6	32.9	33.5	31.3	33.0	31.5	31.2	32.8	31.6	31.2	27.7
2014	***	***	***	***	***	***	***	***	***	***	***	***
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	32.0	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	31.0	27.8
2019	27.9	28.7	31.3	33.4	33.4	33.0	31.5	32.6	32.1	32.1	30.6	25.8
2020	***	***	***	***	***	***	***	***	***	***	***	***
2021	29.5	33.1	34.0	34.3	33.9	31.0	32.0	31.7	32.8	33.2	31.3	28.0
2022	26.4	28.4	33.4	32.6	32.6	31.5	33.3	33.3	32.5	33.2	32.0	29.2
Average of 10 Years	**27.16**	**29.99**	**32.16**	**32.88**	**32.94**	**32.03**	**31.41**	**32.38**	**32.49**	**32.23**	**30.95**	**27.81**

Source: BMD & BBS-Statistical Yearbook 2013 to 2022 (Station: Sitakunda)
(Note: *** means data missing)

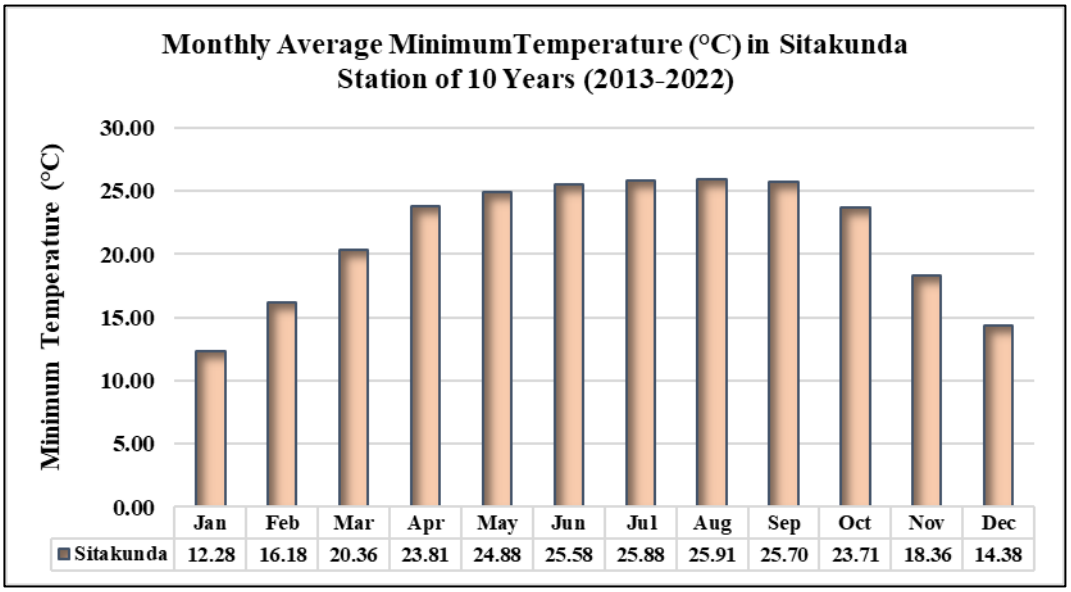


Figure 1: Monthly average minimum temperature (°c) of sitakunda station

Source: BMD & BBS-Statistical Yearbook 2013 to 2022 (Station: Sitakunda)

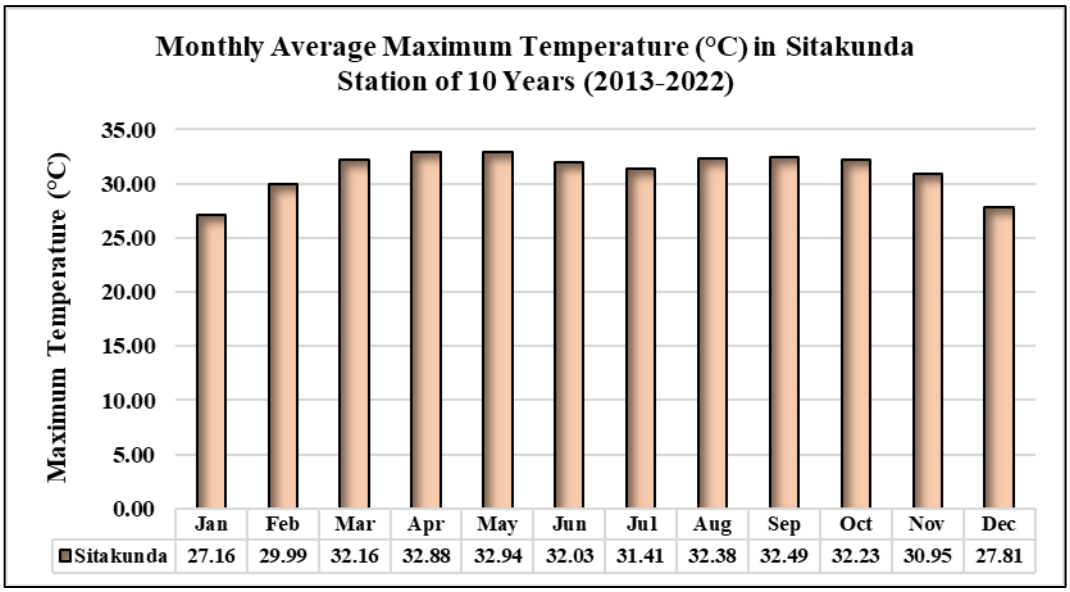


Figure 2: Monthly average maximum temperature (°c) of sitakunda station

Source: BMD & BBS-Statistical Yearbook 2013 to 2022 (Station: Sitakunda)

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 21.86 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 2013-2022) 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	AQ1	29.94	46.72	1013.98	2.28	106.57 (ESE)
2	AQ2	30.14	53.43	1011.41	1.11	106.81 (ESE)
3	AQ3	32.66	63.84	1001.56	1.06	48.27 (NE)
4	AQ4	23.30	79.31	1012.11	0.06	286.04 (WNW)
5	AQ5	23.98	61.68	1012.01	0.21	236.78 (WSW)
6	AQ6	28.78	54.77	1011.30	1.10	106.81 (ESE)
7	AQ7	34.12	45.20	1014.15	2.72	105.51 (E)
8	AQ8	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

Like other coastal regions of the country, the monsoon season is very important in this region. The nearest weather station (BMD) to the site is Sitakunda, which is app. 25.0 km from the EZ site in the SW direction. The average annual rainfall of the Mirershorai region is 2540 mm. June, July, and August are the months of maximum rainfall in the project area. Average monthly rainfall varies from 0.0 to 898.5 mm. The highest rainfall was recorded in the coastal areas of Chittagong district, Sitakunda Area, and the lowest rainfall was observed in the western and northern parts of the country. The maximum rainfall in 2019 was 1589.0 mm in July. The average monthly rainfall data (obtained from BMD) is given in below table and graph.

Table 4: Monthly total rainfall (in mm) in Sitakunda Station (2013 to 2022)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sitakunda												
2013	0.0	0.0	13.0	56.0	479.0	594.0	317.0	517.0	3244.0	260.0	1.0	0.0
2014	***	***	***	***	***	***	***	***	***	***	***	***
2015	3.0	0.0	41.0	149.0	190.0	750.0	1324.0	685.0	438.0	214.0	3.0	5.0
2016	3.0	56.0	140.0	14.0	336.0	337.0	771.0	493.0	312.0	247.0	102.0	0.0
2017	0.0	0.0	113.0	291.0	261.0	940.0	1316.0	812.0	790.0	173.0	1.0	41.0
2018	18.0	0.0	0.0	259.0	270.0	1158.0	1087.0	444.0	157.0	227.0	0.0	3.0
2019	18.0	37.0	40.0	199.0	274.0	226.0	1589.0	420.0	337.0	151.0	117.0	14.0
2020	***	***	***	***	***	***	***	***	***	***	***	***
2021	0.0	0.0	0.0	0.0	94.0	1051.0	587.0	656.0	211.0	129.0	0.0	66.0
2022	6.0	24.0	6.0	79.0	439.0	743.0	197.0	123.0	535.0	147.0	0.0	50.0
Average of 10 Years	**6.0**	**14.6**	**44.1**	**130.9**	**292.9**	**724.9**	**898.5**	**518.8**	**753.0**	**193.5**	**28.0**	**22.4**

Source: BMD & BBS-Statistical Yearbook, 2013 to 2022 (Station: Chattogram & Sitakunda)
*(Note: *** means data missing)*

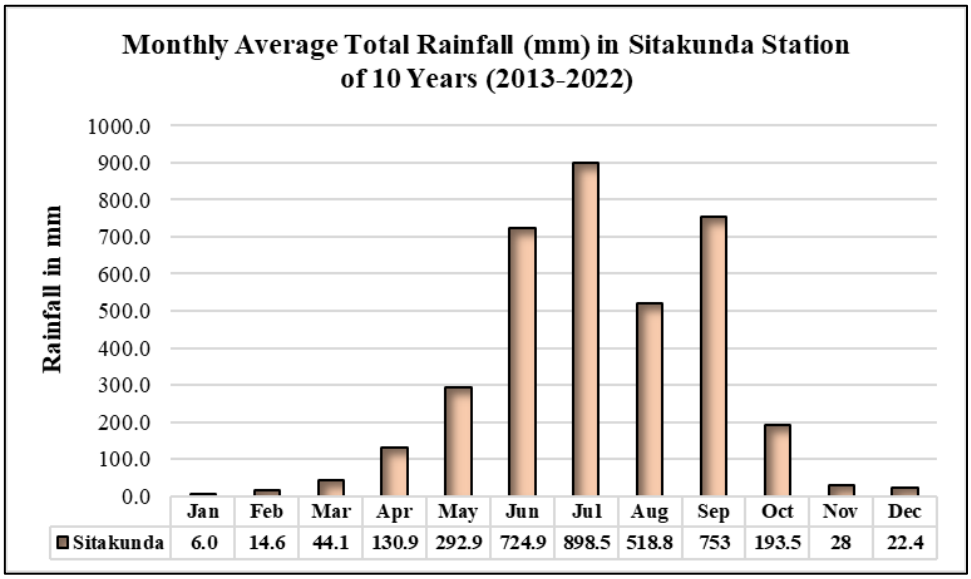


Figure 3: Monthly avrage total rainfall data in stakunda station

Source: BMD & BBS-Statistical Yearbook 2013 to 2022 (Station: Sitakunda)

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.

Humidity

Humidity in the Chattogram district varies from 40% during the day in February to 90% in July and August. The spatial and temporal variation of relative humidity is very low in Bangladesh throughout the year. Data from Sitakunda station have been considered to determine the moisture content of the project area. Monthly normal relative humidity in the project area varies between 72% in February (Sitakunda) and 87% in July (Sitakunda). The data show that monthly normal humidity does not vary much with seasonal changes and is relatively high. Monthly normal humidity data for the Sitakunda areas are given in the table and graph.

Table 5: Monthly normal humidity in Sitakunda Station

Sl.No.	Month	Monthly Normal Relative Humidity (%)
		Sitakunda
01	January	75
02	February	72
03	March	74
04	April	78
05	May	81
06	June	85
07	July	87
08	August	86
09	September	85
10	October	83
11	November	80
12	December	78

Source: BMD

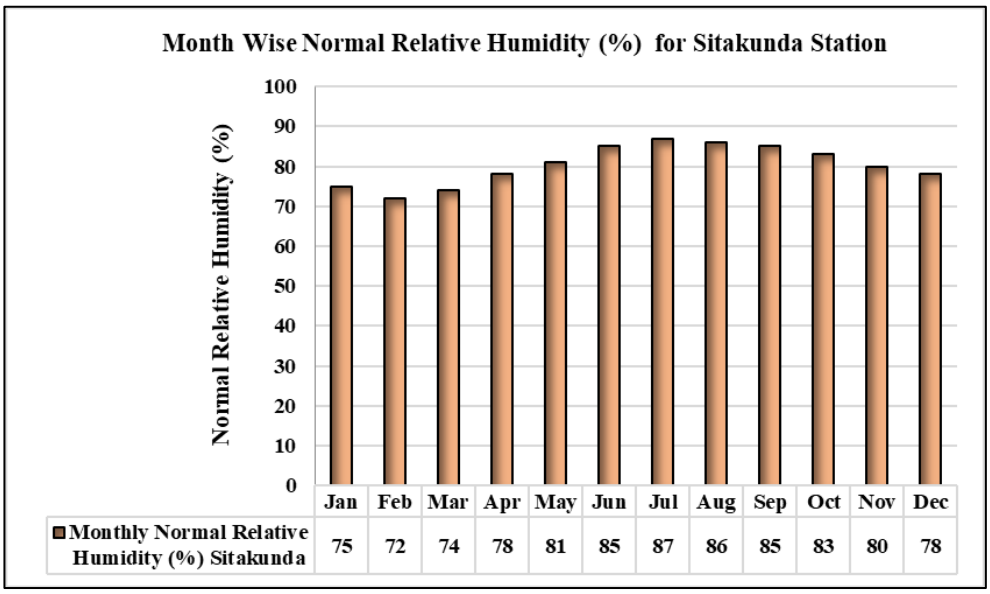


Figure 4: Humidity of Chattogram & Sitakunda station

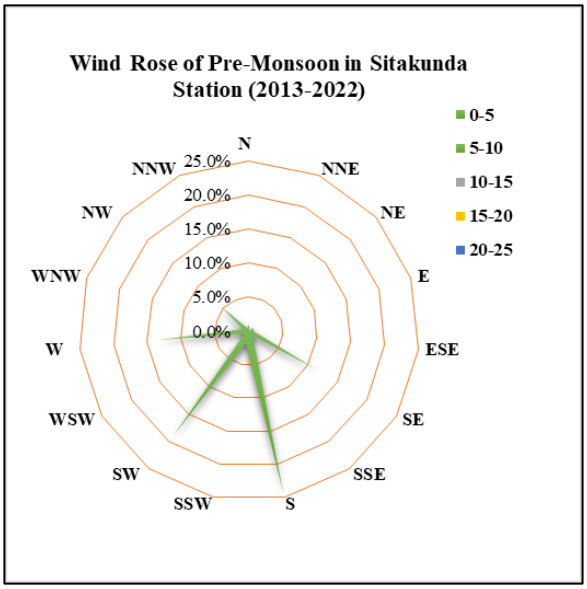
Source: BMD (Bangladesh Meteorological Department)

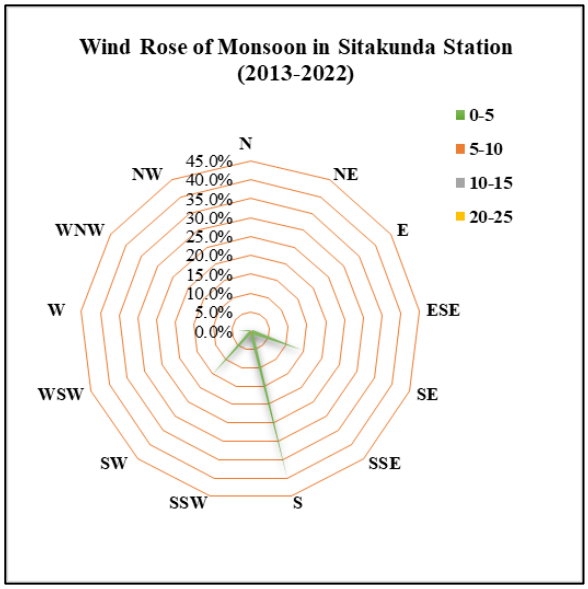
Evaporation

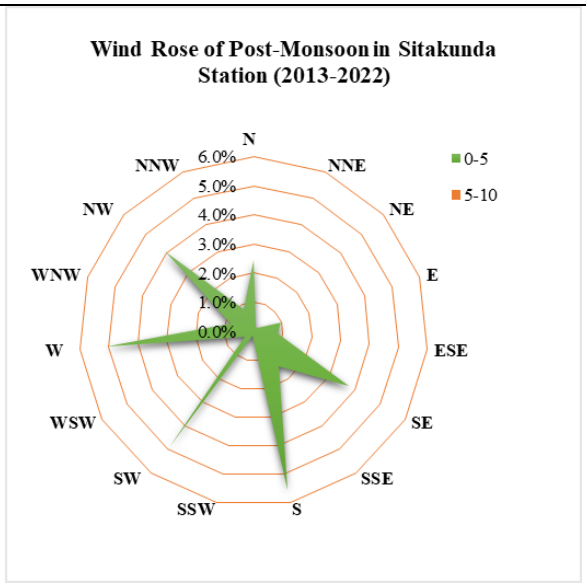
Evaporation in the project area reaches its maximum during April-May when temperature, sunshine, and wind are at or near their maximum levels for the year. Evapotranspiration peaks in April. The app distance from the nearest NNW direction to the Feni site is 15.0 km.

Wind Speed

The Project area is characterized by southerly wind from the Bay of Bengal during monsoon and north-westerly wind from the Himalaya during winter, very similar to the national pattern. The windiest months are April, July. The highest wind speed was observed at Sitakunda station since this station is located at the nearest seashore. The monthly Normal Wind speeds for the past ten years (2013-2022) are shown in the figure below. The Project area experiences natural calamities such as cyclones, tornadoes, and surges caused by the coastal wind and high-risk zones of cyclones.







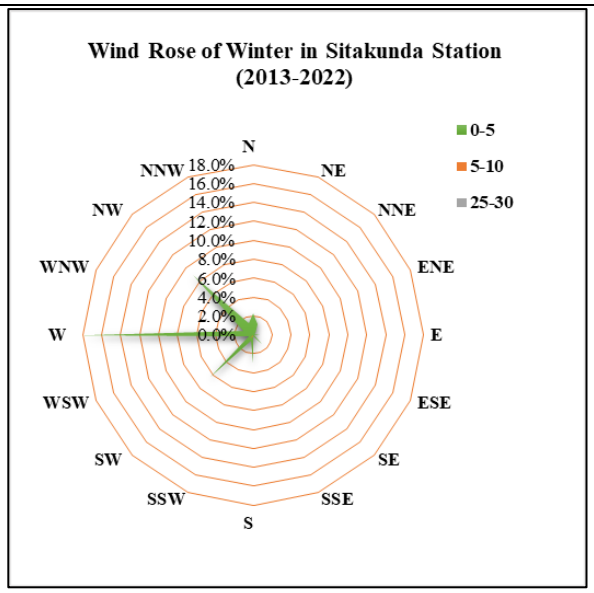
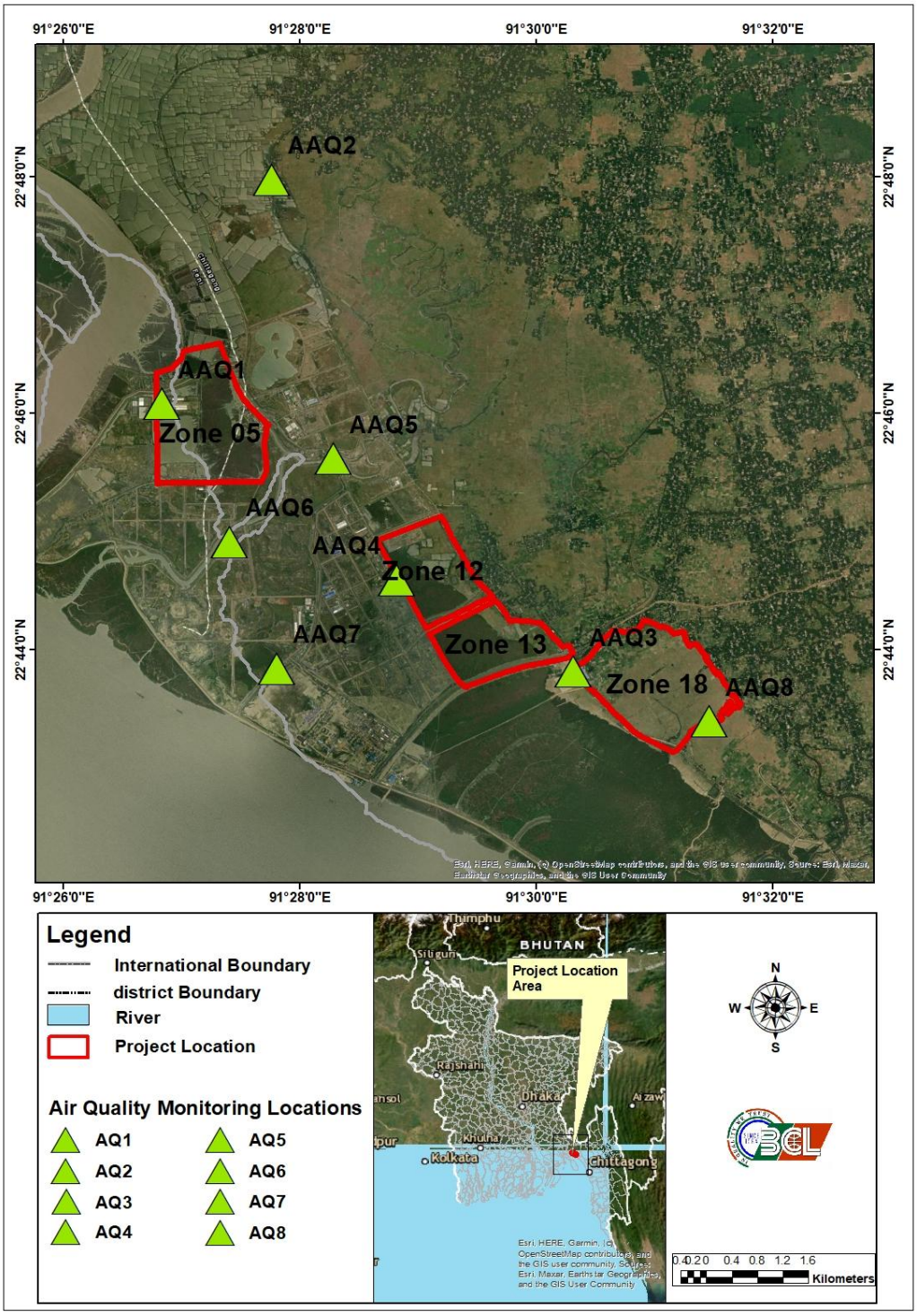


Figure 5: Seasonal variation of wind rose in Sitakunda Station during the years 2013-2022
Units: m/s & Source: Source: Sitakunda Meteorological Station, Bangladesh Meteorological Department (BMD), (2013-2022)

Sunshine Hours

The monthly average sunshine hours in Sitakunda vary from 4 to 9 hours/day. Maximum sunshine hours are recorded in April, May, and June. In general, April, May, and June have a maximum of 12 hours of sunlight per day.

Ambient Air Quality



Map 1: Ambient Air Quality Monitoring location

Table 6: Ambient Air Quality Monitoring Location

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				

Table 7: Summary of Ambient Air Quality Monitoring Results

Station Code	$PM_{2.5}$	PM_{10}	SO_2	NO_2	CO	O3
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	ppm	$\mu g/m^3$
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					
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, 2023

Methodology

The AQM-09 Air Quality Monitoring System machine was used to gather data on ambient air quality, encompassing Oxides of Nitrogen (NOx), O3 (Ozone), Carbon Monoxide (CO), Sulfur Dioxide (SO2), as well as Particulate Matter (PM10 and PM2.5). 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 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).

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

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, PM2.5, 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

[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

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%

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).

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

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 SO_2, $PM_{2.5}$, and PM_{10} parameters, the following power-law equation, as defined in Schroeder and Jugloff was applied:

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

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

AQ1 (Adjacent to CP Mor)

AQ2 (East side of the project location, Daborkhali Point)

AQ3 (Ichakhali Sluice gate Bazar)

AQ4 (Adjacent to the main road, Bodiullah Para Bazar)

AQ5 (Charsarat Village)

AQ6 (Charsarat Village)

AQ7 (In front of Nippon and McDonald Steel Industries Limited, NSEZ)

AQ8 (Baitur Rahman Panjegana Mosque, West Ichakhali, Jorarganj, Mirsharai, Chattogram)

Air Quality Monitoring Test Methodology of Lab Results Sheet

REF NO.: BCL/AAQ/12012024001

BCL ASSOCIATES LIMITED

Ambient Air Quality Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Air Quality Monitoring
Sampling ID and Locations	:	AAQ1, Adjacent to CP Mor, Mirsarai, IMD Zone.
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	08.12.2023
Reporting Date	:	12.01.2024
Description of Results	:	

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ1	08.12.2023 11:30:23 AM	22°43'46.55"N 91°30'21.17"E	7.93	17.50	274.47	10.26	8.79	0.80	156.75
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

Note: *Bangladesh Air Pollution (Control) Rules, 2022;
**WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	29.94	46.72	1013.98	2.28	106.57 (ESE)

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REF NO.: BCL/AAQ/12012024002

BCL ASSOCIATES LIMITED

Ambient Air Quality Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Air Quality Monitoring
Sampling ID and Locations	:	AAQ2, East side of the project location, Daborkhali Point, Mirsarai
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	09.12.2023
Reporting Date	:	12.01.2024
Description of Results	:	

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ2	09.12.2023 11:20:23 AM	22°44'29.00"N 91°29'36.00"E	10.95	15.22	387.44	7.22	24.11	0.52	158.26
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

Note: *Bangladesh Air Pollution (Control) Rules, 2022;
**WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	30.14	53.43	1011.41	1.11	106.81 (ESE)

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BCL ASSOCIATES LIMITED

Ambient Air Quality Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Air Quality Monitoring
Sampling ID and Locations	:	AAQ3, Ichakhali Sluice gate Bazar
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	10.12.2023
Reporting Date	:	12.01.2024
Description of Results	:	

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ3	10.12.2023 10:12:35 AM	22°45'45.79"N 91°28'46.02"E	10.47	13.07	273.75	18.36	24.11	0.72	171.57
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

Note: *Bangladesh Air Pollution (Control) Rules, 2022;
**WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	32.66	63.84	1001.56	1.06	48.27 (NE)

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Ambient Air Quality Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Air Quality Monitoring
Sampling ID and Locations	:	AAQ4, Adjacent to the main road, Bodiullah Para Bazar
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	11.12.2023
Reporting Date	:	12.01.2024
Description of Results	:	

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ4	11.12.2023 9:08:17 AM	22°44'25.81"N 91°31'7.90"E	26.65	33.61	225.32	11.90	50.83	0.59	183.52
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

Note: *Bangladesh Air Pollution (Control) Rules, 2022;
**WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	23.30	79.31	1012.11	0.06	286.04 (WNW)

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Ambient Air Quality Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities : Ambient Air Quality Monitoring
Sampling ID and Locations : AAQ5, Charsarat Village
Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date : 11.12.2023
Reporting Date : 12.01.2024
Description of Results :

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ5	11.12.2023 2:15:23 PM	22°45'2.00"N 91°30'18.00"E	18.37	30.27	90.54	8.75	15.15	0.50	170.49
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

*Note: *Bangladesh Air Pollution (Control) Rules, 2022;*
***WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines*
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	23.98	61.68	1012.01	0.21	236.78 (WSW)

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Ambient Air Quality Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities : Ambient Air Quality Monitoring
Sampling ID and Locations : AAQ6, Charsarat Village
Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date : 12.12.2023
Reporting Date : 12.01.2024
Description of Results :

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ6	12.12.2023 12:00:20 PM	22°46'39.47"N 91°29'50.97"E	7.55	16.06	384.89	10.34	13.99	0.55	161.65
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

*Note: *Bangladesh Air Pollution (Control) Rules, 2022;*
***WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines*
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	28.78	54.77	1011.30	1.10	106.81 (ESE)

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Ambient Air Quality Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities : Ambient Air Quality Monitoring
Sampling ID and Locations : AAQ7, In front of Nippon and McDonald Steel Industries limited
Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date : 13.12.2023
Reporting Date : 12.01.2024
Description of Results :

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ7	13.12.2023 11:25:14 AM	22°46'7.79"N 91°26'48.35"E	20.61	32.75	268.74	2.48	37.34	0.82	173.07
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

*Note: *Bangladesh Air Pollution (Control) Rules, 2022;*
***WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines*
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	34.12	45.20	1014.15	2.72	105.51 (E)

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Ambient Air Quality Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities : Ambient Air Quality Monitoring
Sampling ID and Locations : AAQ8, Dakshin Maghadia, Mirsharai, Chattogram
Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date : 14.12.2023
Reporting Date : 12.01.2024
Description of Results :

Sampling ID	Date and Time	GPS Coordinates	Concentrations (µg/m3)					CO (ppm)	CO_2 (ppm)
			$PM_{2.5}$	PM_{10}	SO_2	NO_2	O_3		
AAQ8	14.12.2023 11:55:14 AM	22°72'30.38"N 91°52'44.81"E	19.62	30.26	255.06	1.68	36.01	0.63	170.61
*Bangladesh Standard			65	150	80	80	100	5	-
**WHO Standard			15	45	40	25	100	10	-
Methods			Light Scattering Nephotometer		High Sensitivity Electrochemical				

*Note: *Bangladesh Air Pollution (Control) Rules, 2022;*
***WHO Ambient Air Quality Guideline Values (2021), which are also being referred in the World Bank and IFC's General EHS Guidelines*
PM_{10}- Particulate Matter of a diameter of 10 micron or less; $PM_{2.5}$- Particulate Matter of a diameter of 2.5 micron or less; NO_2- Nitrogen Dioxides; SO_2- Sulphur Dioxides; O_3- Ozone; CO- Carbon Monoxides; CO_2- Carbon Dioxides;

Micro-Meteorological Monitoring Results:

Parameters	Air Temperature	Relative Humidity	Air Pressure	Wind Speed	Wind Direction
Units	(°C)	(%)	(hPa)	(m/s)	(Degree)
Concentrations	33.12	40.20	1012.15	2.22	100.51 (E)

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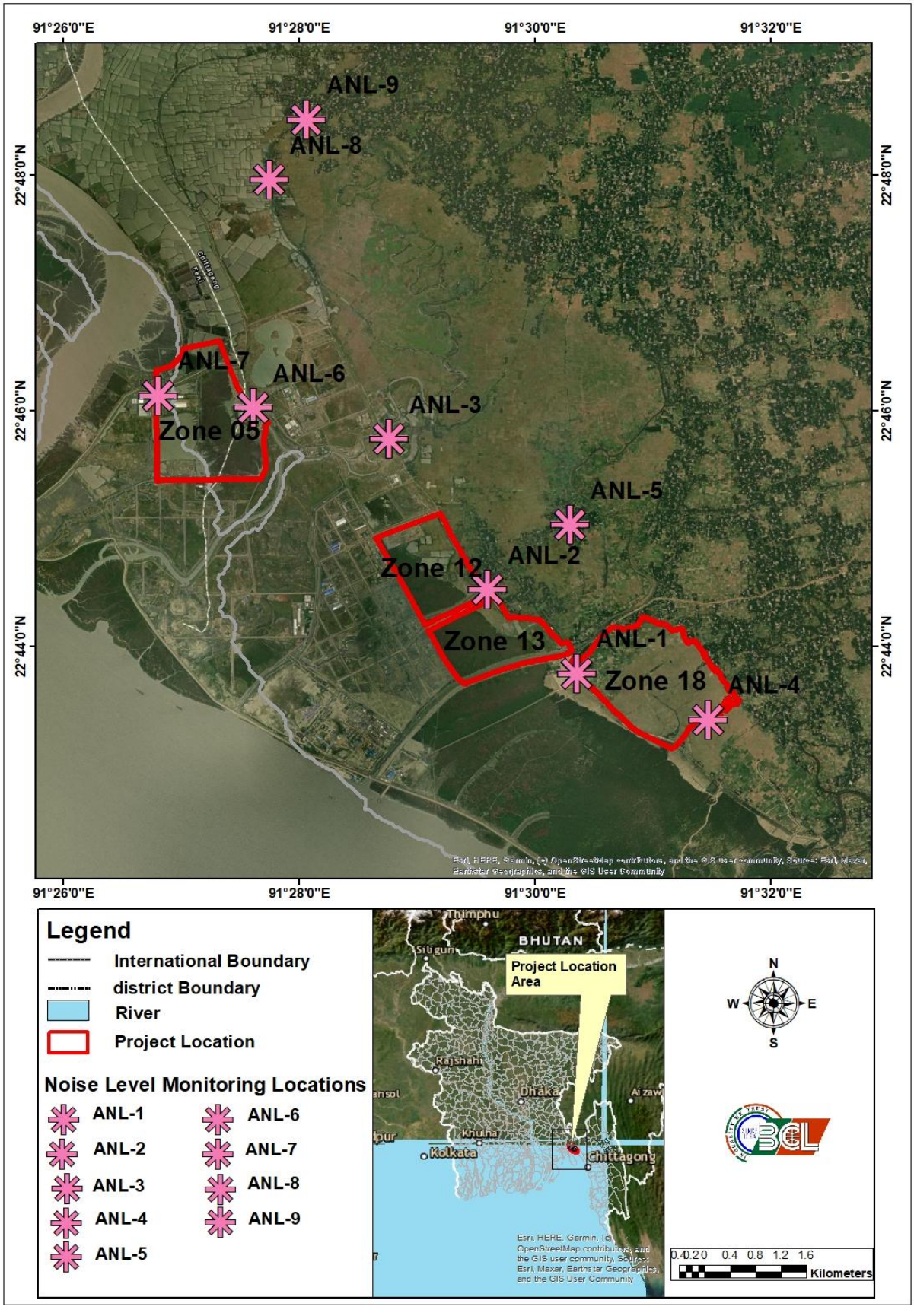
Ambient Noise Level



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

Table 12: Ambient Noise Level Monitoring Result

Sample Code	Noise level (dB(A))[3]			Bangladesh Standard (dB(A))[4]			IFC EHS Guideline (2007)[5]			Location setting (DOE/IFC)
	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

[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

Photographs of Noise Level Measurement

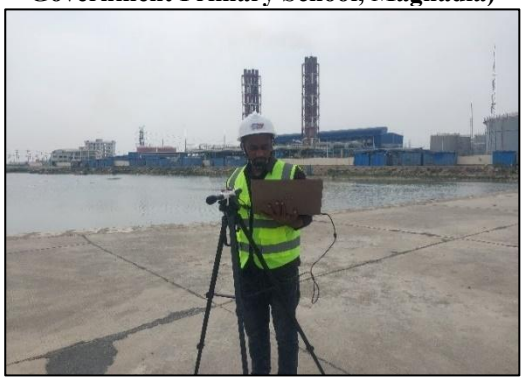
ANL1 (Adjacent to CP Mor, Ichakhali)

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)

Lab Sheets of Noise Level

REF NO.: BCL/ANL/14012024001

BCL ASSOCIATES LIMITED

Ambient Noise Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Noise Level Monitoring
Location Settings	:	Mixed / Commercial Zone
Sampling ID and Locations	:	ANL1, Adjacent to CP Mor, Ichakhali, Mirsarai
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	08.12.2023
Reporting Date	:	14.01.2024
Description of Results	:	

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL1	22°43'46.55"N 91°30'21.17"E	Mixed /Commercial Zone	52.7	68.2	35.1	37.9	55.6	32.5	60	50	70	70

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
***Guidelines values are for noise levels measured out of doors. Guidelines for Community Noise, World Health Organization (WHO), 1999*

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Ambient Noise Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Noise Level Monitoring
Location Settings	:	Mixed / Commercial Zone
Sampling ID and Locations	:	ANL2, East side of the project location, Daborkhali Point, Ichakhali, Mirsarai
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	09.12.2023
Reporting Date	:	14.01.2024
Description of Results	:	

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL2	22°44'29.00"N 91°29'36.00"E	Mixed /Commercial Zone	53.3	78.4	38.3	38.1	55.3	33.1	60	50	70	70

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
***Guidelines values are for noise levels measured out of doors. Guidelines for Community Noise, World Health Organization (WHO), 1999*

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Ambient Noise Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Noise Level Monitoring
Location Settings	:	Commercial
Sampling ID and Locations	:	ANL3, Ichakhali Sluice gate Bazar
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	10.12.2023
Reporting Date	:	13.01.2024
Description of Results	:	

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL3	22°45'45.79"N 91°28'46.02"E	Commercial	67.4	84.2	38.6	44.3	57.0	33.8	70	60	70	70

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
***Guidelines values are for noise levels measured out of doors. Guidelines for Community Noise, World Health Organization (WHO), 1999*

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Ambient Noise Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Ambient Noise Level Monitoring
Location Settings	:	Silent/ Institutional Zone
Sampling ID and Locations	:	ANL4, Adjacent to the main road, Bodiullah Para Government Primary School, Maghadia, Mirsharai, Chattogram
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	11.12.2023
Reporting Date	:	13.01.2024
Description of Results	:	

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL4	22°44'25.81"N 91°31'7.90"E	Silent/ Institutional Zone	62.4	81.5	39.2	42.5	54.8	32.3	50	40	55	45

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
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Ambient Noise Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Ambient Noise Level Monitoring

Location Settings : Residential

Sampling ID and Locations : ANL5, In front of Abdul Kader Mia House, Charsarat

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 12.12.2023

Reporting Date : 14.01.2024

Description of Results :

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL5	22°45'2.00"N 91°30'18.00"E	Residential	38.5	61.5	33.1	34.9	51.3	32.6	55	45	55	45

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
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Ambient Noise Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Ambient Noise Level Monitoring

Location Settings : Industrial

Sampling ID and Locations : ANL6, In front of BR Powergen

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 13.12.2023

Reporting Date : 15.01.2024

Description of Results :

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL6	22°46'1.57"N 91°27'36.74"E	Industrial	57.3	77.6	41.4	50.5	56.6	41.4	75	70	70	70

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
***Guidelines values are for noise levels measured out of doors. Guidelines for Community Noise, World Health Organization (WHO), 1999*

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Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Ambient Noise Level Monitoring

Location Settings : Industrial

Sampling ID and Locations : ANL7, In front of Nippon and McDonald Steel Industries limited

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 13.12.2023

Reporting Date : 15.01.2024

Description of Results :

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL7	22°48'7.76"N 91°26'48.45"E	Industrial	60.5	78.0	30.5	50.3	57.1	41.7	75	70	70	70

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
***Guidelines values are for noise levels measured out of doors. Guidelines for Community Noise, World Health Organization (WHO), 1999*

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Ambient Noise Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Ambient Noise Level Monitoring

Location Settings : Mixed Zone

Sampling ID and Locations : ANL8, Baitur Rahman Panjegana Mosque, West Ichakhali, Jorarganj, Mirsharai, Chattogram

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 14.12.2023

Reporting Date : 15.01.2024

Description of Results :

Code	GPS Coordinates	Category of Locations	Noise Level (dBA)						*BD Standard (dBA)		**IFC EHS Guideline (2017)	
			L_{eqday}	L_{max}	L_{min}	$L_{eqnight}$	L_{max}	L_{min}	Day	Night	Day	Night
ANL8	22°47'57.69"N 91°27'45.01"E	Mixed Zone	53.4	79.4	30.5	38.4	47.1	30.1	60	50	70	70

*Note: *Bangladesh Noise Pollution (Control) Rules, 2006.*
***Guidelines values are for noise levels measured out of doors. Guidelines for Community Noise, World Health Organization (WHO), 1999*

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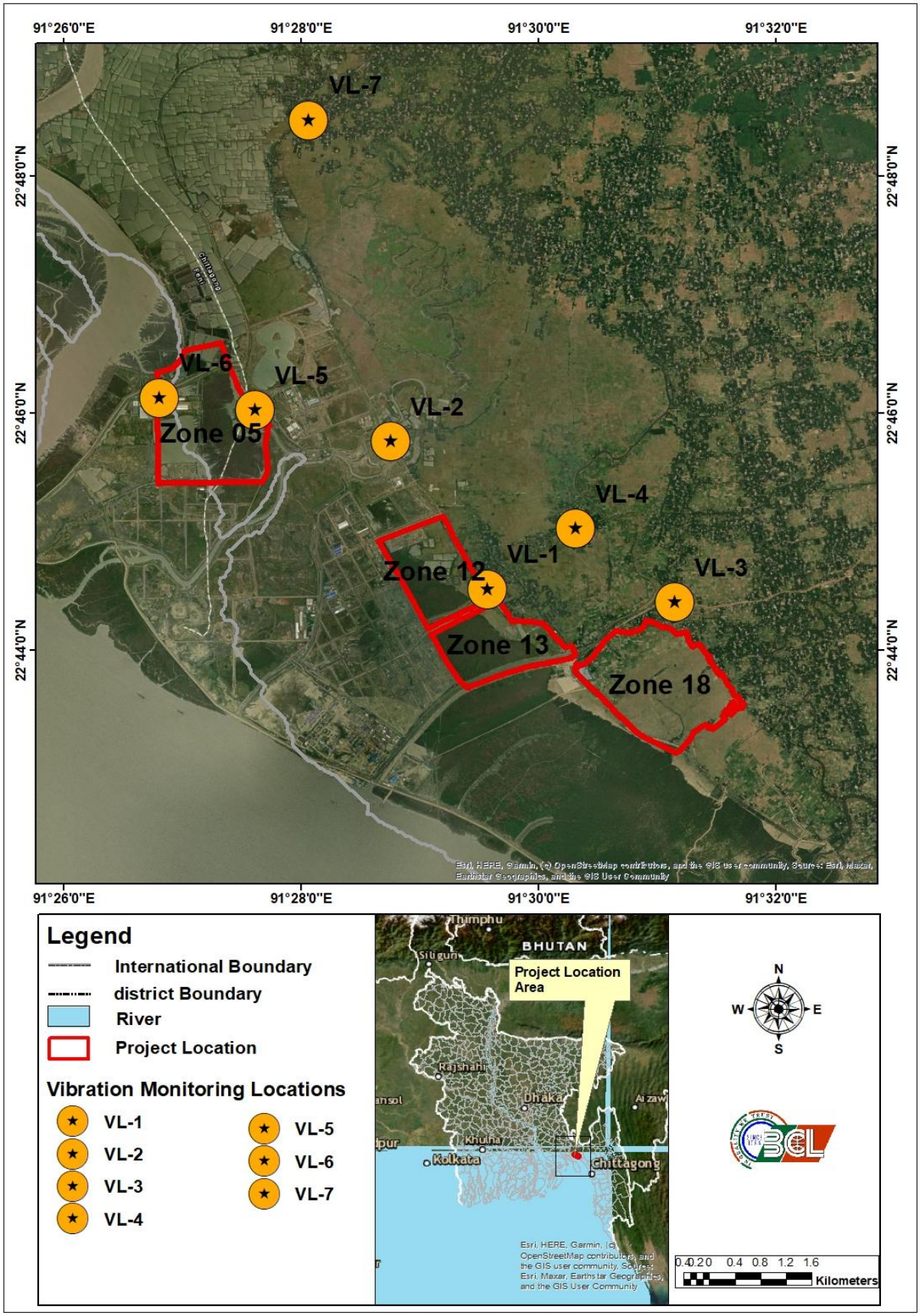
Vibration Level Measurement



Map 3: Vibration Level Monitoring Locations
Source: Primary Data Collection by the Environment Team of BCL Associates Limited, December 2023

Table 13: Vibration Monitoring Locations

Sl. No.	Sampling Station	Station Code	GPS Coordinates	Sampling Date and Time
1.	East side of the project location, Daborkhali Point	VL1	22°44'30.92"N 91°29'34.23"E	10.12.2023 4.35 PM
2.	Ichakhali Sluice gate Bazar	VL2	22°45'45.73"N 91°28'45.30"E	11.12.2023 9.54 AM
3.	Adjacent to the main road, Bodiullah Para Bazar	VL3	22°44'24.33"N 91°31'8.93"E	11.12.2013 3.24 PM
4.	Charsarat Village	VL4	22°45'1.59"N 91°30'18.75"E	12.12.2023 9.12 AM
5.	In front of BR Powergen	VL5	22°46'1.57"N 91°27'36.74"E	13.12.2023 9.30 AM
6.	In front of Nippon and McDonald Steel Industries Limited	VL6	22°46'7.76"N 91°26'48.45"E	13.12.2023 2.30 PM
7.	Tekerhat Bazar	VL7	22°48'28.16"N 91°28'4.10"E	14.12.2023 9.30 AM
Source: Primary Data Collection by the Environment Team of BCL Associates Limited, December 2023				

Table 14: Vibration Level Measurement Result

Sl. No.	Code	Vibration Level (mm/s)			Standard
		Average	Maximum	Minimum	
1.	VL1	0.62	1.23	0.09	Yet to be set for Bangladesh
2.	VL2	0.63	1.20	0.13	
3.	VL3	0.74	1.27	0.11	
4.	VL4	0.36	0.57	0.24	
5.	VL5	0.17	0.38	0.05	
6.	VL6	0.16	0.45	0.04	
7.	VL7	0.22	0.45	0.02	

Lab Sheets of Vibration Level Monitoring

REF NO.: BCL/VL/ 13012024001

BCL ASSOCIATES LIMITED

Vibration Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Vibration Level Monitoring

Sampling ID and Locations : VL1, East side of the project location, Daborkhali Point

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 10.12.2023

Reporting Date : 13.01.2024

Description of Results :

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL1	10.12.2023 4.35 PM	22°44'30.92"N 91°29'34.23"E	0.62	1.23	0.09	Not Set Yet for Bangladesh

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Vibration Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Vibration Level Monitoring

Sampling ID and Locations : VL2, Ichakhali Sluice gate Bazar

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 11.12.2023

Reporting Date : 13.01.2024

Description of Results :

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL2	11.12.2023 9.54 PM	22°45'45.73"N 91°28'45.30"E	0.63	1.20	0.13	Not Set Yet for Bangladesh

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Vibration Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Vibration Level Monitoring

Sampling ID and Locations : VL3, Adjacent to the main road, Bodiullah Para Bazar

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 11.12.2023

Reporting Date : 13.01.2024

Description of Results :

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL3	10.12.2023 3.24 PM	22°44'24.33"N 91°31'8.93"E	0.74	1.27	0.11	Not Set Yet for Bangladesh

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Vibration Level Monitoring Report

Project Name : Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project

Activities : Vibration Level Monitoring

Sampling ID and Locations : VL4, Charsarat Village

Field Officer/Manager : Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited

Monitoring/Sampling Date : 12.12.2023

Reporting Date : 13.01.2024

Description of Results :

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL4	12.12.2023 9.12 AM	22°45'1.59"N 91°30'18.75"E	0.36	0.57	0.24	Not Set Yet for Bangladesh

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Vibration Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Vibration Level Monitoring
Sampling ID and Locations	:	VL5, In front of BR Powergen
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	13.12.2023
Reporting Date	:	13.01.2024
Description of Results	:	

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL5	13.12.2023 9.30 AM	22°46'1.57"N 91°27'36.74"E	0.17	0.38	0.05	Not Set Yet for Bangladesh

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Vibration Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Vibration Level Monitoring
Sampling ID and Locations	:	VL6, In front of Nippon and McDonald Steel Industries limited
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	13.12.2023
Reporting Date	:	13.01.2024
Description of Results	:	

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL6	13.12.2023 2.30 PM	22°46'7.76"N 91°26'48.45"E	0.16	0.45	0.04	Not Set Yet for Bangladesh

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Vibration Level Monitoring Report

Project Name	:	Environmental and Social Impact Assessment (ESIA) for The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B in NSEZ under NSEZ Development Project
Activities	:	Vibration Level Monitoring
Sampling ID and Locations	:	VL7, Tekerhat Bazar
Field Officer/Manager	:	Md. Mustafizur Rahman, Environmentalist, BCL Associates Limited
Monitoring/Sampling Date	:	14.12.2023
Reporting Date	:	13.01.2024
Description of Results	:	

Code	Date and Time	GPS Coordinates	Vibration Level (mm/s)			Standard (mm/s)
			Average	Maximum	Minimum	
VL7	14.12.2023 9.30 AM	22°48'28.16"N 91°28'4.10"E	0.22	0.45	0.02	Not Set Yet for Bangladesh

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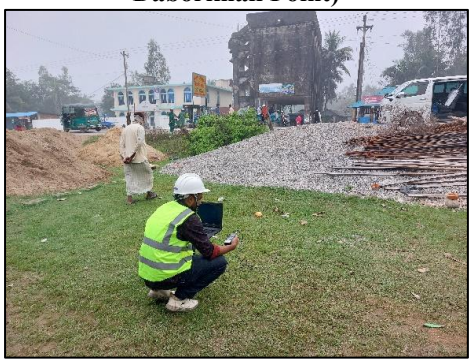
Photographs of Vibration Level Measurement

VL1 (East side of the project location, Daborkhali Point)

VL2 (Ichakhali Sluice gate Bazar)



VL3 (Adjacent to the main road, Bodiullah Para Bazar)

VL4 (Charsarat Village)

VL5 (In front of BR Powergen, NSEZ)

VL6 (In front of Nippon and McDonald Steel Industries Limited)

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

Surface and Ground Water Quqlity

Table 15: Surface water sampling locations

Sl.	Sampling Location	Code	Geographical Location	Sampling Date	Type of Source
1.	Bamonsundor Canal	SW1	22°43'36.06"N 91°29'14.67"E	13.12.2023	Canal Water
2.	Daborkhali Canal	SW2	22°44'30.96" N 91°28'9.60"E	13.12.2023	Canal Water
3.	Ichakhali Canal	SW3	22°44'41.63"N 91°27'11.03"E	13.12.2023	Canal Water
4.	Shaherkhali Khal	SW4	22°71'55.11"N 91°51'40.32"E	13.12.2023	Canal Water
5.	Sandwip Channel	L-05	22°40'33.08"N 91°30'39.42"E	03.01.2024	Channel
6.	Sandwip Channel	L-07	22°41'42.93"N 91°28'45.49"E	03.01.2024	Channel
7.	Sandwip Channel	L-08	22°42'8.14"N 91°27'42.75"E	03.01.2024	Channel
8.	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

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	Less than 0.1	0.2	-	-
COD	mg/L	5.64	1.88	2.82	3.76	50	5220.B
BOD	mg/L	2.32	Less than 0.2	Less than 0.2	0.58	≤6	5210.B
Mercury	mg/L	Less than 0.001	Less than 0.001	Less than 0.001	Less than 0.001	-	3112.B
Lead	mg/L	Less than 0.001	Less than 0.001	Less than 0.001	Less than 0.001	0.1	3111.B
Cadmium	mg/L	Less than 0.001	Less than 0.001	Less than 0.001	Less than 0.001	-	3111.B
Oil and Grease	mg/L	Less than 2.0	Less than 2.0	Less than 2.0	Less than 2.0	-	5520.B
Fecal Coliform	MPN/100ml	2.0	<1.8	2.0	<1.8[7]	2.0 indicates (Absent) as per BDS Standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	2.0	2.0	2.0	<1.8	2.0 indicates (Absent) as per BDS	9221B-C

[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.

Parameters	Unit	SW1	SW2	SW3	SW4	Bangladesh Standard[6]	Test Method (APHA)
						Standard 1240:2021	

Source: Laboratory Analysis in BCSIR, January 2024

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

SurfaceWater Lab Result Sheet

Form No. QSF-22 Revision No. 12 Revision Date: 04 November, 2022

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-751 of Analytical Service Cell, BCSIR, 14/12/2023
Lab/Sample ID : A-910-913
Client's Details : Md. Shafiqul Islam
Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688) BANGLADESH ECONOMIC ZONES AUTHORITY
BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 04 (Four)
Sample Description : Surface Water পরীক্ষণ প্রসঙ্গে, তারিখ ১৩/১২/২০২৩ ইং।
Test Commencement Date : 14/12/2023
Test Completion Date : 10/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-910	Surface Water (SW-01)	TDS (Total dissolved solids)	2168 mg/L	2540.C
		TSS (Total Suspended Solid)	84.0 mg/L	2540.D
		Electrical Conductivity	3910 µS/cm	2510.B
		Turbidity	42.8 NTU	Turbidimeter
		pH at 24.8°C	7.32	4500-H+.B
		Salinity	2.1 ppt	--
		COD (Chemical Oxygen Demand)	5.64 mg/L	5220.B
		BOD (Biological Oxygen Demand)	2.32 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Oil and Grease	Less than 2.0 mg/L	5520.B

Page 1 of 3

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-911	Surface Water (SW-02)	TDS (Total dissolved solids)	1332 mg/L	2540.C
		TSS (Total Suspended Solid)	34.0 mg/L	2540.D
		Electrical Conductivity	2750 µS/cm	2510.B
		Turbidity	81.2 NTU	Turbidimeter
		pH at 24.7°C	8.02	4500-H+.B
		Salinity	1.4 ppt	--
		COD (Chemical Oxygen Demand)	1.88 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Oil and Grease	Less than 2.0 mg/L	5520.B
A-912	Surface Water (SW-03)	TDS (Total dissolved solids)	166 mg/L	2540.C
		TSS (Total Suspended Solid)	6.0 mg/L	2540.D
		Electrical Conductivity	327 µS/cm	2510.B
		Turbidity	65.6 NTU	Turbidimeter
		pH at 25.1°C	7.09	4500-H+.B
		Salinity	Less than 0.1 ppt	--
		COD (Chemical Oxygen Demand)	2.82 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Oil and Grease	Less than 2.0 mg/L	5520.B

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-913	Surface Water (SW-04)	TDS (Total dissolved solids)	304 mg/L	2540.C
		TSS (Total Suspended Solid)	5.0 mg/L	2540.D
		Electrical Conductivity	540 µS/cm	2510.B
		Turbidity	46.9 NTU	Turbidimeter
		pH at 25.2°C	7.08	4500-H+.B
		Salinity	0.2 ppt	--
		COD (Chemical Oxygen Demand)	3.76 mg/L	5220.B
		BOD (Biological Oxygen Demand)	0.58 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Oil and Grease	Less than 2.0 mg/L	5520.B

Analyst: Tanzil Ahamed Shawon, Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhanmondi, Dhaka-1205
Supervisor: Dr. Muhammad Abdullah Al-Mansur, Principal Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205
Director: Sarker Kamruzzaman, Director (Addl. Charge), Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-751 of Analytical Service Cell, BCSIR, 14/12/2023
Lab/Sample ID : A-910-913
Client's Details : Md. Shafiqul Islam
Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688) BANGLADESH ECONOMIC ZONES AUTHORITY
BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 04 (Four)
Sample Description : Surface Water পরীক্ষণ প্রসঙ্গে, তারিখ ১৩/১২/২০২৩ ইং।
Test Commencement Date : 14/12/2023
Test Completion Date : 10/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-910	Surface Water (SW-01)	DO (Dissolved Oxygen)	5.39 mg/L	4500-O-G
A-911	Surface Water (SW-02)	DO (Dissolved Oxygen)	7.56 mg/L	4500-O-G
A-912	Surface Water (SW-03)	DO (Dissolved Oxygen)	7.51 mg/L	4500-O-G
A-913	Surface Water (SW-04)	DO (Dissolved Oxygen)	6.47 mg/L	4500-O-G

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Particulars of supplied sample	Test Parameters	Results	BDS Standard 1240: 2021	Test Method (APHA)
Surface Water **SW-01** (A-910)	Fecal Coliform (MPN/100 ml)	2.0	Absent	9221B-C
	Total Coliform (MPN/100 ml)	2.0	Absent	9221B-C
Surface Water **SW-02** (A-911)	Fecal Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
	Total Coliform (MPN/100 ml)	2.0	Absent	9221B-C
Surface Water **SW-03** (A-912)	Fecal Coliform (MPN/100 ml)	2.0	Absent	9221B-C
	Total Coliform (MPN/100 ml)	2.0	Absent	9221B-C
Surface Water **SW-04** (A-913)	Fecal Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C

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

Analyst — Md. Tanzil Ahamed Shawon, Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhanmondi, Dhaka-1205
Supervisor — Dr. Muhammad Abdullah Al-Mansur, Principal Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205
Director — Sarker Kamruzzaman, Director (Addl. Charge), Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-18 of Analytical Service Cell
BCSIR, 04/01/2024
Lab/Sample ID : A-36-41
Client's Details : Dr. Nahid Amin
Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688)
BANGLADESH ECONOMIC ZONES AUTHORITY
BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 06 (Six)
Sample Description : Surface Water পরীক্ষণ গ্রাসঙ্গে, তারিখঃ ০৮/০১/২০২৪ ইং।
Test Commencement Date : 04/01/2024
Test Completion Date : 22/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-36	Surface Water **(L-05, Sandwip Channel)**	Temperature	24.8°C	In-house
A-37	Surface Water **(L-07, Sandwip Channel)**	Temperature	25.2°C	In-house
A-38	Surface Water **(L-08, Sandwip Channel)**	Temperature	25.3°C	In-house
A-39	Surface Water **(L-09, Sandwip Channel)**	Temperature	24.7°C	In-house
A-40	Feni River Water **(L-14)**	Temperature	25.1°C	In-house
A-41	Feni River Water **(L-15)**	Temperature	24.7°C	In-house

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Particulars of supplied sample	Test Parameters	Results	BDS Standard 1240: 2021	Test Method (APHA)
Surface Water **(L-05, Sandwip Channel, A-36)**	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Surface Water **(L-07, Sandwip Channel, A-37)**	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Surface Water **(L-08, Sandwip Channel, A-38)**	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Surface Water **(L-09, Sandwip Channel, A-39)**	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Feni River Water **(L-14, A-40)**	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Feni River Water **(L-15, A-41)**	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C

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

Analyst — 22-01-24
Supervisor — 22/01/24
Director — Sarker Kamruzzaman, Director (Addl. Charge), Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205

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ANALYSIS REPORT

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Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688)
BANGLADESH ECONOMIC ZONES AUTHORITY
BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 06 (Six)
Sample Description : Surface Water পরীক্ষণ গ্রাসঙ্গে, তারিখঃ ০৪/০১/২০২৪ ইং।
Test Commencement Date : 04/01/2024
Test Completion Date : 22/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-36	Surface Water **(L-05, Sandwip Channel)**	TSS (Total Suspended Solid)	463 mg/L	2540.D
		Electrical Conductivity	27500 µS/cm	2510.B
		Turbidity	83.1 NTU	Turbidimeter
		pH at 24.8°C	7.90	4500-H+.B
		Salinity	16.6 ppt	--
		COD (Chemical Oxygen Demand)	1.95 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Chromium (Cr)	Less than 0.005 mg/L	3113.B

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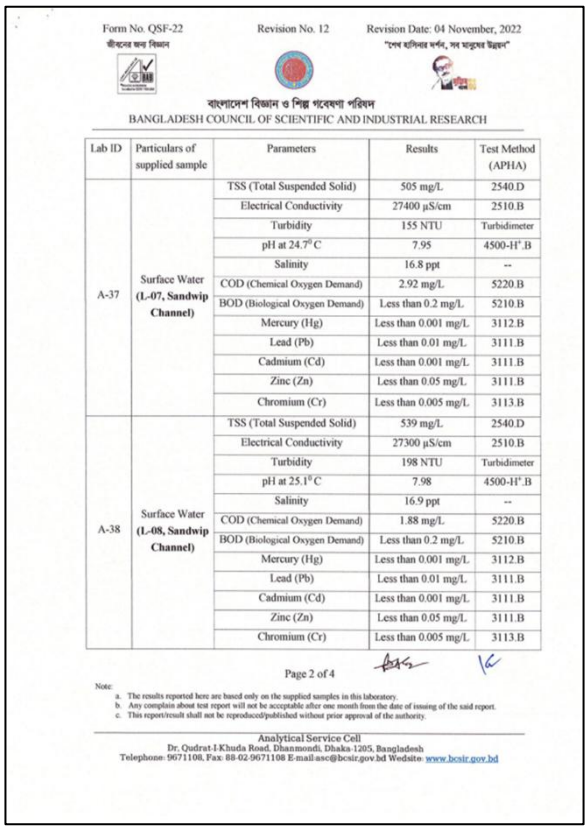

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-37	Surface Water (L-07, Sandwip Channel)	TSS (Total Suspended Solid)	505 mg/L	2540.D
		Electrical Conductivity	27400 µS/cm	2510.B
		Turbidity	155 NTU	Turbidimeter
		pH at 24.7°C	7.95	4500-H+.B
		Salinity	16.8 ppt	--
		COD (Chemical Oxygen Demand)	2.92 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Chromium (Cr)	Less than 0.005 mg/L	3113.B
A-38	Surface Water (L-08, Sandwip Channel)	TSS (Total Suspended Solid)	539 mg/L	2540.D
		Electrical Conductivity	27300 µS/cm	2510.B
		Turbidity	198 NTU	Turbidimeter
		pH at 25.1°C	7.98	4500-H+.B
		Salinity	16.9 ppt	--
		COD (Chemical Oxygen Demand)	1.88 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Chromium (Cr)	Less than 0.005 mg/L	3113.B

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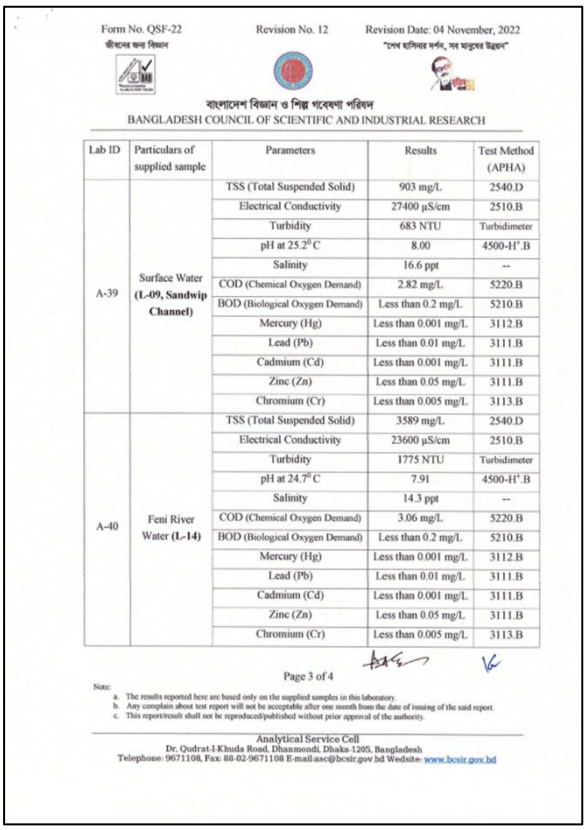
Dr. Qudrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh
Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd



Form No. QSF-22 Revision No. 12 Revision Date: 04 November, 2022

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-39	Surface Water (L-09, Sandwip Channel)	TSS (Total Suspended Solid)	903 mg/L	2540.D
		Electrical Conductivity	27400 µS/cm	2510.B
		Turbidity	683 NTU	Turbidimeter
		pH at 25.2°C	8.00	4500-H+.B
		Salinity	16.6 ppt	--
		COD (Chemical Oxygen Demand)	2.82 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Chromium (Cr)	Less than 0.005 mg/L	3113.B
A-40	Feni River Water (L-14)	TSS (Total Suspended Solid)	3589 mg/L	2540.D
		Electrical Conductivity	23600 µS/cm	2510.B
		Turbidity	1775 NTU	Turbidimeter
		pH at 24.7°C	7.91	4500-H+.B
		Salinity	14.3 ppt	--
		COD (Chemical Oxygen Demand)	3.06 mg/L	5220.B
		BOD (Biological Oxygen Demand)	Less than 0.2 mg/L	5210.B
		Mercury (Hg)	Less than 0.001 mg/L	3112.B
		Lead (Pb)	Less than 0.01 mg/L	3111.B
		Cadmium (Cd)	Less than 0.001 mg/L	3111.B
		Zinc (Zn)	Less than 0.05 mg/L	3111.B
		Chromium (Cr)	Less than 0.005 mg/L	3113.B

Page 3 of 4

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Photograph of the Surface Water Sample 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)

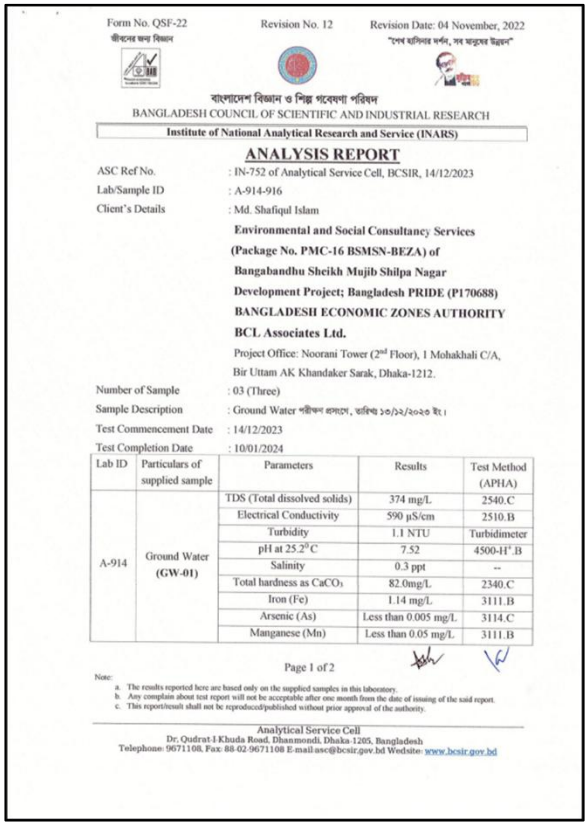
Proposed dredging Location 09 at Sandwip Channel (L-09)

Table 18: Groundwater Sampling Locations

SN	Sampling Location	Code	Sampling Date	Geographical Location
1.	Charsarat Village	GW1	13.12. 2023	22°44'34.01"N, 91°29'33.45"E
2.	BEZA Office	GW2	13.12. 2023	22°45'40.00"N, 91°28'13.00"E
3.	Near to CP Mor	GW3	13.12. 2023	22°44'5.64"N, 91°30'32.35"E

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

Ground Water Lab Result Sheet



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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-752 of Analytical Service Cell, BCSIR, 14/12/2023
Lab/Sample ID : A-914-916
Client's Details : Md. Shafiqul Islam
Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688) BANGLADESH ECONOMIC ZONES AUTHORITY BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 03 (Three)
Sample Description : Ground Water পরীক্ষণ প্রসঙ্গে, তারিখ্য ১৩/১২/২০২৩ ইং।
Test Commencement Date : 14/12/2023
Test Completion Date : 10/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-914	Ground Water (GW-01)	TDS (Total dissolved solids)	374 mg/L	2540.C
		Electrical Conductivity	590 µS/cm	2510.B
		Turbidity	1.1 NTU	Turbidimeter
		pH at 25.2°C	7.52	4500-H+.B
		Salinity	0.3 ppt	--
		Total hardness as $CaCO_3$	82.0mg/L	2340.C
		Iron (Fe)	1.14 mg/L	3111.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Manganese (Mn)	Less than 0.05 mg/L	3111.B

Page 1 of 2

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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-915	Ground Water (GW-02)	TDS (Total dissolved solids)	332 mg/L	2540.C
		Electrical Conductivity	587 µS/cm	2510.B
		Turbidity	0.83 NTU	Turbidimeter
		pH at 24.7°C	7.30	4500-H+.B
		Salinity	0.3 ppt	--
		Total hardness as $CaCO_3$	118 mg/L	2340.C
		Iron (Fe)	1.82 mg/L	3111.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Manganese (Mn)	Less than 0.05 mg/L	3111.B
A-916	Ground Water (GW-03)	TDS (Total dissolved solids)	2544 mg/L	2540.C
		Electrical Conductivity	5580 µS/cm	2510.B
		Turbidity	90.8 NTU	Turbidimeter
		pH at 24.8°C	7.31	4500-H+.B
		Salinity	2.4 ppt	--
		Total hardness as $CaCO_3$	944 mg/L	2340.C
		Iron (Fe)	7.18 mg/L	3111.B
		Arsenic (As)	Less than 0.005 mg/L	3114.C
		Manganese (Mn)	0.38 mg/L	3111.B

Analyst 10/01/2024
Md. Tanvir Ahamed Shaheen
Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhanmondi, Dhaka-1205

Supervisor 10.01.2024
Dr. Mohammad Abdullah Al-Mansur
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

Director 10/1/24
Sarker Kamruzzaman
Director (Addl. Charge)
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

Page 2 of 2

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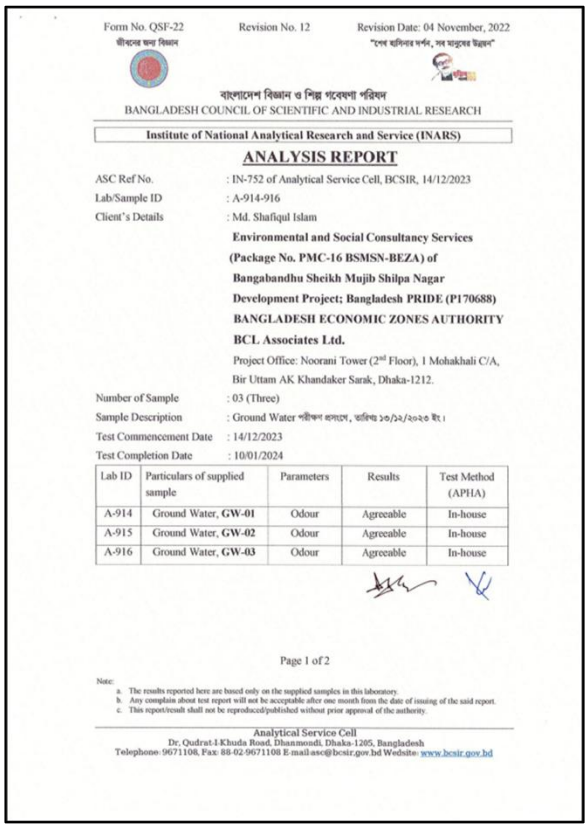

Form No. QSF-22 Revision No. 12 Revision Date: 04 November, 2022

"দেশে খাদ্যের দর্শন, সব মানুষের উন্নয়ন"

বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ
BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-752 of Analytical Service Cell, BCSIR, 14/12/2023
Lab/Sample ID : A-914-916
Client's Details : Md. Shafiqul Islam
Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688) BANGLADESH ECONOMIC ZONES AUTHORITY BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 03 (Three)
Sample Description : Ground Water পরীক্ষণ ধলাগে, তারিখঃ ১৩/১২/২০২৩ ইং।
Test Commencement Date : 14/12/2023
Test Completion Date : 10/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-914	Ground Water, **GW-01**	Odour	Agreeable	In-house
A-915	Ground Water, **GW-02**	Odour	Agreeable	In-house
A-916	Ground Water, **GW-03**	Odour	Agreeable	In-house

Page 1 of 2

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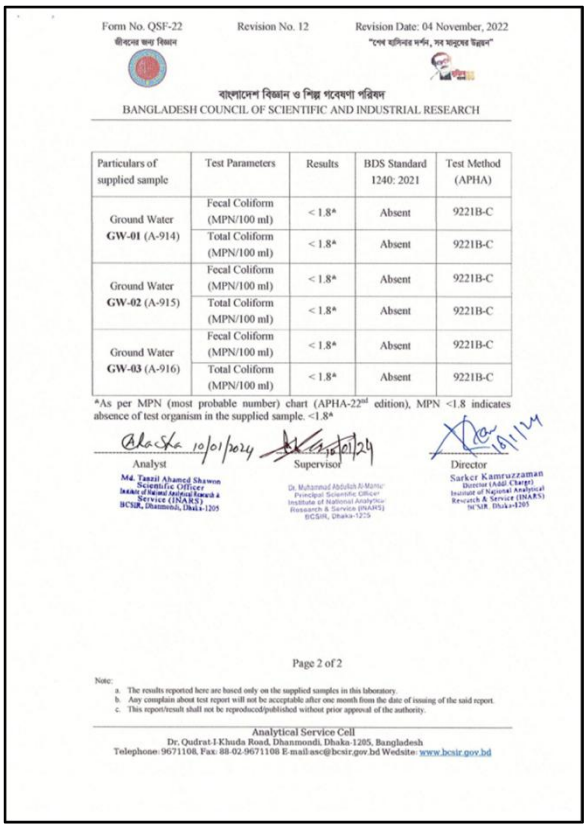

Form No. QSF-22 Revision No. 12 Revision Date: 04 November, 2022

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Particulars of supplied sample	Test Parameters	Results	BDS Standard 1240: 2021	Test Method (APHA)
Ground Water **GW-01** (A-914)	Fecal Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Ground Water **GW-02** (A-915)	Fecal Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
Ground Water **GW-03** (A-916)	Fecal Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C
	Total Coliform (MPN/100 ml)	< 1.8*	Absent	9221B-C

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

Analyst — Md. Tanzil Ahamed Shawon, Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhanmondi, Dhaka-1205

Supervisor — Dr. Muhammad Abdullah Al Mamun, Principal Scientific Officer, Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205

Director — Sarker Kamruzzaman, Director (Add. Charge), Institute of National Analytical Research & Service (INARS), BCSIR, Dhaka-1205

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Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd

Photographs of Ground Water Sampling

Charsarat Village

BEZA Office

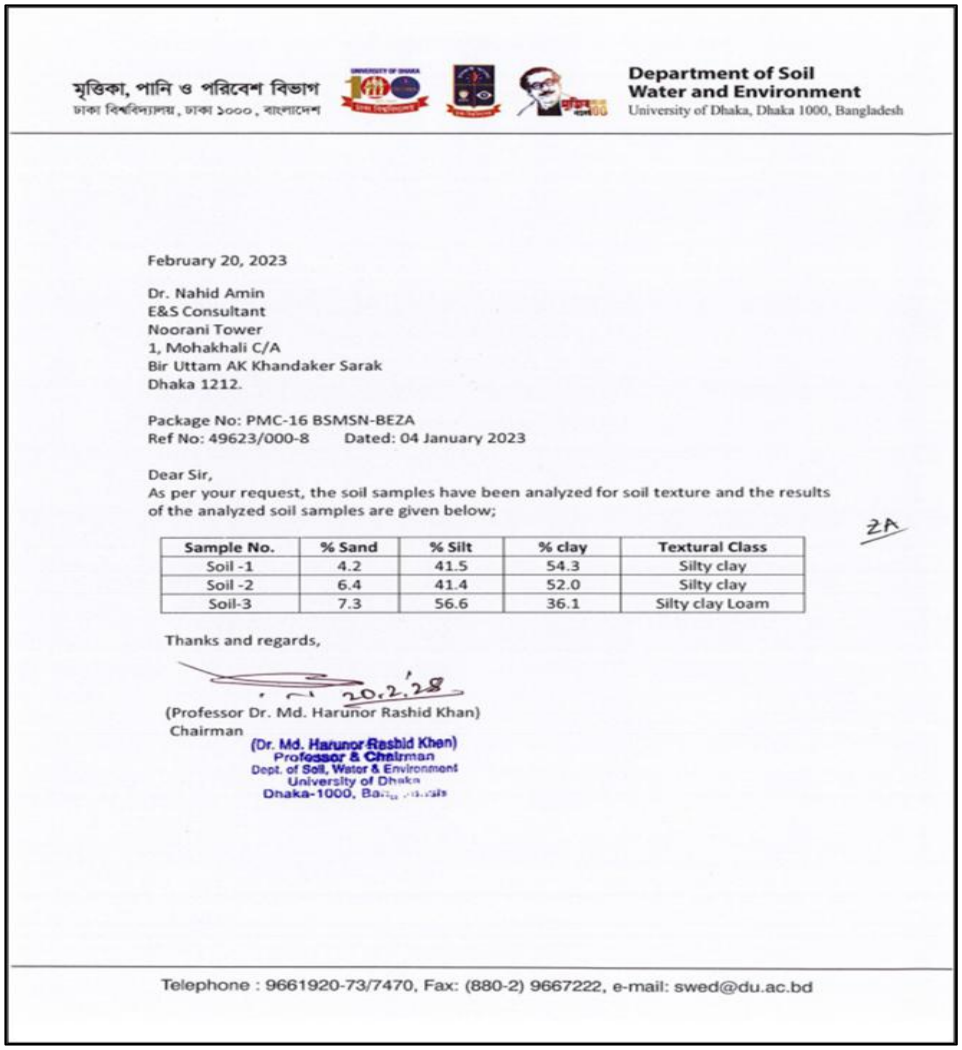
Near to CP Mor

Table 19: Soil textural class of the samples collected from the IMD Zone 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

Soil Samples Laboratory Results Sheets



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;

ZA

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

Thanks and regards,

20.2.23

(Professor Dr. Md. Harunor Rashid Khan)
Chairman

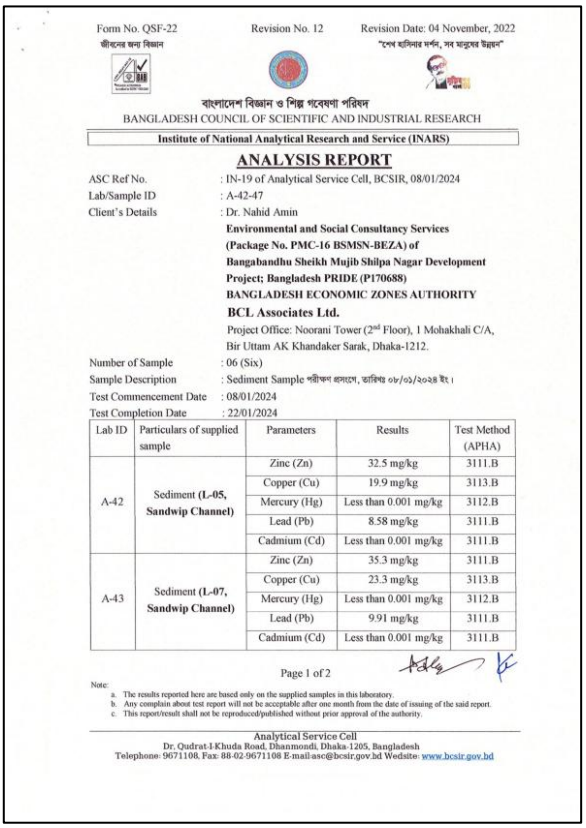
(Dr. Md. Harunor Rashid Khan)
Professor & Chairman
Dept. of Soil, Water & Environment
University of Dhaka
Dhaka-1000, Ba...

Telephone : 9661920-73/7470, Fax: (880-2) 9667222, e-mail: swed@du.ac.bd

Table 20: 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



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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-19 of Analytical Service Cell, BCSIR, 08/01/2024
Lab/Sample ID : A-42-47
Client's Details : Dr. Nahid Amin
Environmental and Social Consultancy Services (Package No. PMC-16 BSMSN-BEZA) of Bangabandhu Sheikh Mujib Shilpa Nagar Development Project; Bangladesh PRIDE (P170688) BANGLADESH ECONOMIC ZONES AUTHORITY
BCL Associates Ltd.
Project Office: Noorani Tower (2nd Floor), 1 Mohakhali C/A, Bir Uttam AK Khandaker Sarak, Dhaka-1212.
Number of Sample : 06 (Six)
Sample Description : Sediment Sample পরীক্ষণ গ্রাসাগে, তারিখঃ ০৮/০১/২০২৪ ইং।
Test Commencement Date : 08/01/2024
Test Completion Date : 22/01/2024

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-42	Sediment (L-05, Sandwip Channel)	Zinc (Zn)	32.5 mg/kg	3111.B
		Copper (Cu)	19.9 mg/kg	3113.B
		Mercury (Hg)	Less than 0.001 mg/kg	3112.B
		Lead (Pb)	8.58 mg/kg	3111.B
		Cadmium (Cd)	Less than 0.001 mg/kg	3111.B
A-43	Sediment (L-07, Sandwip Channel)	Zinc (Zn)	35.3 mg/kg	3111.B
		Copper (Cu)	23.3 mg/kg	3113.B
		Mercury (Hg)	Less than 0.001 mg/kg	3112.B
		Lead (Pb)	9.91 mg/kg	3111.B
		Cadmium (Cd)	Less than 0.001 mg/kg	3111.B

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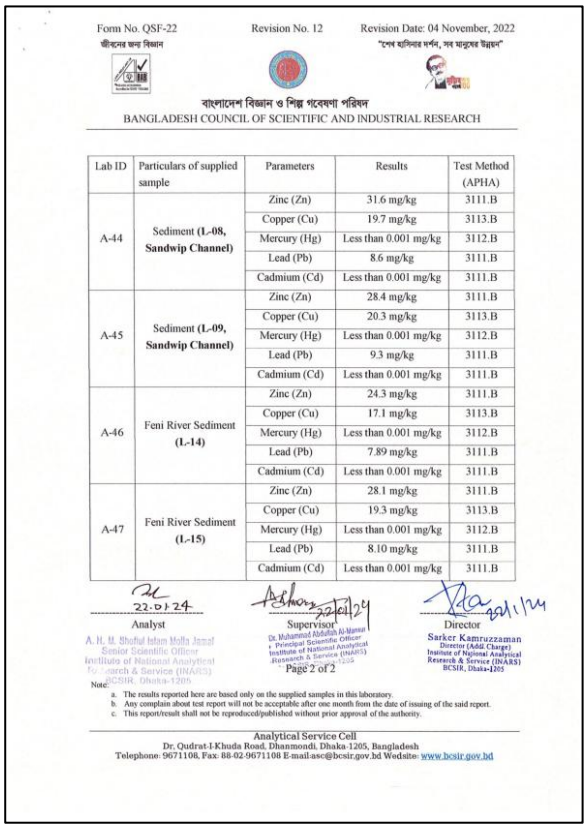

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Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-44	Sediment (L-08, Sandwip Channel)	Zinc (Zn)	31.6 mg/kg	3111.B
		Copper (Cu)	19.7 mg/kg	3113.B
		Mercury (Hg)	Less than 0.001 mg/kg	3112.B
		Lead (Pb)	8.6 mg/kg	3111.B
		Cadmium (Cd)	Less than 0.001 mg/kg	3111.B
A-45	Sediment (L-09, Sandwip Channel)	Zinc (Zn)	28.4 mg/kg	3111.B
		Copper (Cu)	20.3 mg/kg	3113.B
		Mercury (Hg)	Less than 0.001 mg/kg	3112.B
		Lead (Pb)	9.3 mg/kg	3111.B
		Cadmium (Cd)	Less than 0.001 mg/kg	3111.B
A-46	Feni River Sediment (L-14)	Zinc (Zn)	24.3 mg/kg	3111.B
		Copper (Cu)	17.1 mg/kg	3113.B
		Mercury (Hg)	Less than 0.001 mg/kg	3112.B
		Lead (Pb)	7.89 mg/kg	3111.B
		Cadmium (Cd)	Less than 0.001 mg/kg	3111.B
A-47	Feni River Sediment (L-15)	Zinc (Zn)	28.1 mg/kg	3111.B
		Copper (Cu)	19.3 mg/kg	3113.B
		Mercury (Hg)	Less than 0.001 mg/kg	3112.B
		Lead (Pb)	8.10 mg/kg	3111.B
		Cadmium (Cd)	Less than 0.001 mg/kg	3111.B

22.01.24
Analyst
A. H. M. Shofiul Islam Molla Jamal
Senior Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

Supervisor
Dr. Muhammad Abdullah Al-Mamun
Principal Scientific Officer
Institute of National Analytical Research & Service (INARS)
BCSIR, Dhaka-1205

Director
Sarker Kamruzzaman
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BCSIR, Dhaka-1205

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Telephone: 9671108, Fax: 88-02-9671108 E-mail:asc@bcsir.gov.bd Website: www.bcsir.gov.bd

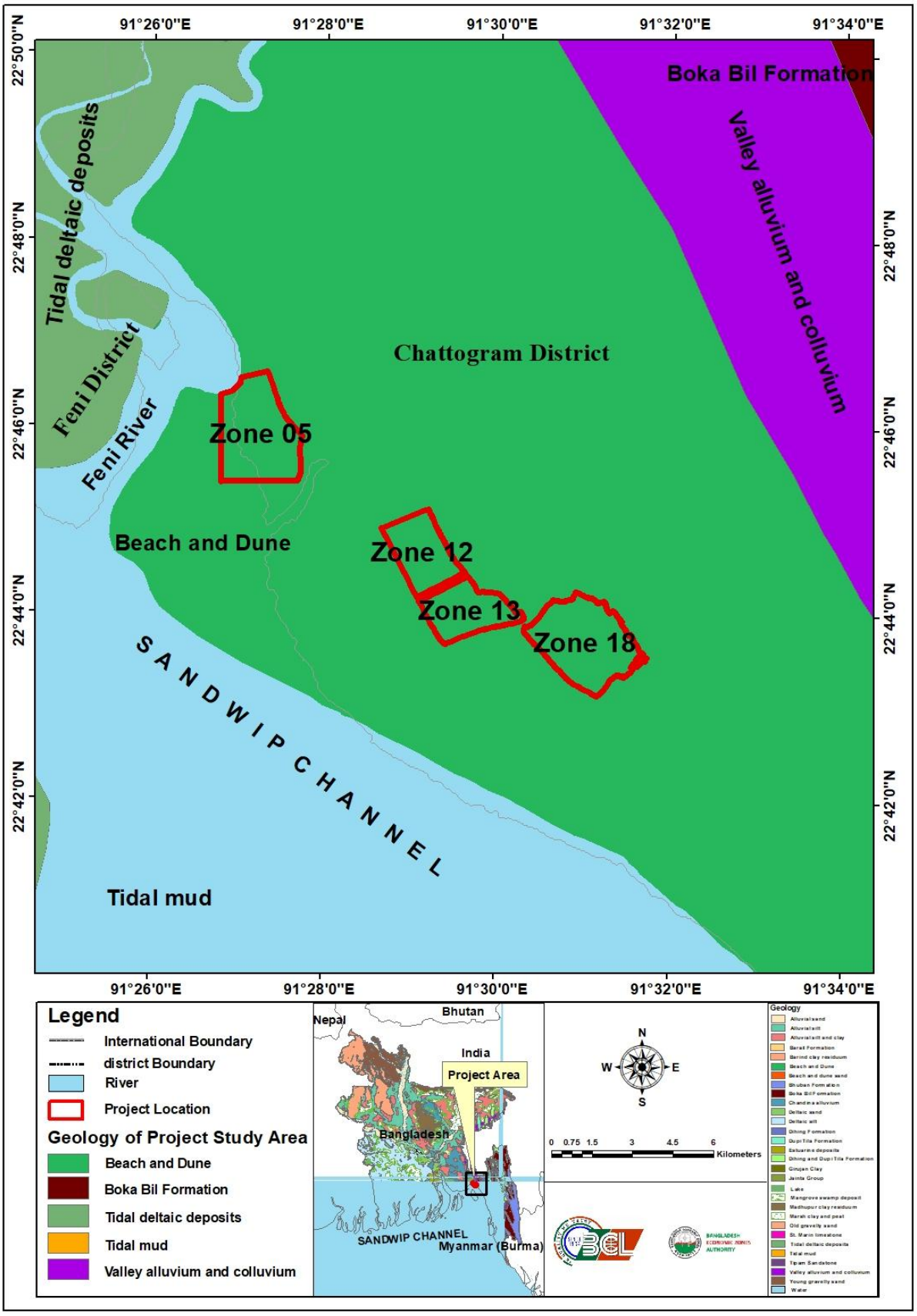
Photograph of the Sediment Samples Collection

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

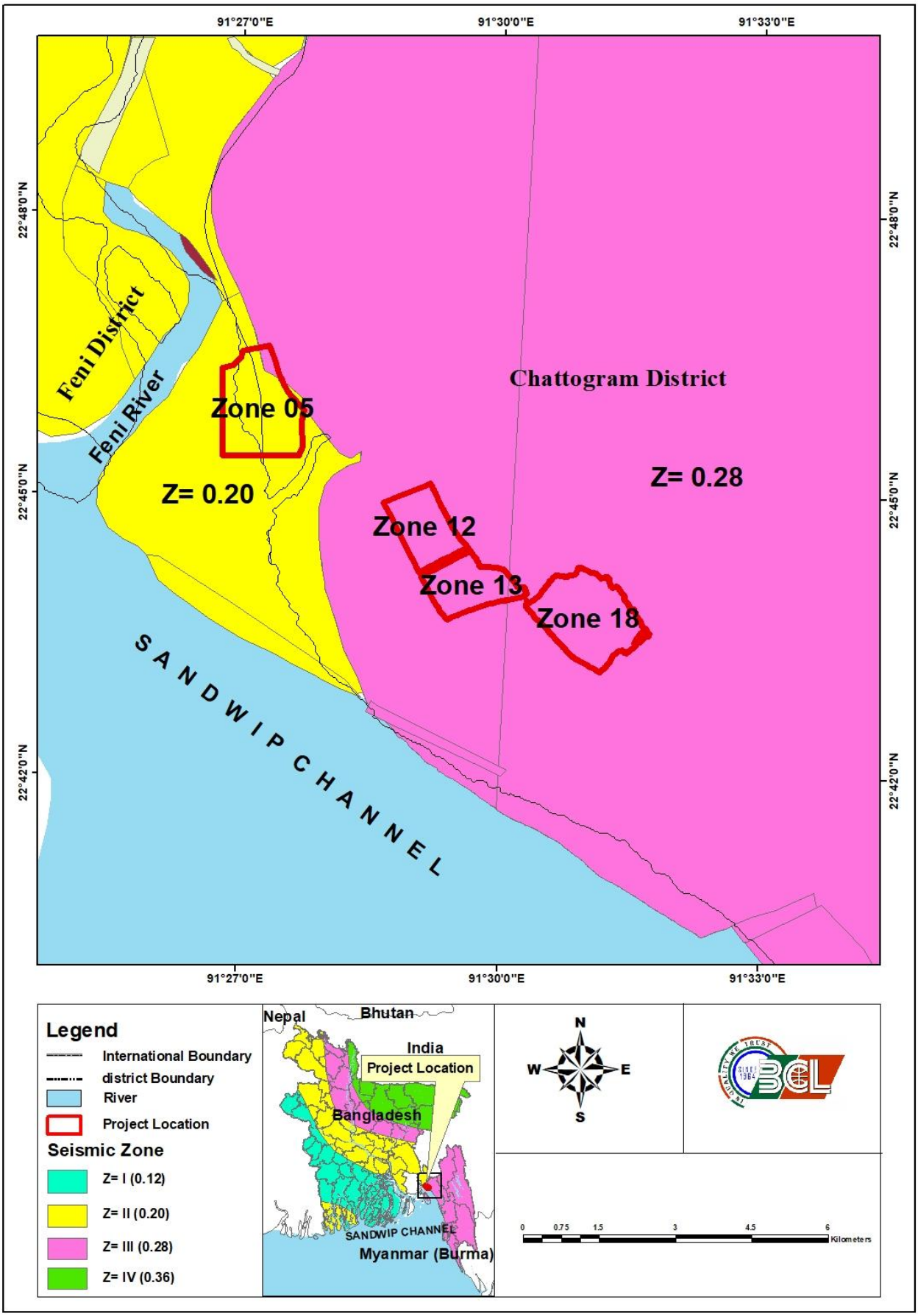
Proposed dredging Location 07 at Sandwip Channel(L-07)

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

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

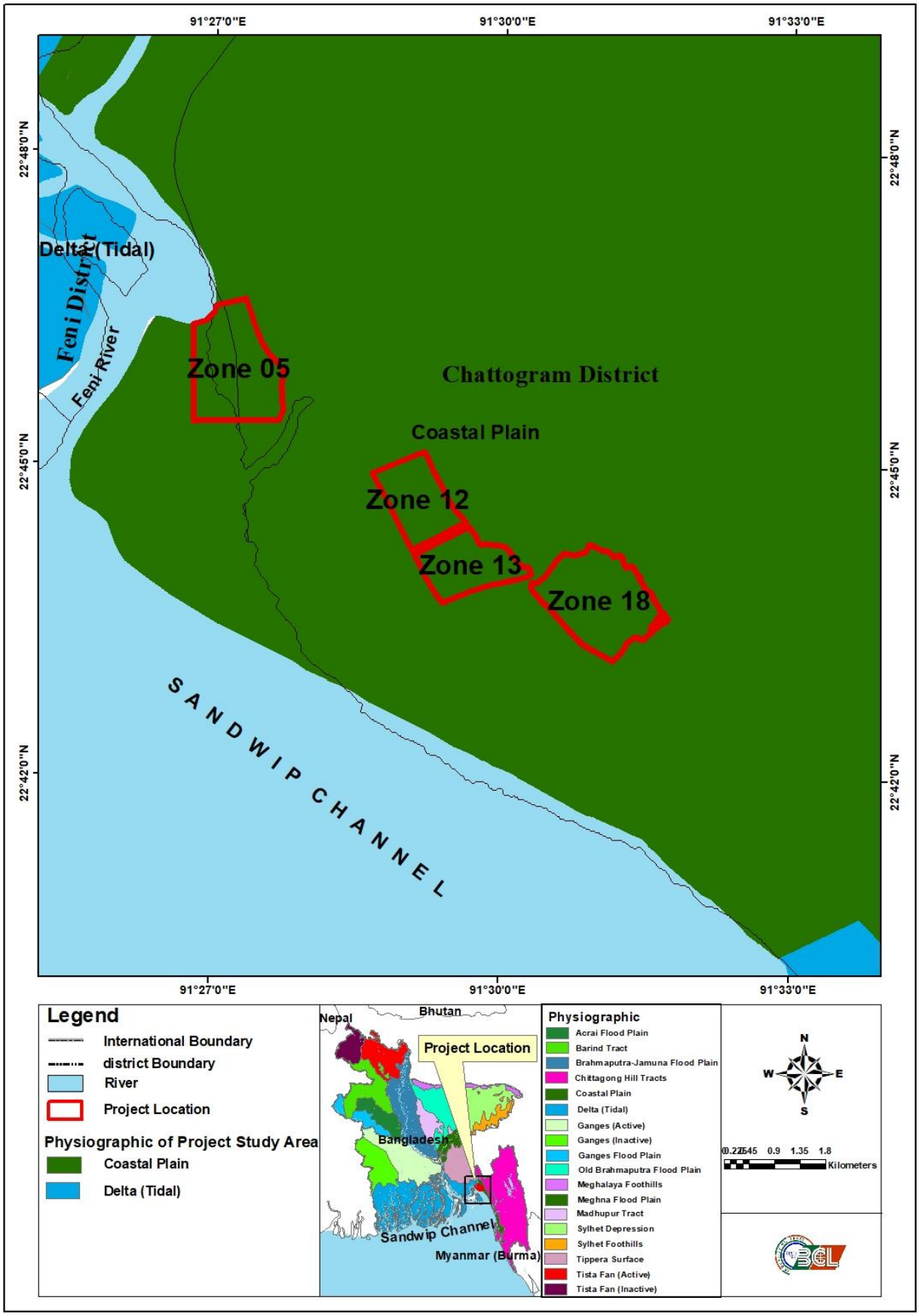


Map 5: Geological map of the study area



Map 6: Seismic zone of the project area

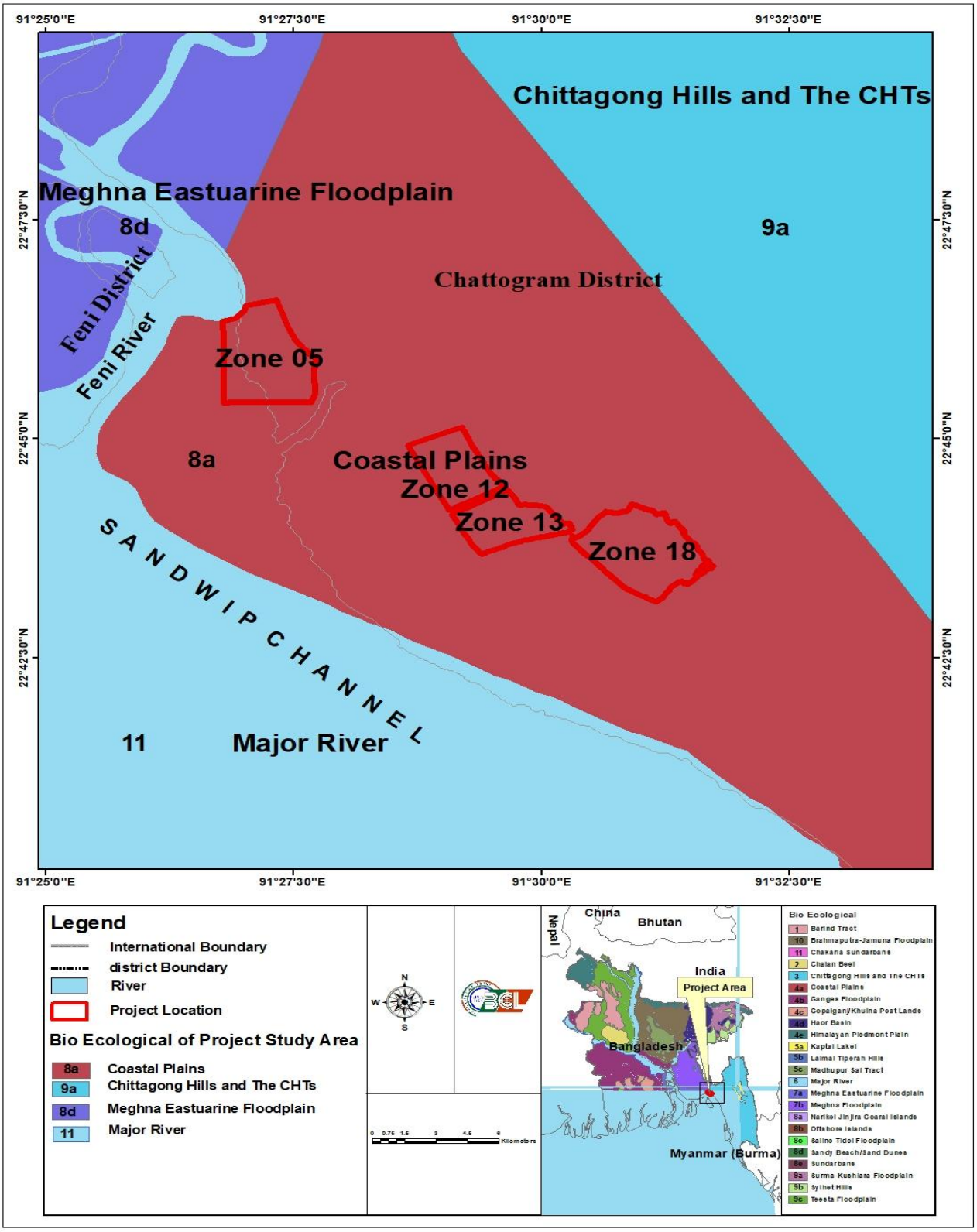
(*Source: BNBC 2020*)



Map 7: General physiography of the sub-project area

B. BASELINE ECOLOGICAL ENVIRONMENT

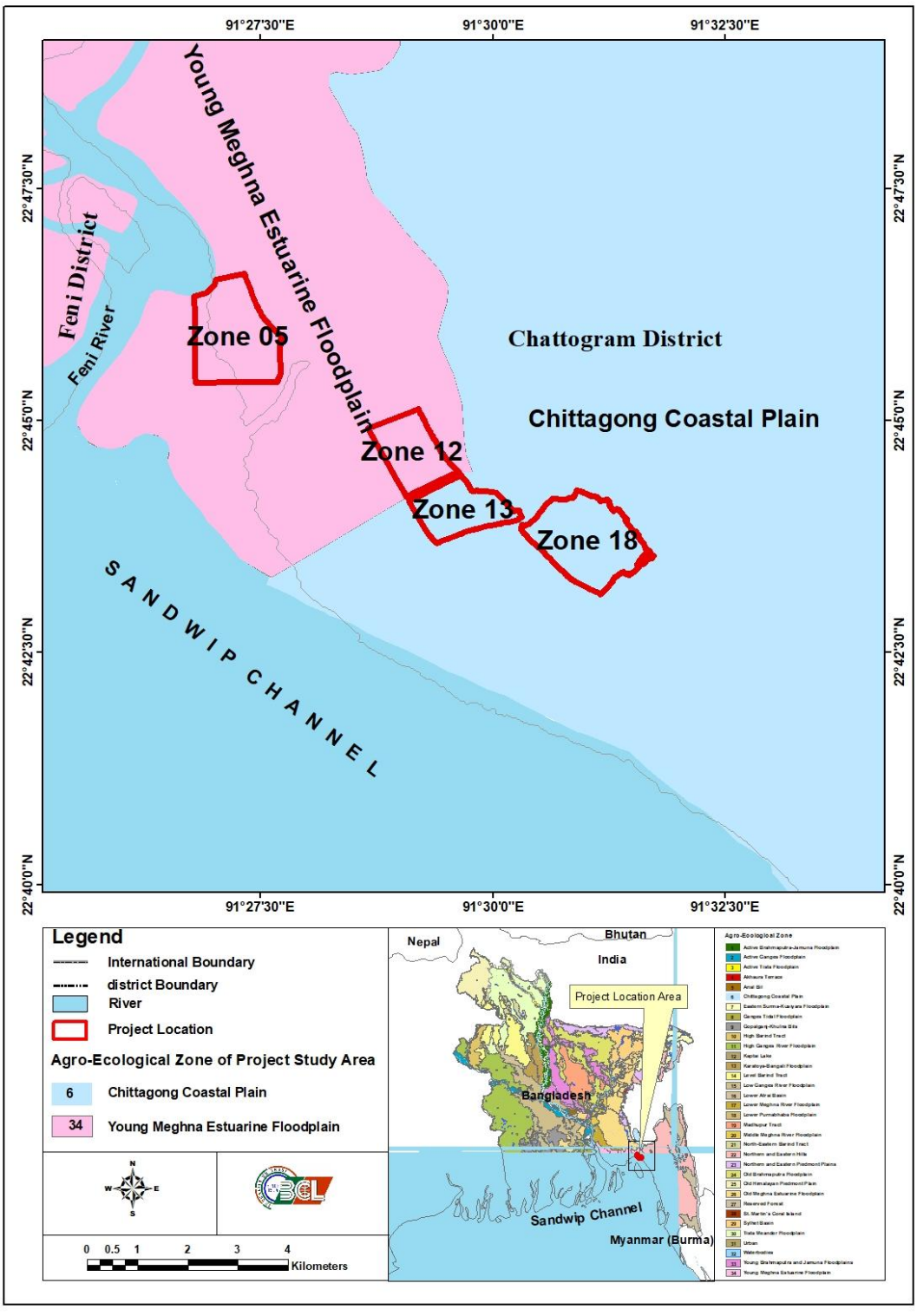
Bio-ecological Zone of coastal areas of Bangladesh shelters a variety of biodiversity especially avifauna, including both nationally and internationally threatened water-bird species. These areas act as wintering stopover grounds for many migratory birds, especially in winter season. Some of these coastal islands are also declared as Important Bird Area (IBA) and Ecological critical areas (ECAs) (Khan, 2018) and considered as migratory flyway sites. The study area situated in the Chattogram district, Bangladesh which is in the confluence Zone of south-central and south-eastern coastal region of Bangladesh. IUCN, The World Conservation Union, has divided Bangladesh into 25 Bio-ecological Zones (Nishat et al, 2002) in the context of physiographic and biological diversity. The study area has fallen under two bio-ecological zones of Coastal Floodplain and coastal marine water. The area (both directly and indirectly impacted area) occupies terrestrial as well as aquatic ecosystems. Each of the bio-ecological zones represents the overall ecological situation of an area of the country. The study area contains divers types of habitat and landforms and ecosystems, including mangrove forest, mudflat, offshore, salt pan, cropland, freshwater aquaculture pond, beach, settlements, rivers, and so on. Terrestrial ecosystems are categorized based on their habitat. Various plant species are supported by each habitat. The aquatic habitat as well as marine habitat around the study area are the habitats for aquatic mammals, especially for dolphin. One species of sea turtle is found in the coastal areas.



Map 8: Bioecological Map of Bangladesh
(Source: IUCN 2002)

Agro-ecological zone

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



Map 9: Argo-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 ECOLOGY

Plants Survey Methods

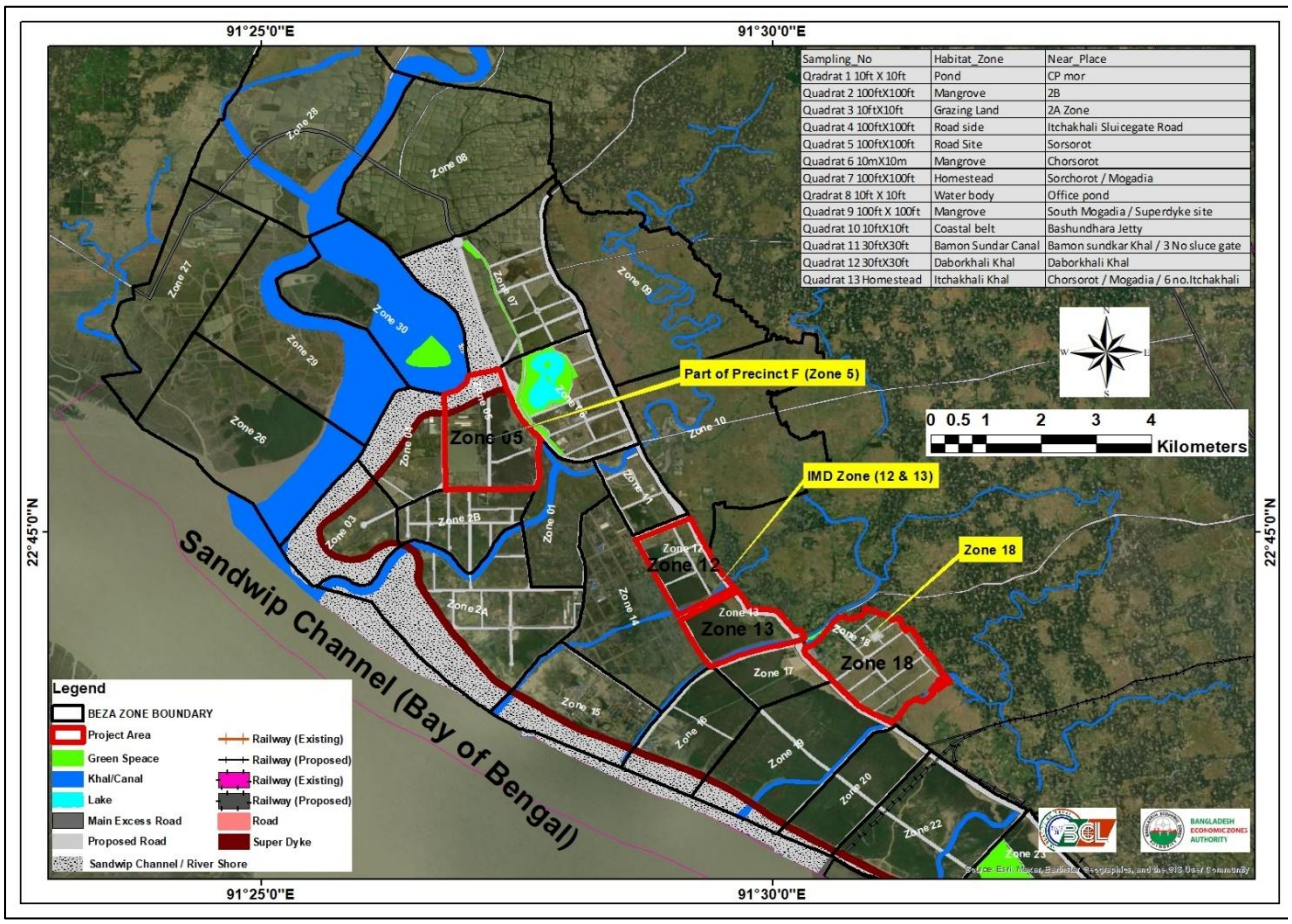
Terrestrial plants have been investigated using Random Meander method (Cropper, 1993) and also conducted study on habitat wise by using quadrat (100ftX100ft, 30ftX30ft, and 10ftX10ft) dated on 8-12 December, 2023, in this method the researcher explored plant data and information throughout the study 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.

Local people have been interviewed during the investigation. A maximum of plant species have 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 is shown in **Map 21.**

Table 21: 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 Sluicegate 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

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

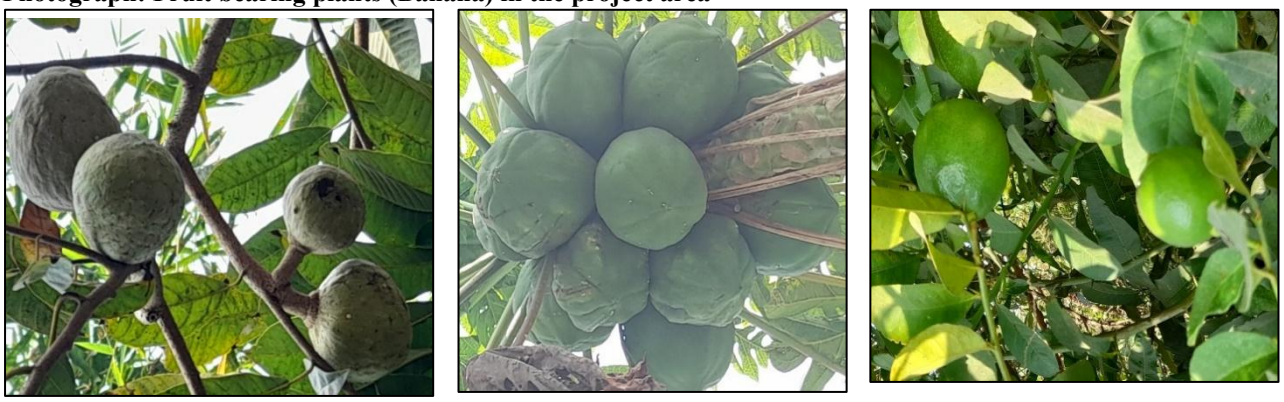
Data collection on Chorsorot Mangrove

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

Terrestrial plants

A total of 123 species of important terrestrial plants under genera of 116 of family 61 have been recorded in the project area. Among them 44% tree, 41% herb and the rest are shrub. However, no one is threatened according to red data book on Vascular plants of Bangladesh (Bangladesh National Herbarium). Important terrestrial and aquatic plants observed and noted. Out of 123 species of terrestrial plants mostly uses as medicinal and which is 56 in number and use as timber 27, fruit bearing 28, ornament 08 and fuel 04. 23 species of aquatic plants have also been identified. IUCN-Global status of terrestrial plans is DD=03, Least Concern-41, Unknown-76 and near threatened -03. Global status of aquatic plants is Least Concern=10 and Unknown -13.

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

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

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

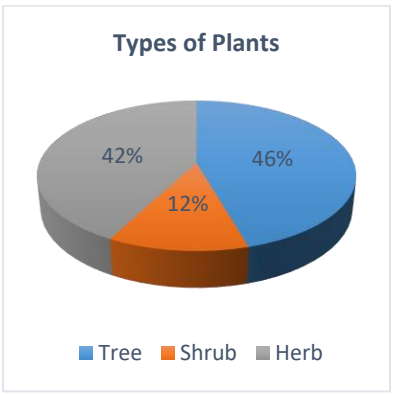
S/N	Local Name	English name	Scientific name	Family	Relative abundance	Type	Use	IUCN-Global
112	Mehogani	American mahogany,	*Swietenia mahagoni*	Meliaceae	C	Tree	Timber	NT
113	Jam	Black berry	*Syzygium cuminii*	Myrtaceae	C	Tree	Timber	Unknown
114	Katbadam	Almond	*Terminalia catappa*	Combretaceea	C	Tree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

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

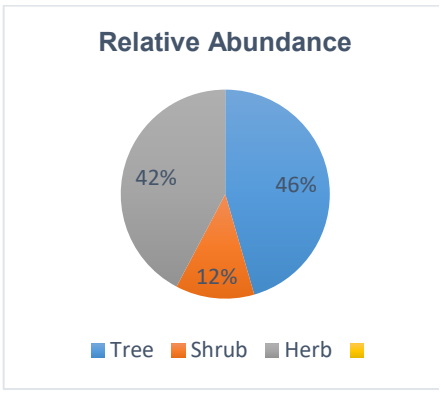
Some Important timber trees are Acacia nilotica, Albizia lebbeck, Albizia procera, Ficus benghalensis, Ficus hispida, Ficus racemose, Ficus religiosa, Eucalyptus camaldulensis, Syzygium cumini, Neolamarckia cadamba, Swietenia mahagoni, Samaneae saman and Acacia auriculiformis.

Important Fruit bearing trees are Elaeocarpus robustus, Psidium guajava, Musa paradisiaca, Citrus grandis, Mangifera indica, Spondias piñata, Annona reticulate, Annona squamosal, Cococs nucifera, Areca catechu, Avarrhoa carambola, Moringa olefera, Phyllanthus emblica, Punica granatum, Angle marmelos, Citrus aurantifolia, Limonia acidissima, Litchi chinensis, Manilkara sapota, Phoenix sylvestris, Dillenia indica, Diospytos eregrine, Diospyros blancoi. Artocarpus heterophyllus, Zizyphus mauritiana, Feronia limonia and Borassus flabollifer.

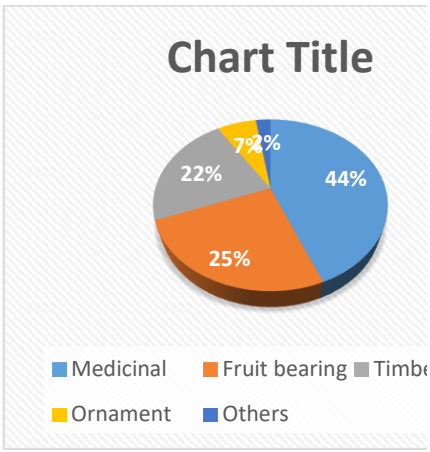
Important Medicinal plants are Achyrenthes aspera, Centella asiatica, Vinca rosea, Enhydra fluctuans, Eupatorium odoratum, Mikania scandens, Diplazium esculantum, Heliotropium indicum, Chenopodium album, Commelia benghalensis, Eclipta alba, Tridax procumbens, Coccinia cordifolia, Phyllanthus urinaria, Acalypha indica, Croton bonplandinus, Euphorba hirta, Jatropha gossipifolia, Ocimum sanctum, Aloe vera, Marsilea quadrifolia, Mimosa pudica, Argemone Mexicana, Bacopa monnieri, Cynodon dactylon, Spilenthes acmela, Persicaria hydropiper, Scoparia dulcis, Smilax macrophylla, Datura metel, Datura stramonium, Physalis minima, Solanum nigram, Solanum xanthocarpum, Clerodendrum viscosum, Lippia geminate, Vitex negundo, Amiranthus viridis, Carica papaya, Cuscuta reflexa, Ricinus communis, Leucas aspera, Calotropis gigantean, Ficus racemose, Tamarindus indica, Terminalia aurjuna, Melia azedarach, 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.



Types of plants with % in the project area



Relative abundance of plants



Uses of plants in the project area

Figure 5: Types of plants and its use

Terrestrial fauna

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

Survey Method

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 Subcontinent' (Grimmet et al. 2013) and 'A Field Guide to Indian Mammals 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

A total of 98 species of wildlife were recorded during this current study. Another study recorded 181 species of wildlife from Mirsharai Upazila (Anonymous 2018). The current study found 10 species of amphibians, 8 reptiles, 70 birds and 10 species of mammals.

Amphibians

A total of 10 species of amphibians were observed in the project area. None of the species were in the threatened categories of IUCN. Whereas in total 29 species were identified by other studies at Mirsharai (Anonymous 2018) of them 1 endangered, 1 vulnerable and 2 data deficient according to IUCN red list (2015, v.2).

Table 23: 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	*Duttaphrynus melanostictus*	Bufonidae	VC	LC	LC	Schedule - II
2	Katkati Bang	Skipper Frog	*Euphlyctis cyanophyctis*	Dicroglossidae	VC	LC	LC	Schedule – II
3	Shobuj Bang	green pond frog,	*Euphlyctis hexadactylus*	Dicroglossidae	VC	LC	LC	Schedule-1
4	Kakrabhuk Bang	Crab-eating Frog	*Fejervarya cancrivora*	Dicroglossidae	C	LC	LC	Unknown
5	Syhadra Jhi-jhi Bang	Bombay Wart Frog	*Fejervarya syhadrensis*	Dicroglossidae	F	LC	LC	Schedule – II
6	Sona Bang	Indian Bullfrog	*Hoplobatrachus tigerinus*	Dicroglossidae	C	LC	LC	Schedule-1
7	pana bang	Green puddle frog	*Hylarana tyleri*	Ranidae	C	LC	Unknown	Schedule 1
8	Venpu Bang	Painted Bull Frog	*Kaloula pulchara*	Microhylidae	F	NT	LC	Schedule - I
9	Dorakata Gechho Bang	Common Tree Frog	*Polypedates leucomystax*	Rhacophoridae	FC	LC	LC	Schedule – II
10	Chitra Gecho Bang	Indian tree frog	*Polypedates maculatus*	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

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 24: 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	*Hemidactylus brookii*	C	LR	LC	Bh, Op
2	Rokto-chosa	Common Garden Lizard	*Calotis versicolor*	VC	LR	Unknown	Bh, Op
3	Anjoni	Common Skink	*Mabuya carinata*	VC	LR	LC	Bh, Op
4	Dhora-shap	Cheekered Keel back Snake	*Xenochorphis piscator*	C	LR	Unknown	P, C, Dt

S/N	Local Name	English Name	Scientific Name	Sighting	IUCN Local status	IUCN Global status	Habitat
5	Dhora-shap	Stripped Keel back snake	*Amphiesma stolatum*	C	LR	LC	Bh, Op
6	Darash shap	Rat Snake	*Coluber mucosus*	C	LR	LC	Bh, Op
7	Girgiti	Grey Indian Monitor	*Varanus benghalensis*	C	LR	Unknown	Tt, Op
8	Kocchop	Striped Roof Turtle	*Kachuga dhongoka*	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

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.

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 viverinus) 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

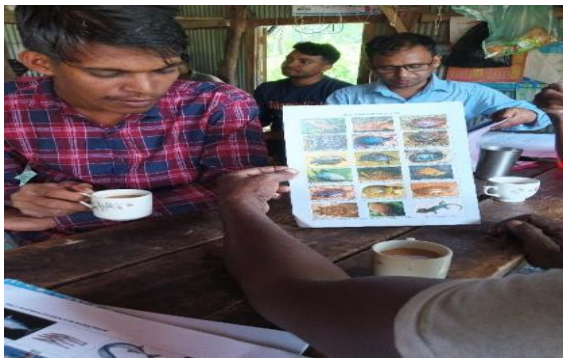
Table 25: List of Mammals Found in the Project AOI with IUCN Status

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

brookii), 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 (Girghiti) in the project area



Species identification technique by fishermen

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

Terrestrial Avifauna

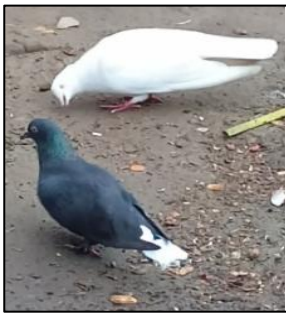
A total of 70 species of birds were identified from the terrestrial site of our current study (Figure 19 and Appendix 6). Whereas in another study recorded 109 species of birds in the Mirsharai Upazila (Anonymous 2018). Some species of birds such as House crow (Corvus splendens), Baya Weaver (Ploceus 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 brested 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)

jungle myna (Acridotheres fuscus)

Black drongo (Dicrurus macrocercus)

Common myna or Indian myna



Common Pigeon, Jalali Kobutor

House crow

Photograph: Commonly Found Avifauna in the Project Site.

Table 26: Table: List of Avifauna Identified in the Study Area

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundan	IUCN GL	WCSA BD
1	Sturnidae	*Acridotheres fuscus*	Jungle Myna	Jhuti Shalik	VC	LC	Schedule – II
2	Sturnidae	*Acridotheres ginginianus*	Bank Myna	Gang Shalik	C	LC	Schedule – I
3	Sturnidae	*Acridotheres tristis*	Common Myna	Bhat Shalik	VC	LC	Schedule – II

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundan	IUCN GL	WCSA BD
4	Sylvidae	*Acrocephalus stentoreus*	Clamorous Reed Warbler	Passerine bird	C	LC	Schedule – I
5	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	Pati Batan	C	LC	Schedule – II
6	Alcedinidae	*Alcedo atthis*	Common Kingfisher	Pati Machranga	C	LC	Schedule – II
7	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	Dahuk	C	LC	Schedule - II
8	Ciconidae	*Anas acuta*	Northern Pintail	Lenja Hans	C	LC	Unknown
9	Ciconidae	*Anastomus oscitans*	Asian Openbill	Sam Khol	FC	LC	Schedule – I
10	Motacillidae	*Anthus rufulus*	Paddy field Pipit	Dhani Tulika	F	LC	Schedule - II
11	Ardeidae	*Ardeola grayii*	Indian Pond Heron	Kani Bok	VC	LC	Schedule – I
12	Ardeidae	*Ardea alba*	Great Egret	Go Bok	VC	LC	Schedule – II
13	Cuculidae	*Cacomantis merulinus*	Plaintive Cuckoo	Korno Papia	FC	LC	Schedule - I
14	Picidae	*Celeus brachyurus*	Rufous Woodpecker	Khoira Kathkurali	FC	LC	Schedule – I
15	Cuculidae	*Centropus sinensis*	Greater Coucal	Kana Ko	C	LC	Schedule - I
16	Charadridae	*Charadrius dubius*	Little Ringed Plover	-	FC	LC	Schedule – I
17	Charadridae	*Charadrius mongolus*	Lesser Sand Plover	Chhoto Duljiria	FC	LC	Schedule – II
18	Laridae	*Chlidonias hybrida*	Whiskered Tern	Julphi Panchil	FC	LC	Schedule – I
19	Columbidae	*Columba livia*	Common Pigeon	Jalali Kobutor	VC	LC	Schedule – I
20	Muscicapidae	*Copsychus salaris*	Oriental Magpie Robin	Doel	C	LC	Schedule - II
21	Coraciidae	*Coracias benghalensis*	Indian Rollar	Bangla Nilkanto	FC	LC	Schedule – I
22	Corvidae	*Corvus levaillantii*	Jungle Crow	Dar Kak	FC	LC	Schedule - II
23	Corvidae	*Corvus splendens*	House Crow	Pati Kak	C	LC	Schedule – II
24	Cuculidae	*Cuculus micropterus*	Indian Cuckoo	Boukothakou Papia	C	LC	Schedule – II
25	Apodidae	*Cypsiurus balasiensis*	Asian Palm Swift	Asio Talbatashi	VC	LC	Schedule – I
26	Corvidae	*Dendrocitta vagabunda*	Rufous Treepie	Harichacha	C	LC	Schedule – II
27	Dendrocygnidae	*Dendrocygna javanica*	Lesser Whistling Duck	Pati Sorali	C	LC	Schedule – I
28	Dicruridae	*Dicrurus macrocercus*	Black Drongo	Finge	VC	LC	Schedule – II
29	Picidae	*Dinopium benghalensis*	Black-rumped Flameback	Bangla Kaththokra	C	LC	Schedule - II
30	Ardeidae	*Egretta garzetta*	Little Egret	Chhoto Boga	C	LC	Schedule - II
31	Cuculidae	*Eudynamis scolopacea*	Western Koel	Asio Kokil	C	LC	Schedule - II

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundan	IUCN GL	WCSA BD
32	Falconidae	*Falco tinnunculus*	Common Kestrel	-	FC	LC	Schedule – II
33	Scolopacidae	*Gallinago gallinago*	Common Snipe	Pati Chega	FC	LC	Schedule – I
34	Scolopacidae	*Gallinago stenura*	Pin-tailed Snipe	Lenja Chega	C	LC	Schedule – I
35	Accipitridae	*Haliastur indus*	Brahminy Kite	Sonkho Chil	C	LC	Schedule - II
36	Cuculidae	*Hierococcyx varius*	Common Hawk Cuckoo	Pati Chokhgelo	FC	LC	Schedule – II
37	Ardeidae	*Ixobrychus cinnamomeus*	Cinnamon Bittern	Lal Bogi	C	LC	Schedule – I
38	Strigidae	*Ketupa zeylonensis*	Brown Fish Owl	Hutum Pecha	F	LC	Schedule – I
39	Lanidae	*Lanius cristatus*	Brown Shrike	Khoira Latora	VC	LC	Schedule – II
40	Lanidae	*Lanius schach*	Long-tailed Shrike	Lenja Latora	C	LC	Schedule – II
41	Laridae	*Larus ridibundus*	Black-headed Gull	Kala Matha Jol Kobutor	F	LC	Schedule - II
42	Estrillidae	*Lonchura puntulata*	Scally-breasted Munia	Butibuk Munia	F	LC	Schedule – I
43	Anatidae	*Mareca strepera*	Gadwall	Gadwall	FC	LC	Schedule – I
44	Sylvidae	*Megalurus palustris*	Striated Grassbird	Dagi Ghas Pakhi	FC	LC	Schedule - II
45	Meropidae	*Merops orientalis*	Asian Green Bee-eater	Sobuj Suichora	FC	LC	Schedule - II
46	Ardeidae	*Mesophoyx intermedia*	Intermediate Egret	Majhla Boga	C	LC	Schedule – II
47	Accipitridae	*Milvus migrans*	Black Kite	Kalo Chil	C	LC	Schedule – II
48	Motacillidae	*Motacilla alba*	White Wagtail	Sada Khonjon	C	LC	Schedule - II
49	Motacillidae	*Motacilla maderaspatensis*	White-browed Wagtail	Dholabhru Khonjon	FC	LC	Schedule – I
50	Nectariniidae	*Nectarinia asiatica*	Purple Sunbird	Beguni Moutushi	FC	LC	Schedule – I
51	Nectariniidae	*Nectarinia zeylonica*	Purple-rumped Sunbird	Beguni Komor Moutushi	FC	LC	Schedule – I
52	Ardeidae	*Nycticorax nycticorax*	Black-crowned Night Heron	Nishi Bok	FC	LC	Schedule – I
53	Oriolidae	*Oriolus xanthornus*	Black-hooded Oriole	Holde Pakhi	C	LC	Schedule – II
54	Sylvidae	*Orthotomus sutorius*	Common Tailorbird	Tuntuni	VC	LC	Schedule – II
55	Paridae	*Parus major*	Great Tit	Boro Tit	C	LC	Schedule – I
56	Passeridae	*Passer domesticus*	House Sparrow	Ghor Chorui	VC	LC	Schedule - II
57	Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	Pati Pankouri	VC	LC	Schedule – I
58	Passeridae	*Ploceus philippinus*	Baya Weaver	Deshi Babui	FC	LC	Schedule – I

Sl. No	Family	Scientific Name	Common Name	Bengali Name	Relative Abundan	IUCN GL	WCSA BD
59	Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	Sabuj Tia	F	LC	Schedule – II
60	Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	Laltala Bulbul	VC	LC	Schedule - II
61	Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	Sipahi Bulbul	FC	LC	Schedule – I
62	Laridae	*Sterna albifrons*	Little Tern	Choto Panchil	FC	LC	Schedule – I
63	Laridae	*Sterna aurantia*	River Tern	Nadia Panchil	R	NT	Schedule – I
64	Columbidae	*Streptopelia decaocto*	Eurasian Collared Dove	Eurasio Kanthi Ghugu	C	LC	Schedule – I
65	Sturnidae	*Sturnus contra*	Asian Pied Starling	Go Shalik	VC	LC	Schedule – II
66	Podicipedidae	*Tachybaptus ruficollis*	Little Grebe	Chhoto Duburi	FC	LC	Schedule – I
67	Anatidae	*Tadorna ferruginea*	Ruddy shelduck	Khoira Chokachoki	C	LC	Unknown
68	Timalidae	*Turdoides earlei*	Striated Babbler	Dagi Chhatare	FC	LC	Schedule – I
69	Charadridae	*Vanellus cinereus*	Grey-headed Lapwing	Metematha Titi	F	LC	Schedule – II
70	Charadridae	*Vanellus indicus*	Red-wattled Lapwing	Hot Titi	FC	LC	Schedule – I

B.2 AQUATIC ECOSYSTEMS

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

Table 27: 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	*Abelmuschus moschatus*	Malvaceae	Unknown
2	Malanchai	Alligator Weed	*Alternanthera philoxerodies*	Amaranthaceae	Unknown
3	Brahmisak	Water Hyssop	*Bacopa monnieri*	Plantaginaceae	LC
4	Phutki	Balloon Vine	*Cardiospermum halicacabum*	Sapindaceae	Unknown
5	Kochu	Arum	*Colocasia esculenta*	Araceae	LC
6	Kanaidoga	Day Flower	*Commelina apendiculata*	Commelinaceae	Unknown
7	Kachuripana	Water Hyacinth	*Eichhornia crassipes*	Pontederiaceae	Unknown
8	Helencha	Water cress	*Enhydra fluctuans*	Asteraceae	Unknown
9	Hatishur	Indian Heliotrope	*Heliotropium indicum*	Boraginaceae	Unknown
10	Kalmishak	Water spinach	*Ipomea aquatica*	Convulvulaceae	Unknown
11	Kolmishak	Swamp Morning Glory	*Ipomoea aquatica*	Convolvulaceae	LC
12	Dholkolmi	Pink Morning Glory	*Ipomoea carnea*	Convolvulaceae	Unknown
13	Arail	Southern Cutgrass	*Leersia hexandra*	Poaceae	LC
14	Khudipana	Duckweed	*Lemna minor*	Araceae	LC
15	Matmatia	Bushy Lippia	*Lippia geminata*	Verbenaceae	Unknown
16	Keshordam	Water Primrose	*Ludwigia adscendens*	Onagraceae	LC
17	Sushnishak	Water Clover	*Marsilea quadrifolia*	Marsileaceae	LC
18	Chadmala	Banana Lily	*Nymphoides aquatica*	Menyanthaceae	LC
19	Amroolshak	Creeping Wood sorrel	*Oxalis corniculata*	Oxalidaceae	Unknown
20	Futki	Native Goose berry	*Physalis minima*	Solanaceae	Unknown
21	Topapana	Water Cabbage	*Pistia stratiotes*	Araceae	LC
22	Pani Biskhatali	Water Pepper	*Poligonum lanatum*	Poligonaceae	Unknown
23	Bishkatali	Water Pepper	*Polygonum hydropiper*	Polygonaceae	LC

Freshwater Fishes

A total of 59 species of freshwater and brackishwater 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.

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.

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, Nylotika, Mud crabs, Holona, mrigal, silver carp, gras carp, karpo, 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 28: List of Fresh Water and Brakish Water Fish Species Found in the Project Impact Area

Sl.No.	Local Name	English name	Scientific Name	IUCN-Local	IUCN Global
1	Kajuli	Catfish	*Ailia coilia*	NT	Unknown
2	Mola Carplet	Mola carplet	*Amblypharyngodon mola*	LC	LC
3	Koi	Climbing perch	*Anabas testudineus*	LC	LC
4	Teen Chokha	Blue panchax	*Aplocheilus panchax*	LC	LC

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

Source: Field survey and local consultations, 2023

Sl.No.	Local Name	English name	Scientific Name	IUCN-Local	IUCN Global

*. * 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

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 Itchakhali, 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 Itchakhali 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**

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 was conducted with him. He said that 23,200 acres of forest land will be 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, they are now no 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

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.

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.

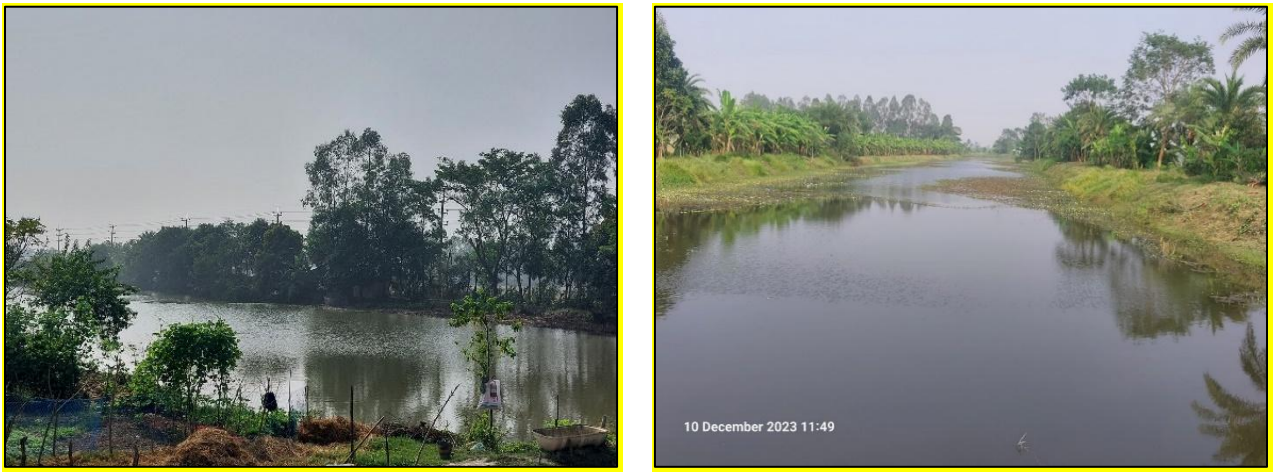
Buffalo grazing in the project area

Take rest in the water because of high temperature

Sheep grazing area

Photograph: Common Livestock Found in the Project Area

During the visit site was observed three types of domestic animals were observed grazing surrounding the 2A zone 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 ECOLOGY

Introduction

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 µm), meiofauna (62 µm- 0.5µm) and microfauna (<62 µm). 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.

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

The Precinct F (IMD Zone and Housing Facilities) is 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

Project authority, BEZA, is planning to dredge from the Sandwip channel and surrounding areas in order to land development of part of Precinct F (IMD Zone and Housing Facilities) 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:

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.

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.

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.

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.

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.

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:

There is no ecologically sensitive area or biological hotspot in or around the EZ-2 or the proposed additional area,

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,

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,

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,

No sensitive aquatic species like dolphins are reported within 10 km radius of the EZ site (Aziz 2019),

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,

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.

Therefore, 5, 7, 8, 9 locations were selected to collect the primary data for baseline and analysis.

Methodology of Study of Plankton and Benthos

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

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-

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

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

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:

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

Were,
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).

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

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 µm 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 µm 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**

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

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

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.

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

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

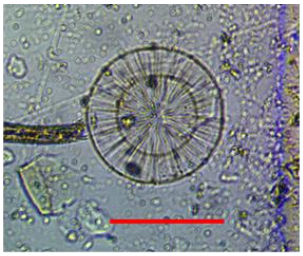
Phytoplankton

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 Dinoflagelate, 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

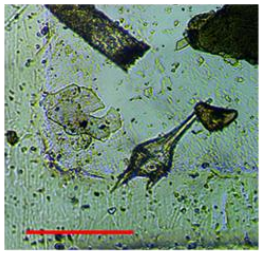
Table 29: Abundance of Phytoplankton Genus at Various Sites in the Sandwip Channel

Phylum	Genus	St 5	St 7	St 8	St 9
Bacillariophyta	Bascillaria	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

Phylum	Genus	St 5	St 7	St 8	St 9
	Melosira	0	55	345	291
	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
	Thalassioosira	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.

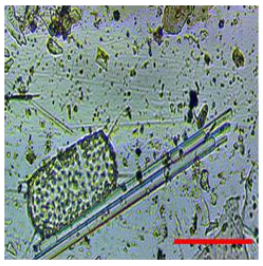

Anabaena sp.

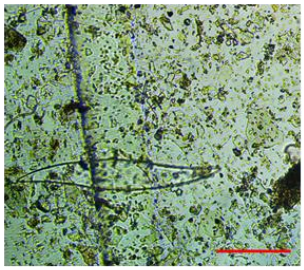

Ceratium sp.

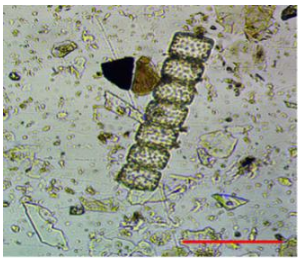

Chaetoceros sp.

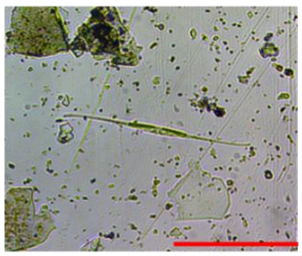

Ditylum sp.

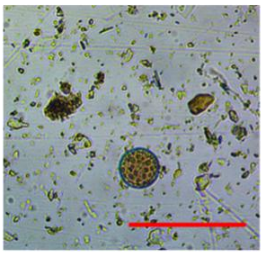

Entomoneis sp.

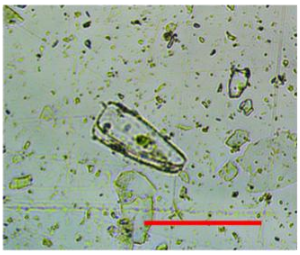

Entomoneis sp.

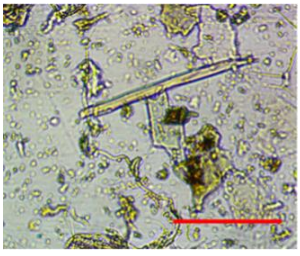

Gyrosigma sp.

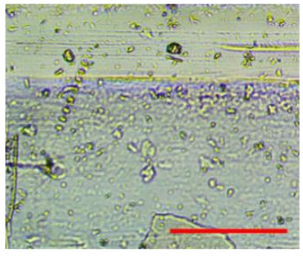

Melosira sp.

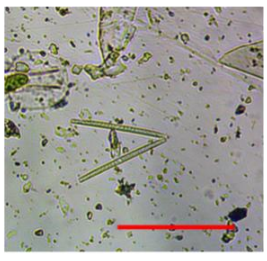

Cylindrotheca sp.

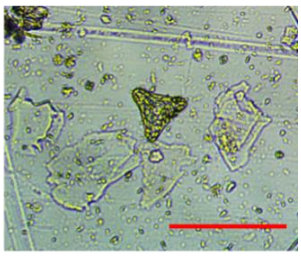

Thalassiosira sp.

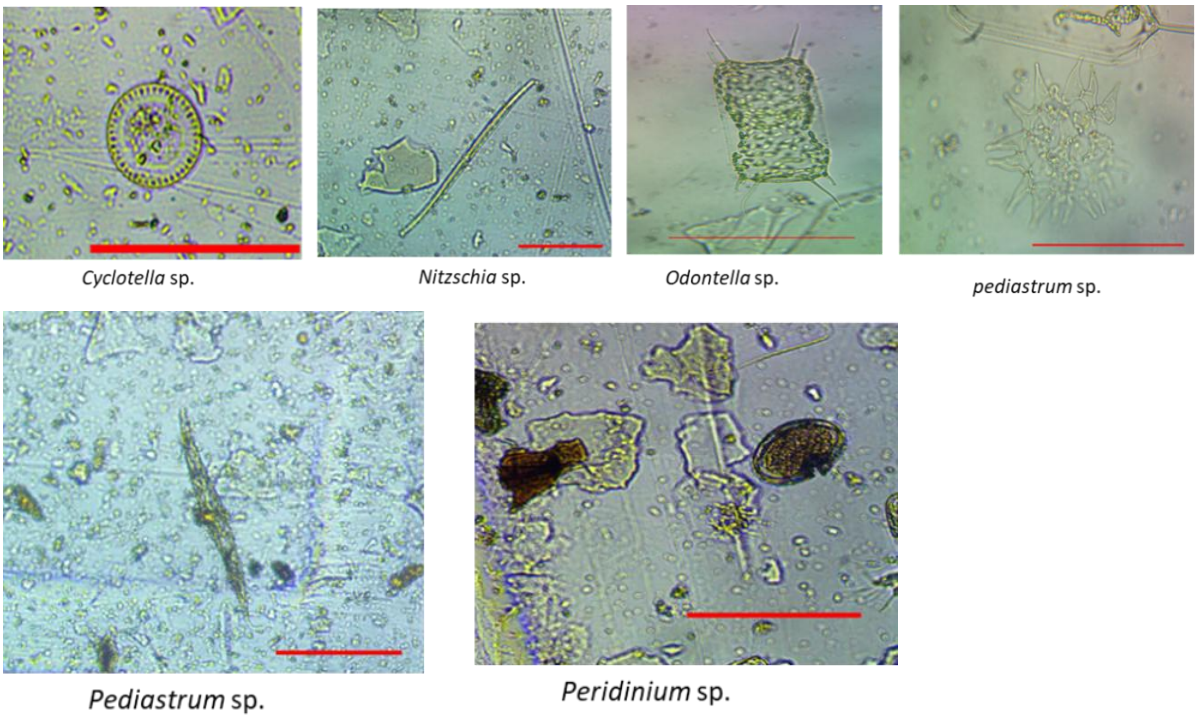

Surirella sp.


Rhizosolenia sp.


Skeletonema sp.


Thalassionema sp.


Triceratium sp.



Photograph: Representative Phytoplankton Genera Identified from Sandwip Channel Survey

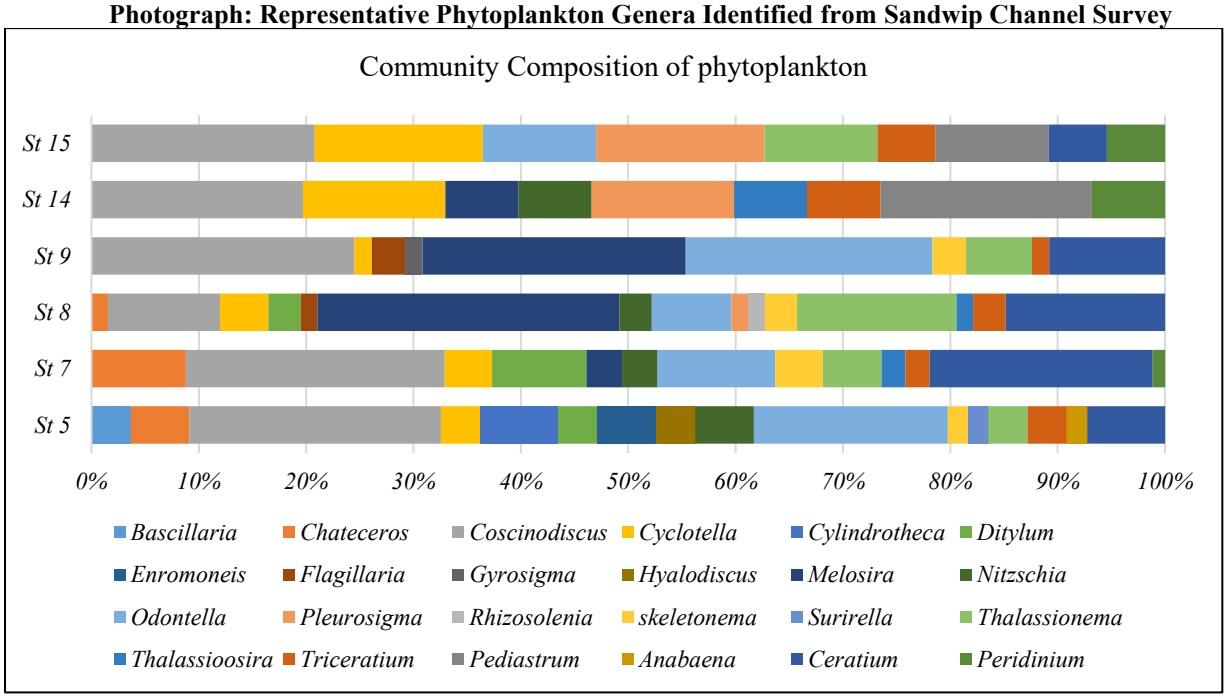


Figure 6: Community Composition of Phytoplankton Genus in the Sandwip Channel

Zooplankton

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 (>15ppt). 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 30: Abundance of Zooplankton Genus at Various Locations in the Sandwip Channel

Group	Sub grup	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
		Macrocyclops	4	8	4
		Mesocyclops	24	20	24
		Microcyclops	0	4	4
		Paracyclops	0	0	4
		Thermocyclops	0	4	0
Oligotrichea	Ostracoda	Favella	0	0	0
Protozoa	Choreotrichida	Tintinopsis	140	232	180
Total			336	456	408

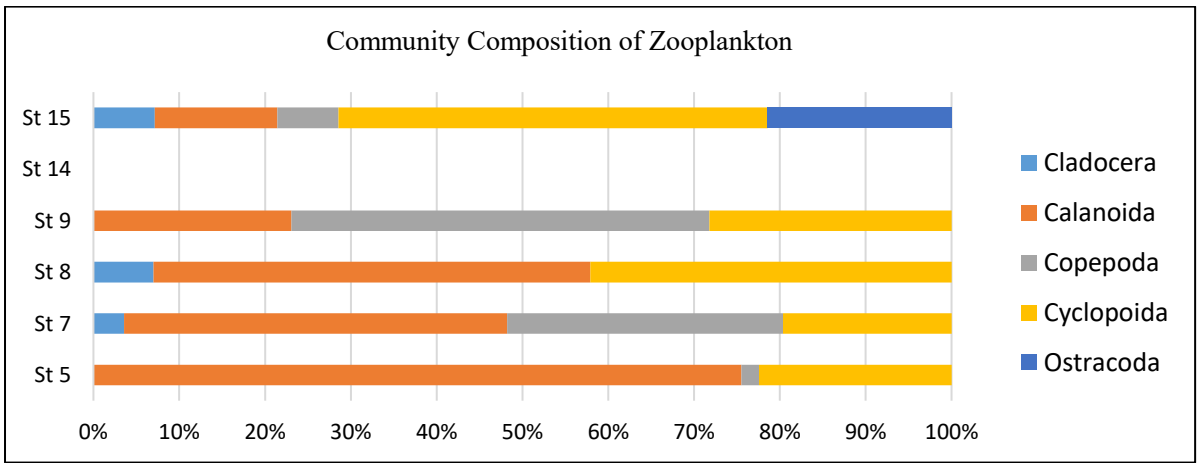
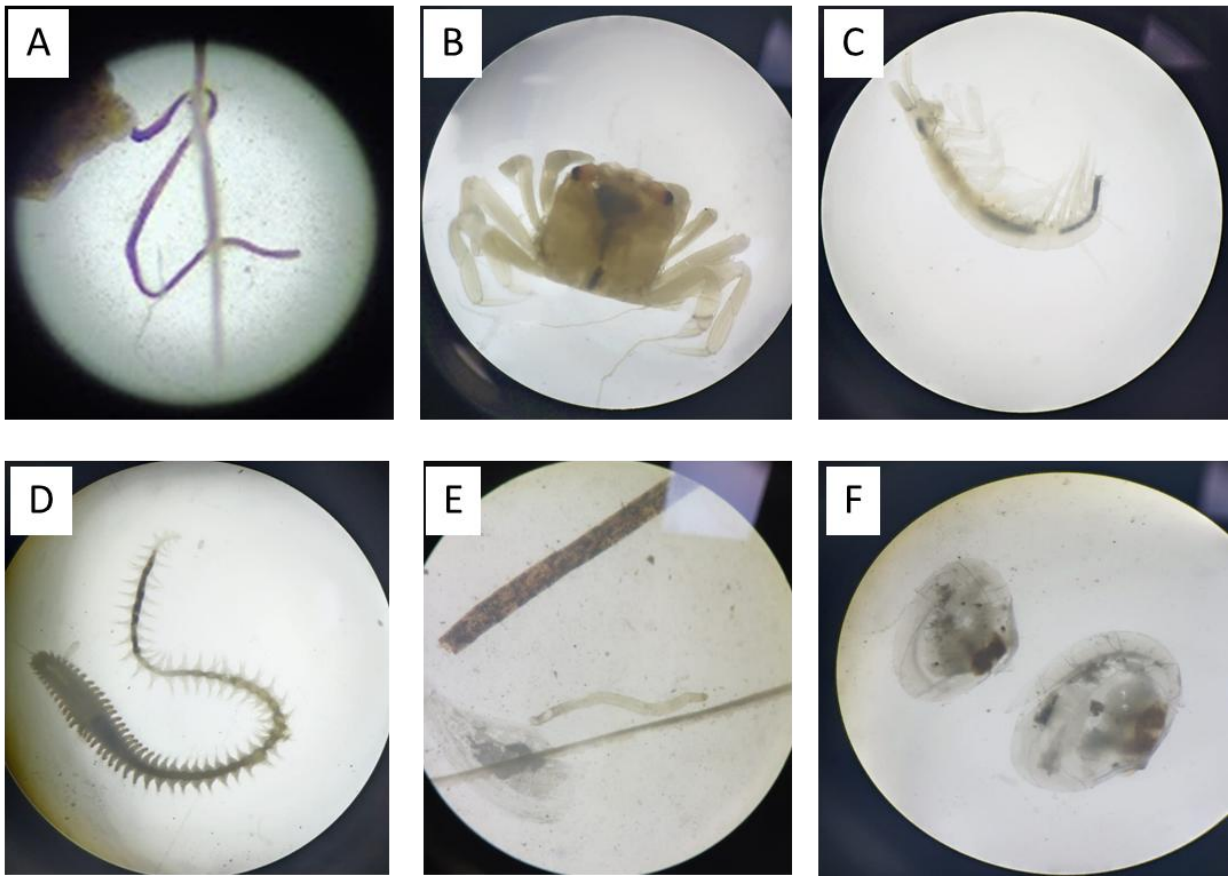


Figure 7: Community Composition of Zooplankton Genus at Various Sites

Benthos

A total of 19 taxa (families) of soft-bottom macrobenthos were recorded of which 14 families were identified over the six sampling sites 6). 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 7) 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

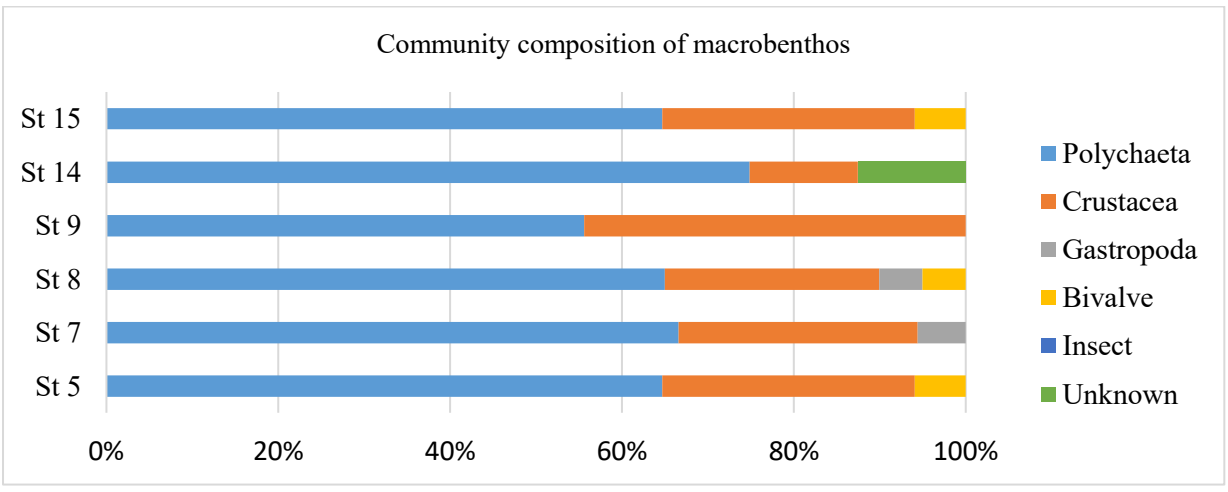


Figure 8: Community Composition of Benthic Macroinvertebrates Collected from Subtidal Zone of the Sandwip channel

Table 31: Abundance of Benthic Macroinvertebrates Collected from the Subtidal Zone of the Sandwip Channel

Class	Family	Abundance (individual/m2)			
		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
	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

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 (Derin et al., 2003).

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.

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.

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

A total of 95 species of marine fish were recorded from the marine habitat adjacent to the proposed Zone

Table-32: List of Marine Fish Species Recorded from the Marine Habitat

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
1	*Polynemus paradiseus*	Paradise Threadfin	Topsi/Rilsha	Abundant	LC
2	*Parastromateus niger*	Black Pomfret	Hail Chanda, Kala Chanda	Less abundant	LC
3	*Eleutheronema tetradactylum*	Fourfinger Threadfin	Thailla	Less abundant	EN
4	*Pomadasys hasta*	Silver Grunt	Sada Datina/Gangoria	Less abundant	LC
5	*Selar boops*	Oxeye Scad	Chukha Surma	Less abundant	LC
6	*Pomadasys argenteus*	Silver Grunt	Datina/ Kalo Poa	Rare	LC
7	*Megalaspis cordyla*	Torpedo Scad	Kauwa Mouri, Kauwa, Lohamorri, Kawa Surma	Rare	LC
8	*Psettodes erumei*	Indian Halibut	(Samudra Serbot	Abundant	DD
9	*Chirocentrus dorab*	Dorab Wolf-Herring	Karati Chela/ Chela	Abundant	LC
10	*Johnius belangerii*	Belanger's Croaker	Lalpoa, Rupali	Rare	LC
11	*Tenualosa ilisha*	Hilsa Shad	Ilish	Most abundant	LC/LC
12	*Ilisha filigera*	Coromandel Ilisha	Chamila/ Boro Choukka	Less abundant	DD/LC
13	*Sardinella frimbiata*	Fringescale Sardinella	Kochuna/ Khaira	Less abundant	LC
14	*Otolithes ruber*	Tigertooth Croaker	Poa	Most abundant	LC
15	*Sardinella melanura*	Blacktip Sardinella	Chapila/Takhia, Chandana	Rare	LC
16	*Conger cinereus*	Longfin African Conger	Kailla/ Kamila	Rare	LC
17	*Dendrophysa russelii*	Goatee Croaker	Dhari Poa/ Poa	Rare	LC
18	*Panna microdon*	Panna Croaker	Chotta Lambu	Rare	LC
19	*Cynoglossus cynoglossus*	Bengal Tongue Sole	Kukur Jeeb/ Churboti	Most abundant	LC
20	*Drepane longimana*	Concertina Fish	Pan Mach	Less abundant	LC
21	*Protonibea diacanthus*	Blackspotted Croaker	Kala Poa	Rare	NT
22	*Setipinna taty*	Scaly Hairfin Anchovy	Phaisa	Most abundant	LC/LC
23	*Thryssa mystax*	Moustached Thryssa	Phasa, Phaisa	Most abundant	LC
24	*Coilia dussumieri*	Goldspotted Grenadier Anchovy	Olua	Most abundant	LC/LC
25	*Ephippus orbis*	Orbfish	Hatir Kan	Rare	LC
26	*Gerres filamentosus*	Whipfin Silver-Biddy	Dom Mach	Less abundant	LC
27	*Pentaprion longimanus*	Longfin Mojarra	Jagri	Less abundant	LC
28	*Harpadon nehereus*	Bombay-Duck	Loittya Machh	Most abundant	NT

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
29	*Therapon jarbua*	Jarbua Terapon	Gangori/ Barguni	Most abundant	LC
30	*Lobotes surinamensis*	Tripletail	Samudra Koi/ Gang Koi	Most abundant	LC
31	*Sillaginopsis panijus*	Flathead Sillago	Hundura	Abundant	NE/LC
32	*Pampus argenteus*	Silver Pomfret	Foli Chanda	Less abundant	VU
33	*Pampus chinensis*	Chinese Silver Pomfret	Rup Chanda	Less abundant	NE
34	*Saurida tumbil*	Greater Lizardfish	Tiktiki Machh, Achila, Koniari	Rare	LC
35	*Lepturacanthus savala*	Savalai Hairtail	Churi Macch	Less abundant	DD
36	*Planiliza subviridis*	Greenback Mullet	Bata/ Sonali Bata	Most abundant	LC
37	*Mugil cephalus*	Flathead Grey Mullet	Khorul Bata	Less abundant	LC/LC
38	*Platycephalus indicus*	Bartail Flathead	Murbaila	Most abundant	DD/LC
39	*Leptomelanosoma indicum*	Indian Threadfin	Thaila/ Lakkha	Rare	NE
40	*Megalops atlanticus*	Tarpon	Lady Fish/ Sundori Koral	Rare	VU
41	*Megalops cyprinoides*	Indo-Pacific Tarpon	Nanchil Koral	Rare	DD
42	*Gymnothorax tile*	Indian Mud Moray	Kuiccha	Most abundant	LC
43	*Pisodonophis cancrivorus*	Longfin Snake-Eel	Idura	Most abundant	LC/LC
44	*Escualosa thoracata*	White Sardine	Moila	Rare	LC
45	*Gonialosa manmina*	Ganges River Gizzard Shad	Goni Chapila	Less abundant	LC/LC
46	*Hilsa kelee*	Kelee Shad	Chokkha Ilish	Abundant	LC/LC
47	*Coilia neglecta*	Neglected Grenadier Anchovy	Chobi Olua	Most abundant	LC
48	*Coilia reynaldi*	Reynald's Grenadier Anchovy	Olua	Most abundant	LC
49	*Stolephorus commersonnii*	Commerson's Anchovy	Chepta Mola	Most abundant	LC
50	*Thryssa hamiltonii*	Hamilton's Thryssa	Ram Fesa	Abundant	LC
51	*Ilisha megaloptera*	Bigeye Ilish	Boro Chokha Ilish	Less abundant	LC
52	*Raconda russeliana*	Raconda	Modhu Paia	Most abundant	LC
53	*Mystus gulio*	Long Whisker Catfish	Nuna Tengra	Abundant	LC/NT
54	*Pangasius pangasius*	Pangas Catfish	Bangla Pangus	Abundant	LC/EN
55	*Arius gagora*	Gagora Catfish	Kata Mach/ Gora Mach	Abundant	NT
56	*Arius arius*	Threadfin Sea Catfish	Chiccha Poa	Most abundant	LC
57	*Allenbatrachus reticulatus*	Toadfish	Bang Mach	Rare	NE
58	*Halieutaea stellata*	Minipizza Batfish	Pizza Mach	Rare	LC
59	*Strongylura leiura*	Banded Needlefish	Dora Kakila	Less abundant	LC
60	*Rhynchorhamphus georgii*	Long Billed Half Beak	Ekthuitta	Less abundant	LC

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
61	*Trachyrhamphus bicoarctatus*	Double-Ended Pipefish	Dumukha Kumirer Heel	Most abundant	LC
62	*Grammoplites scaber*	Rough Flathead	Mur Bailla	Less abundant	NE
63	*Lates calcarifer*	Seabass	Koral	Most abundant	LC
64	*Epinephelus coioides*	Orange Spotted Grouper	Guti Boal	Less abundant	LC
65	*Priacanthus macracanthus*	Red Bigeye	Boro Akhi Lal Mach	Less abundant	LC
66	*Lactarius lactarius*	False Travel	Cungamukhi Mach	Rare	LC
67	*Alectis indica*	Indian Threadfish	Pekhm Mouri	Less abundant	LC
68	*Parastromateus niger*	Black Pomfret	Hail Canda	Less abundant	LC
69	*Ulua mentalis*	Longrakered Trevally	Olua Mouri	Less abundant	LC
70	*Pomadasys andamanensis*	Andaman Grunt	Gangori/ Dora Mach	Less abundant	DD
71	*Otolithoides pama*	Pama Croaker	Payra Poa	Most abundant	DD/LC
72	*Daysciaena albida*	Bengal Corvina	Jati Poa	Most abundant	LC
73	*Drepane punctata*	Spotted Sicklefish	Goti Pan Mach	Less abundant	LC
74	*Apocryptes bato*	Gobies	Ful Ciring	Most abundant	LC/LC
75	*Awaous guamensis*	Gobies	Choto Chela/Veda	Less abundant	LC/LC
76	*Odontamblyopus rubicundus*	Gobies	Cheua	Most abundant	LC/LC
77	*Trypauchen vagina*	Gobies	Sada Cheua	Most abundant	LC/LC
78	*Planiliza parsia*	Goldspot Mullet	Faissa Bata	Most abundant	LC
79	*Osteomugil cunnesius*	Longarm Mullet	Jati Bata	Less abundant	NE
80	*Paramugil parmatus*	Broad-Mouthed Mullet	Bash Pata Bata	Less abundant	LC
81	*Pseudorhombus elevatus*	Deep Flounder	Fali Sherboti	Abundant	LC
82	*Paraplagusia bilineata*	Doblelined Tonguesole	Duirekha Kukur Jib	Most abundant	LC/LC
83	*Carcharhinus limbatus*	Blacktip Shark	Kala Hangor	Rare	VU
84	*Carcharhinus melanopterus*	Blacktip Reef Shark	Ilissha Boli Hangor	Rare	VU
85	*Scoliodon laticaudus*	Spadnose Shark	Thutte Hangor, Churi Hangor	Abundant	NT
86	*Chiloscyllium punctatum*	Grey Carpet Shark	Bilai Hangor	Rare	NT
87	*Rhina ancylostoma*	Brownmouth Guitarfish	Bang Hangor/ Titamari Hangor	Abundant	CR
88	*Gymnura poecilura*	Long Tailed Butterfly Ray	Podoni	Less abundant	VU
89	*Himantura undulata*	Honeycomb Whipray	Bagha Haus	Rare	EN
90	*Pateobatis bleekeri*	Bleeker's Whipray	Hauspata	Less abundant	EN

Sl No.	Scientific Name	Common Name	Local name	Availability	IUCN G/N*
91	*Himantura imbricata*	Drawf Whipray	Hauspata	Abundant	VU
92	*Maculabatis gerrardi*	Whitespotted Whipray	Hauspata	Abundant	EN
93	*Maculabatis pastinacoides*	Round Whipray	Hauspata	Rare	EN
94	*Maculabatis rundalli*	Arabian Banded Whipray	Rammi Shapla	Less abundant	LC
95	*Aetobatus flagellum*	Longhead Eagle Ray	Chil Haus	Rare	EN

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) 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.

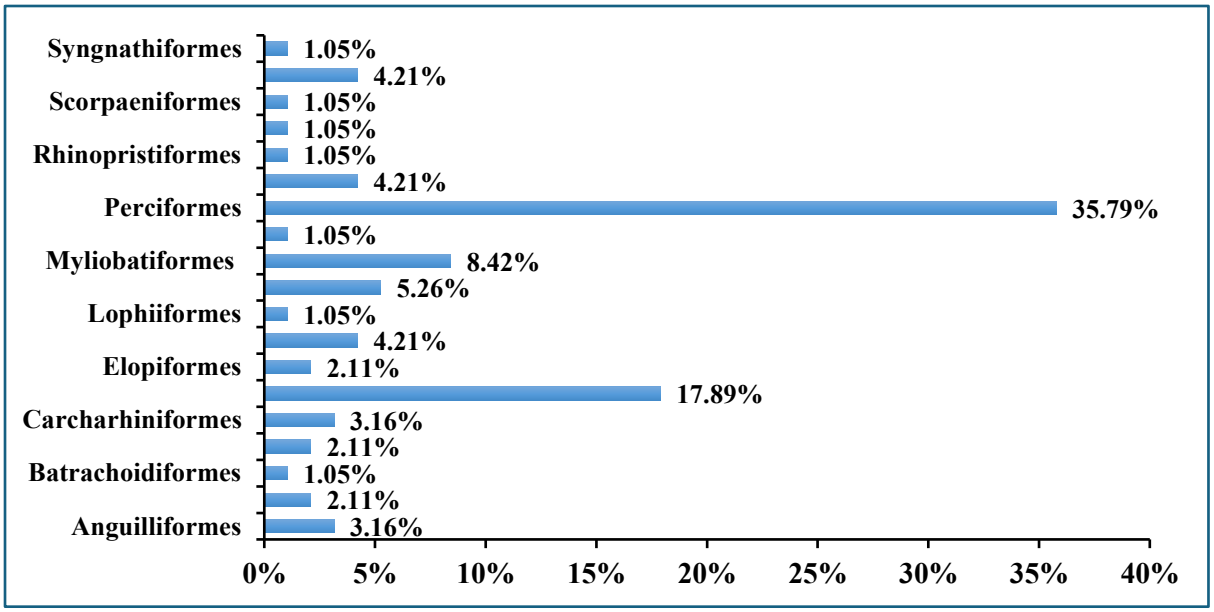


Figure 9: Composition of Identified Marine Fish Species Based on their Taxonomic Order.

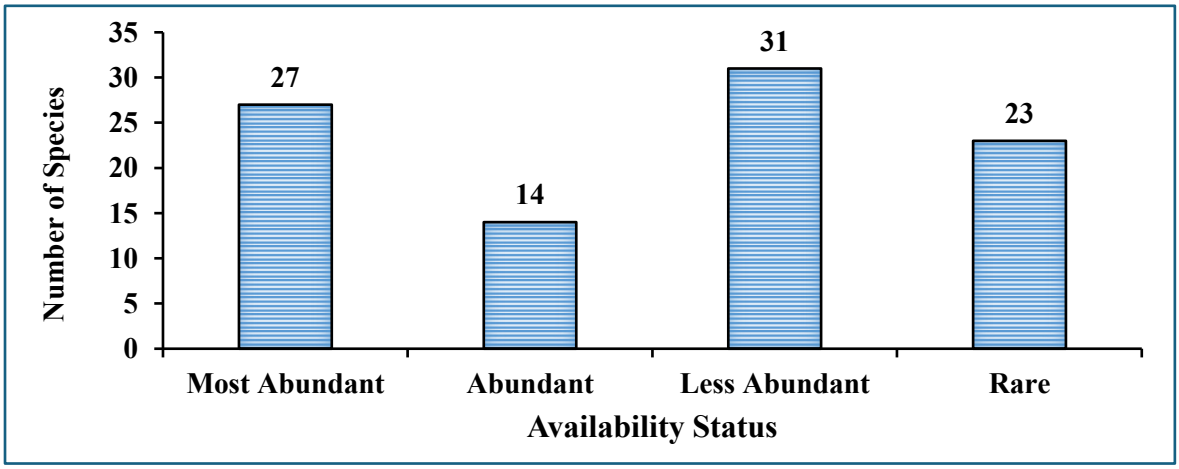


Figure 10: Marine Fish Species Composition According to Availability

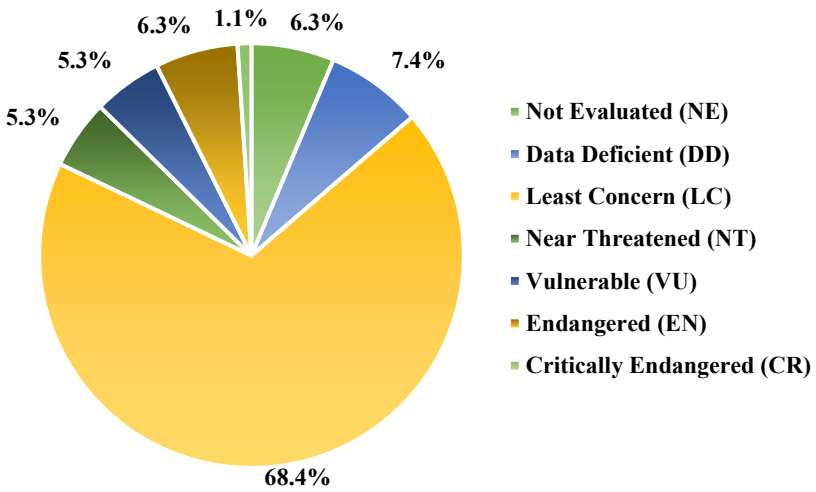


Figure 11: Fish Species Composition According to IUCN Global Red-List Categories.

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).

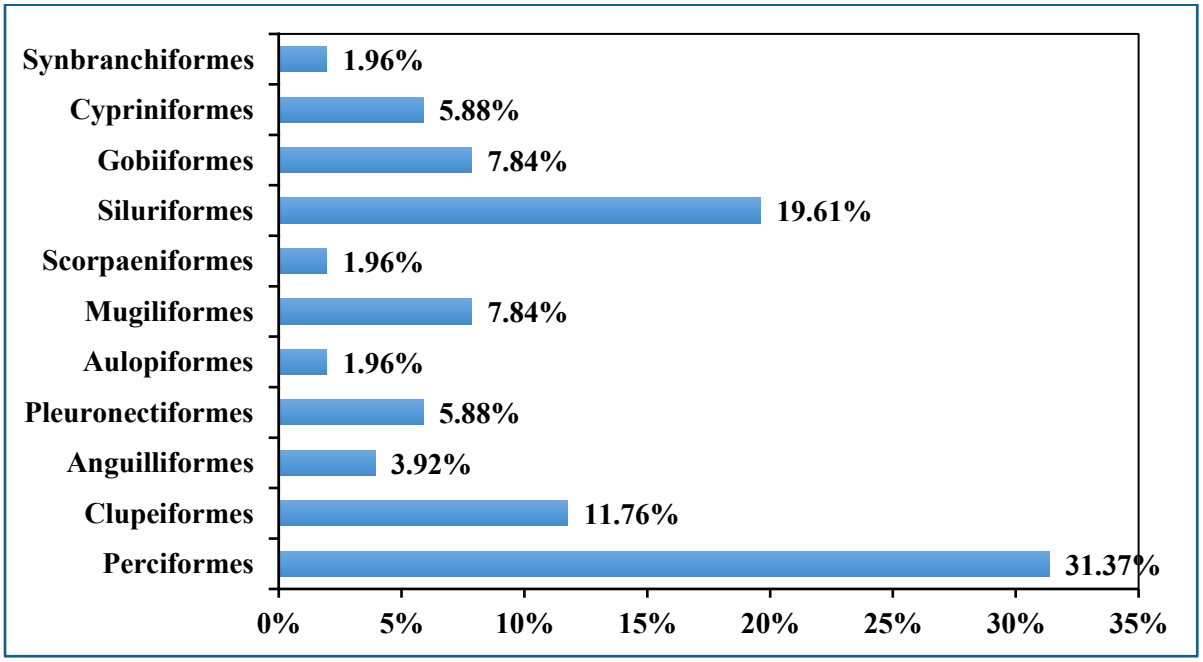


Figure 12: Composition of Fish in the Muhuri Reservoir Based on Taxonomic Order.

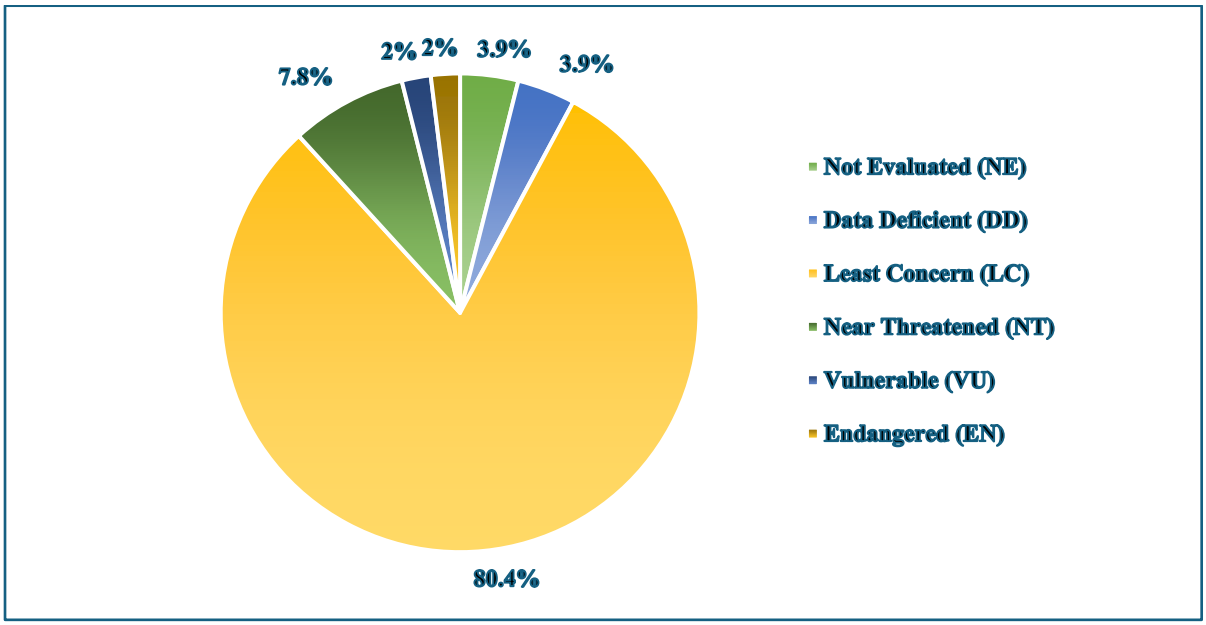


Figure 13: Fish Species Composition According to IUCN Global Red-List Categories.

Impact Assessment for Fisheries

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.

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

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.

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

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

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

Faunal Diversity and Species Composition

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.

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

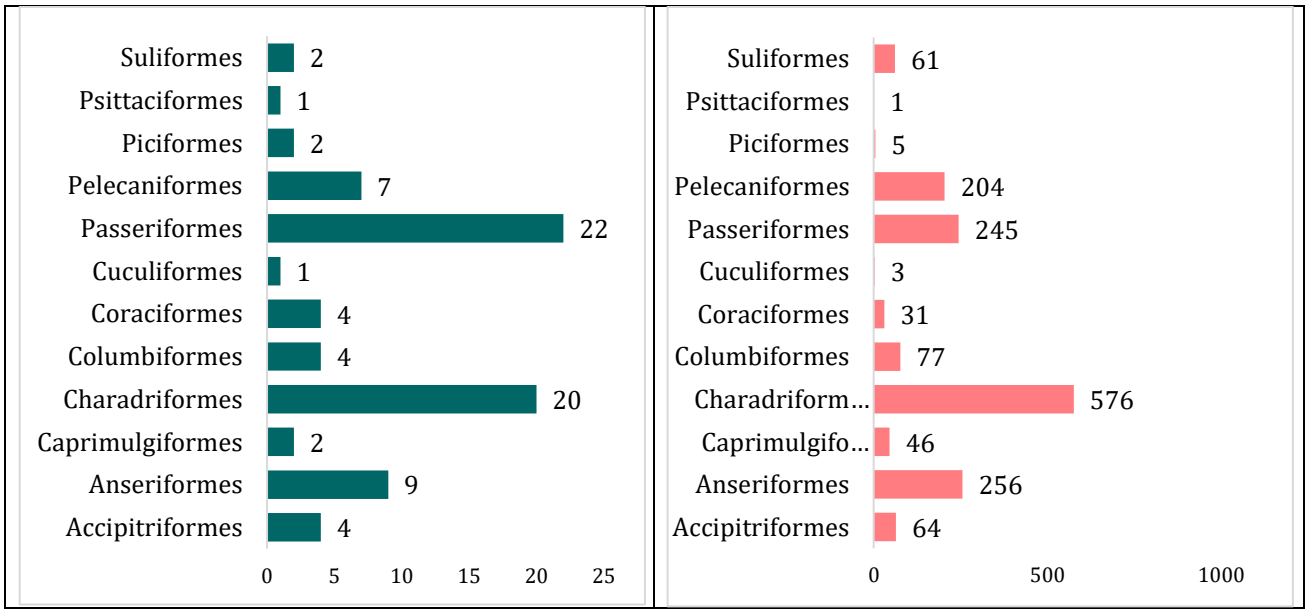


Figure 14: Order Wise Species (A) Richness and (B) Abundance in the Study Area.

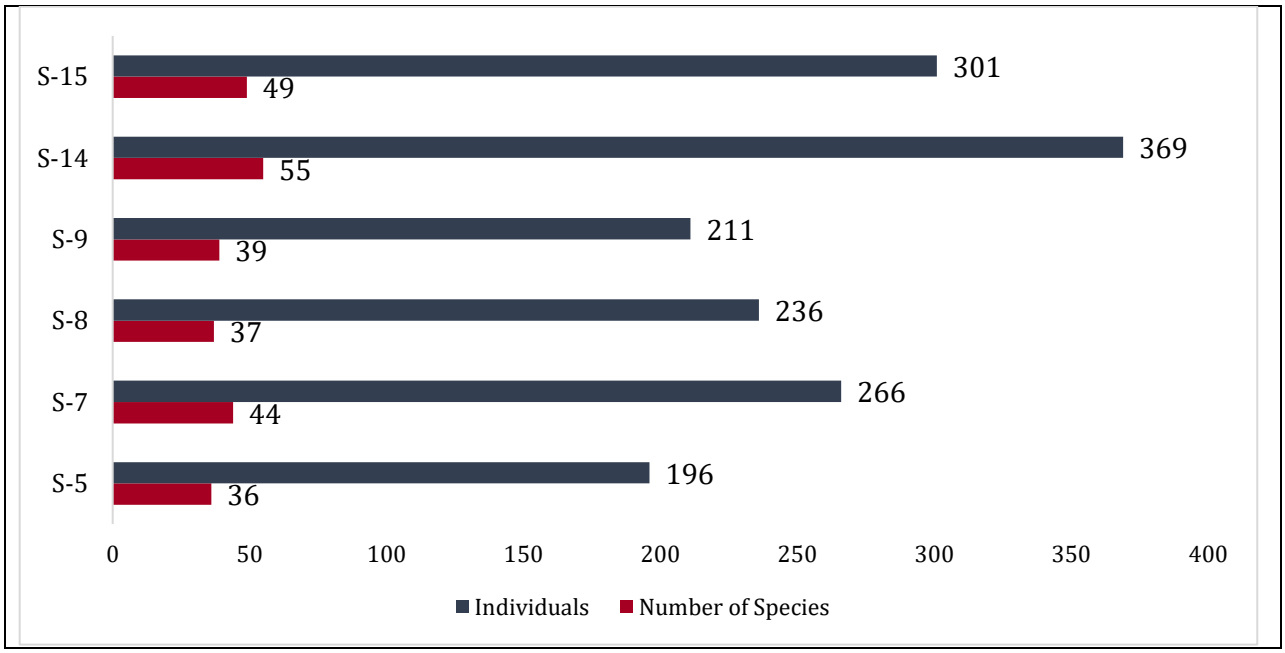


Figure 15: Site Wise Species Richness and Abundance.

Limosa limosa

Tadorna tadorna

Halcyon pileata

Pandion haliaetus

Tadorna ferruginea

Mareca penelope

Larus brunnicephalus

Recurvirostra avosetta

Chlidonias hybrida

Axis 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 33: 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

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.

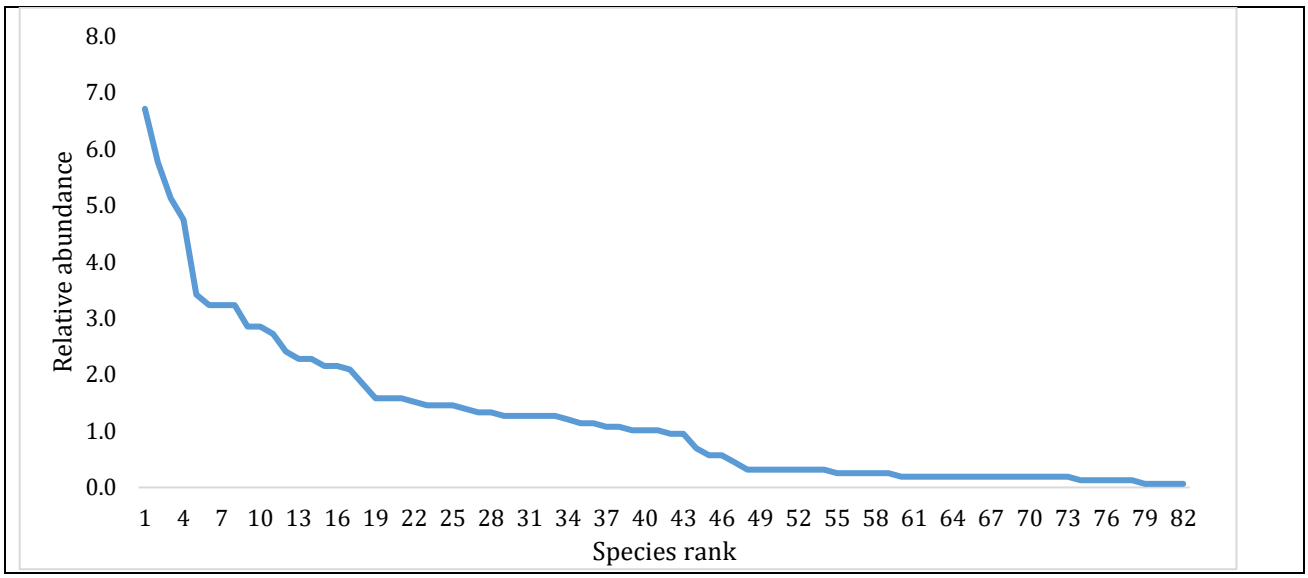


Figure 16: Rank Abundance Plot for Species Recorded from the Study Site.

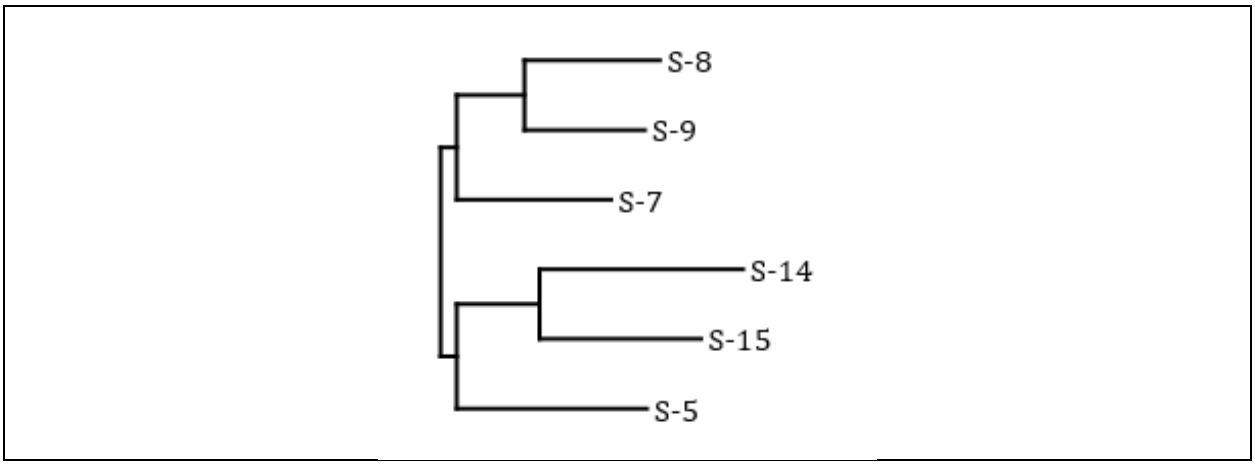


Figure 17: Similarity Profile Test Among Different Study Site Using Bray-Curti's Index.

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 clanga, Threskiornis melanocephalus) two species was near threatened (Limosa 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.

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

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.

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 34: 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)

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.

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 Upazilla

Ramgarh Sitakunda Reserved Forest

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

Conservation of Protected and significant areas

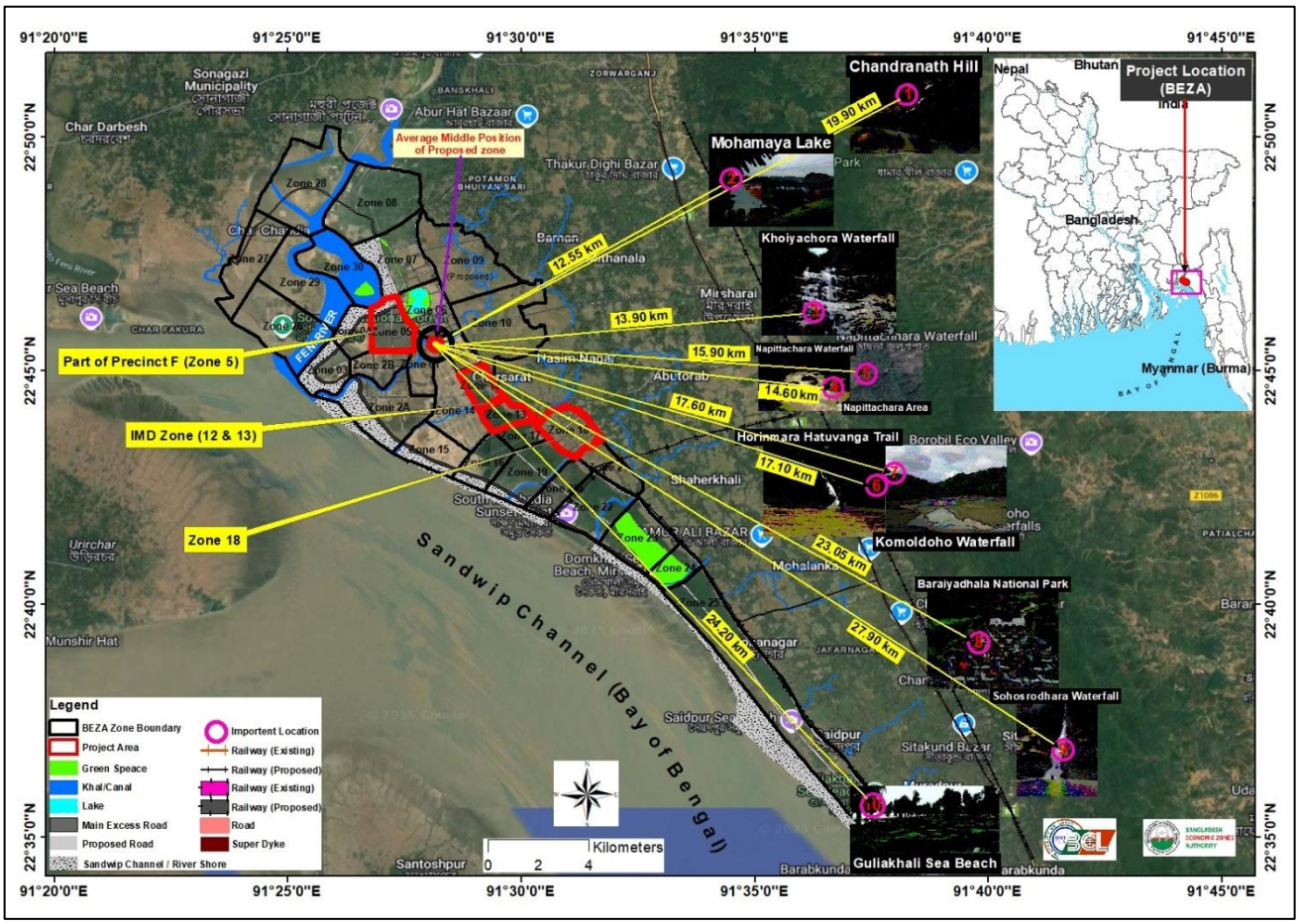
To explore the project area to find protected and ecologically significant areas, and Consultant also consulted with forest people and other concerned stakeholders. Protected and significant areas previously declared by the Government of Bangladesh were not found within the project area. Identification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

Table 35: 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

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 (IMD Zone and Housing Facilities) are as follows:



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

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.

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.

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.

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.

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.

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.

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.

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.

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

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

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.

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.

Out of the 150 HH survey conducted (94.67% male and 5.33% is female) under this ESIA study area, average household size and the percentage distribution of HHs by different sizes. The average family size of BEZA 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.

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%.

Educational status of HHs population

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 36: 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

Occupation of Surveyed HH Population

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 BEZA influence zone 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 37: 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**

Occupation of Surveyed HH Heads

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 38: 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**

Employment Status of HH Population

As it is evident from the **Table 39** 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 39: Distribution of population by employment status

Employment Status	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Aged blow 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

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

Household Assets and Capital Resources

Land:

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 40: 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	

As it is shown in **Table 41,** the average land owned per HH is acre; of which 8.34 acre is homestead land and 23.11acre is cultivable land.

Table 41: Average amount of land per HH

Land types	Average Land per HH (Acre)							
	Own	Sharecropped		Mortgaged		Leased		Total Net Operated Land
		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

Value of land owned by the sampled HHs

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

Table 42: 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			

Livestock and Poultry

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 43: 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								

Average Value of Livestock and Poultry per Household

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 44: 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)				

Access to utility and wash facilities

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 45: 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

Accessibility to Health Care Facilities

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.

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 46: 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

Income and Expenditure

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.

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.

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 47: 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%

Average Annual Income and Expenditure

Table 44 shows that the average monthly income of surveyed HHs is TK 17048.67/- HH, and the annual average expenditure per HH.

Table 48: 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

Average Annual Expenditure

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 49: 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

Overall Economic Condition Sample HHs

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 50: 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

Community Safety and Social Conflict

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.

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.

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 51: 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**
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**

Status of Women in the Project Area

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

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 52** 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 52: 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

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 53: 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

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

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 54: 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

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.

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.

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

Table 55: 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

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 rising[9]. 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.

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**.

Table 56: 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

Violence against Women

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

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.

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.

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.

Table 41 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.

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 57: 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

APPENDIX-2: WASTE MANAGEMENT PLAN

Objectives Of Waste Management

The main objective of the 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 a reason; 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 to treatment and disposal sinks/sumps.

Source: National 3R strategy for Waste Management, Bangladesh

Types Of Wastes

In addition to bulk materials and debris, based on the Solid Waste Management Rules, 2021, the potential construction waste generated during the 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, and antiseptic container	No
	Torch light, syringe, needle etc.	No
	Clean wood and stumps	Yes
	Organic waste/kitchen waste	No
	Use tires	Yes

Source: Solid Waste Management Rule 2021, Article 7(2), 10(4)

Hazardous waste:

Hazardous waste management is outlined below in accordance with relevant waste legislation and the Bangladesh E-waste Management Guidelines (2012).

Source of waste, including hazardous wastes:

The probable sources of various types of waste throughout the dredging and post-dredging phase will be as follows:

- 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

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 Waste 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:

- Waste generated during dredging works must be stored and disposed of in approved areas selected by BEZA.
- 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.
- Use color-coded containers (solid, hazardous, and organic) at dredging sites, storage areas, and campsites 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).

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 for Waste management during Dredging and Post-Dredging Activities

Locations	Kinds of waste	Quantity (kg)	Disposal method
Landfill sites			
Dredging sites			
Labor campsites			
Storage sites			

APPENDIX-3: DRAINAGE MANAGEMENT PLAN FOR LAND FILLING

Introduction

Background of the Study

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

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.

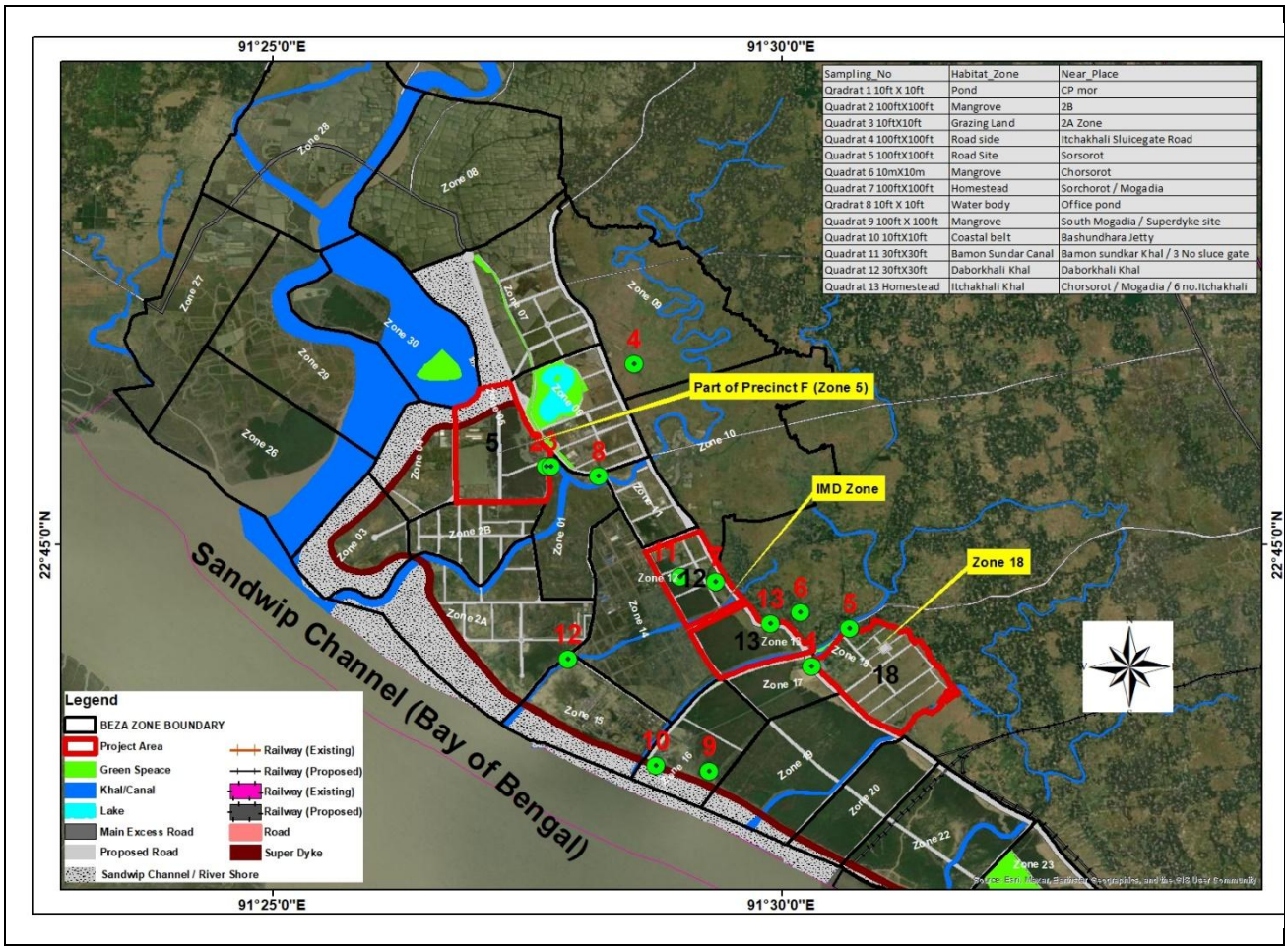
Existing drainage conditions

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
9.	Bamonsundor Canal	22°43'36.06"N 91°29'14.67"E
10.	Daborkhali Canal	22°44'30.96"N 91°28'9.60"E
11.	Ichakhali Canal	22°44'41.63"N 91°27'11.03"E
12.	Shaherkhali Khal	22°71'55.11"N 91°51'40.32"E

Source: Baseline survey, BCL, 2023.

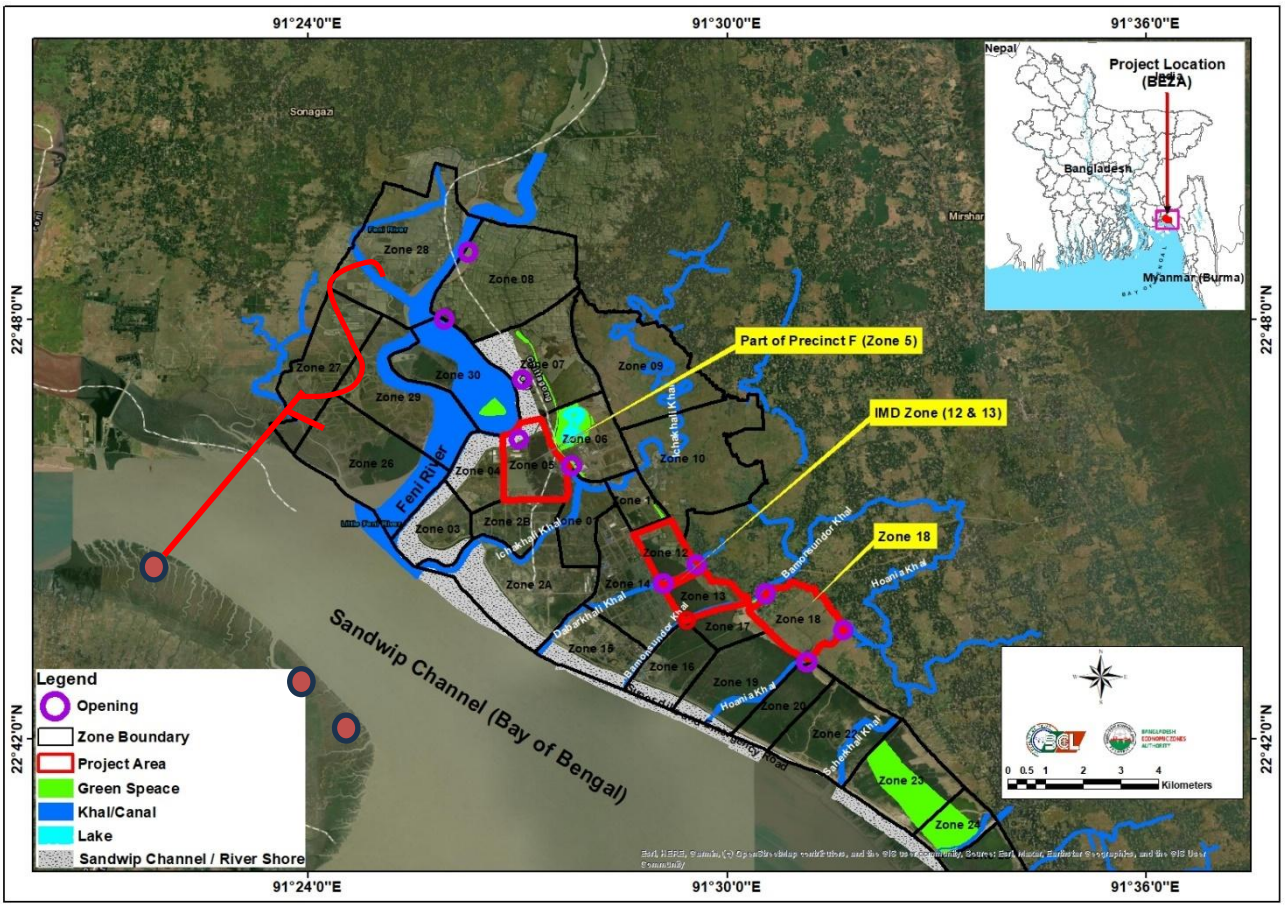


Map 1: Drainage system of the project areas.

Drainage Management System

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.

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.

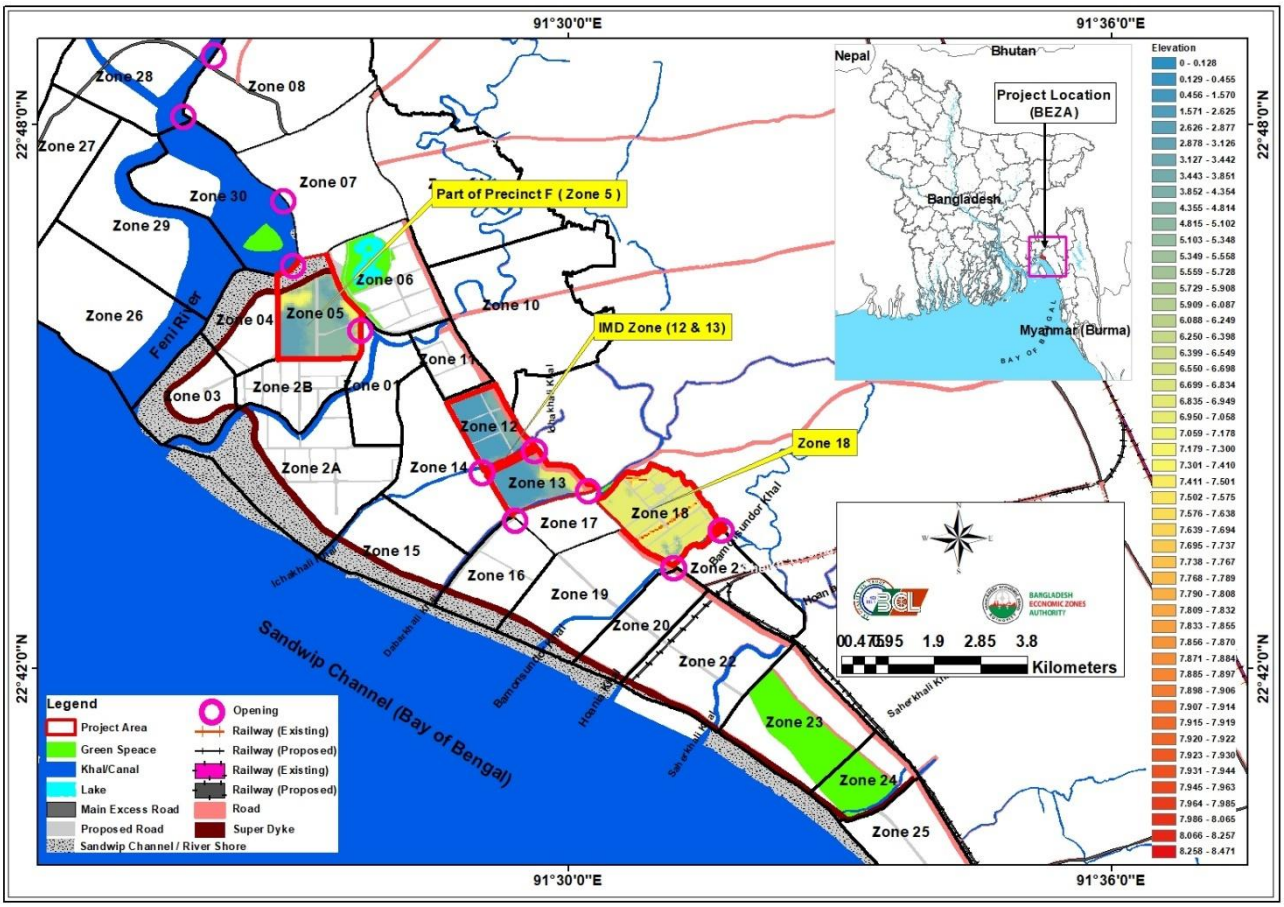
Proposed Drainage System under the project

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):

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.

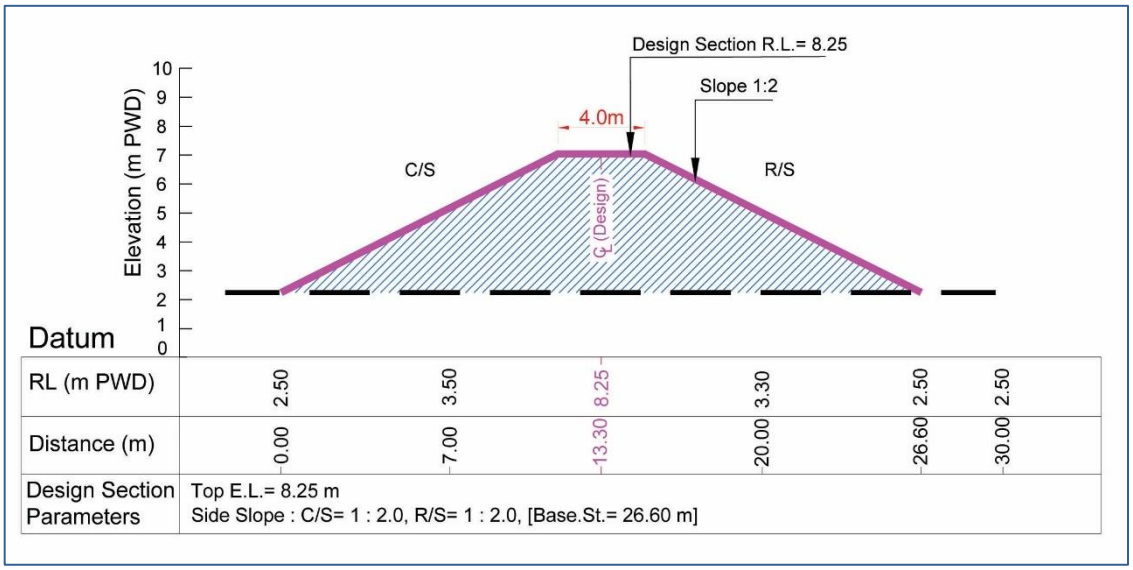


Figure 1: A Typical Embankment Section.

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

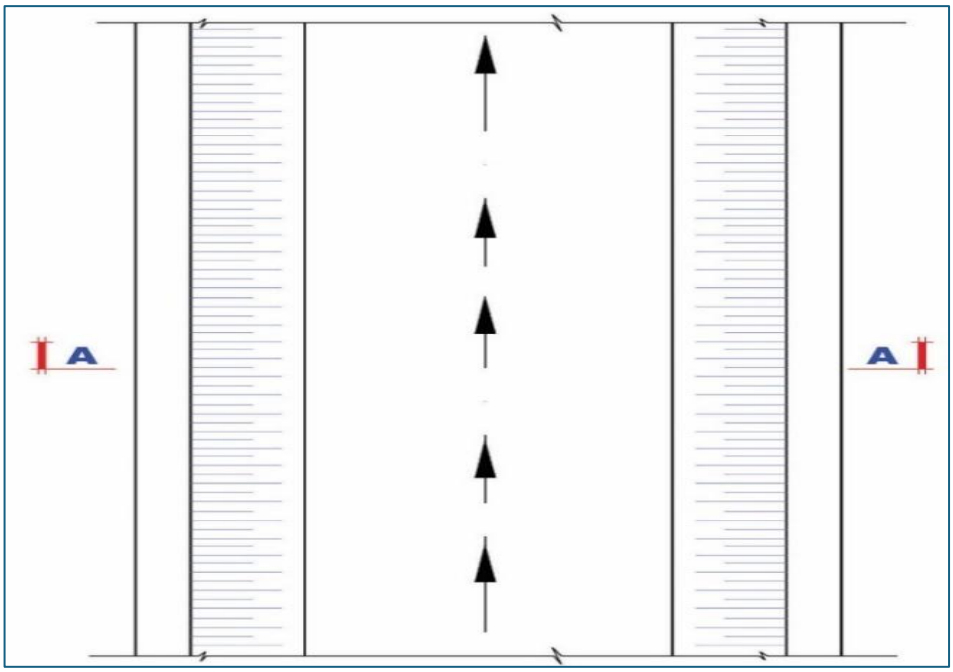
Parameters	Zone-5	Zone-7	Zone-8	Zone-12	Zone-13	Zone-18
Design Height (meter)	3.25	1.75	2.75	5.75	5.75	1.25
Top Width (meter)	4	4	4	4	4	4
Side Slope	1: 2	1: 2	1: 2	1: 2	1: 2	1: 2
Base Width (meter)	17	11	15	27	27	9

Source: Digital Elevation Model

Construction of Diversion Canal

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

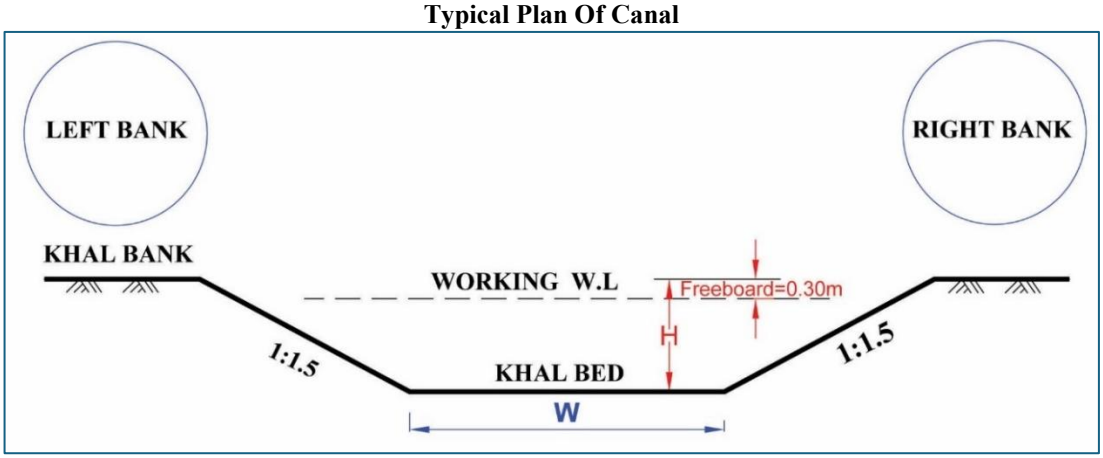


Figure 2: Typical Plan and Section of Diversion Canal

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

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.

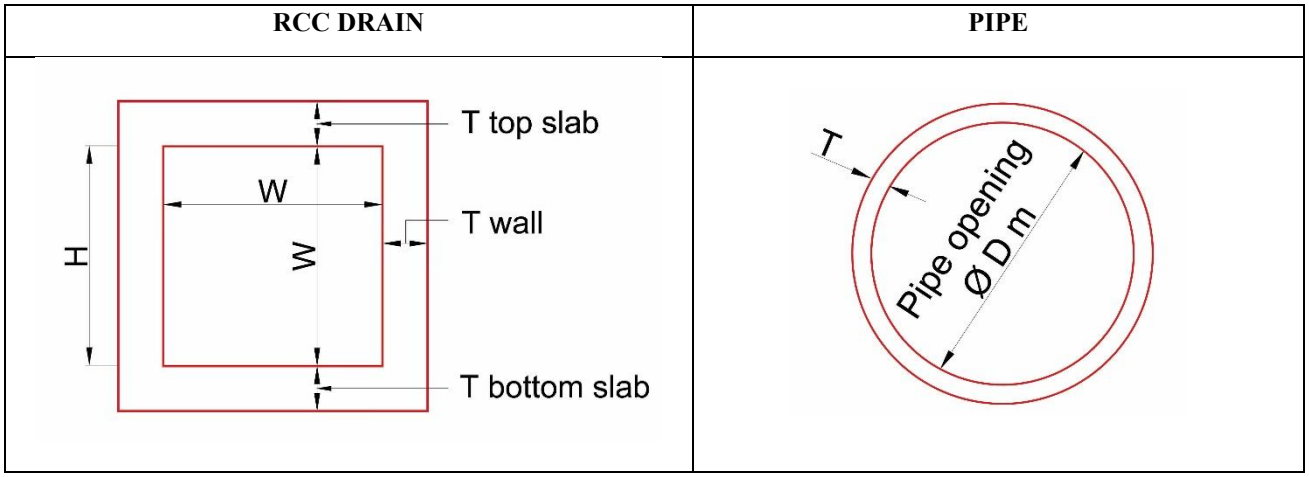


Figure 3: Typical Section of Drain

Cross-Drainage

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:

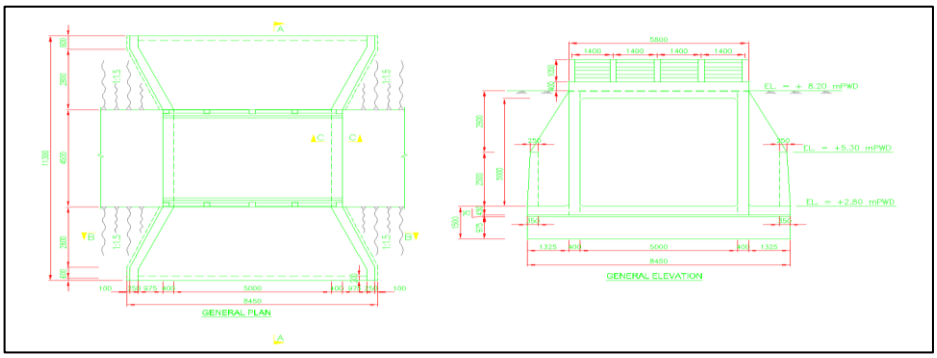


Figure 4: Typical Plan and Section of Culvert

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, and siltation of canal bed.	• 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
		• 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 stilt 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.

APPENDIX-4: DREDGING MANAGEMENT/LAND DEVELOPMENT PLAN

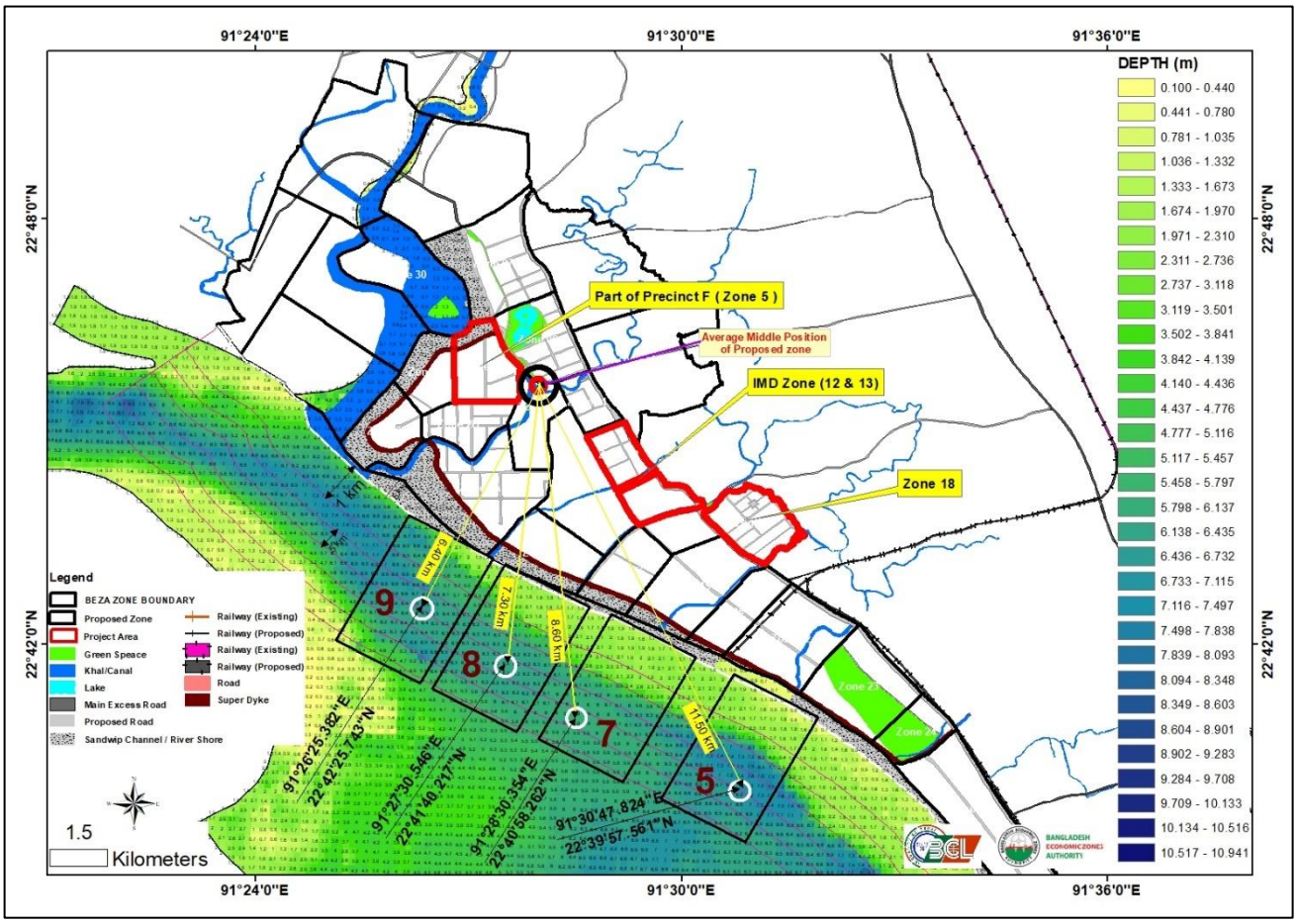
Land Development Plan

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

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.

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

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

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

Dreading 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

The following four sub-systems can be classified as dredging process:

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.

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.

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

The dredgers are classified into the following categories:

- Mechanical dredgers
- Hydraulic dredgers
- Pneumatic dredgers
- Special dredging equipment

Mechanical Dredger

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:

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	--

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

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.

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

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

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

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

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

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

Plain Suction Dredger

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

Trailing Hopper Suction Dredgers

The trailing hopper suction dredger is essentially a self-propelled, self-loading and self-discharging sea going vessel with one or more flexible suction pipes equipped with special suction heads i.e. this type of dredgers 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.

The main advantages and disadvantages of the trailing suction dredger are as under:

Advantages

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

Disadvantages

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

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

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

The hopper is loaded by pumping soil water mixture and using the hopper as sand trap allowing the suspended solid to settle and water to flow through over arrangements provided in the dredger. The loading time for hopper dredger depends upon the characteristic of the soil dredged. In case of fine-grained soil such as very fine sands, silts and soft clays due to their low rate of settlement, it is unlikely that there will be any significant increase in the hopper load achieved by continued pumping beyond the time that hopper overflow commences. However, in case of coarse-grained soil such as sand loading 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.

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

7 Cutter Suction Dredger

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

Advantages

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

Disadvantages

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

The cutter suction dredger is usually rated according to either diameter of the discharge pipe, which may range from 150 mm to 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

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

Selection of Dredgers

The 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

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.

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

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

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

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.

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

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)[10]
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

[10] https://www.vlmaritime.com/product/a0410-cutter-suction-dredger/

Figure: 2: Photographs of Dredger

The rotating cutter excavates the soil during their movement, generated by the side winches, form 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.

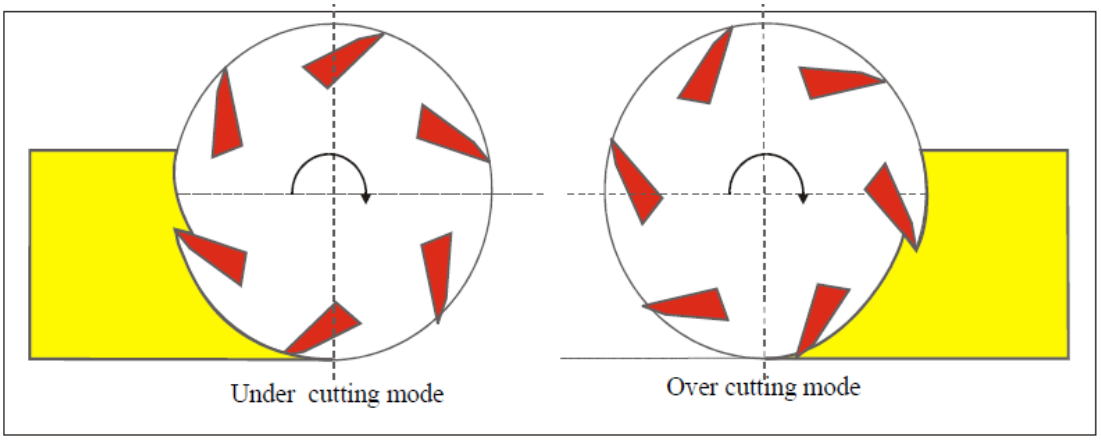


Figure 3: The rotating cutter

- 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.

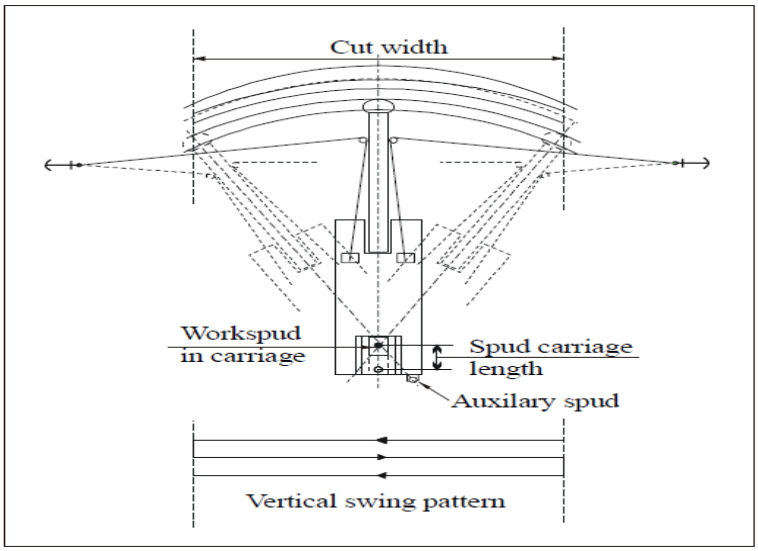


Figure 4: Swing Pattern for A Cutter Suction Dredger

Calculation of Dredging Material:

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

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

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.

APPENDIX-5: OCCUPATIONAL HEALTH AND SAFETY PLAN

Occupational Health and Safety Plan

Objectives

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 accidents, 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.

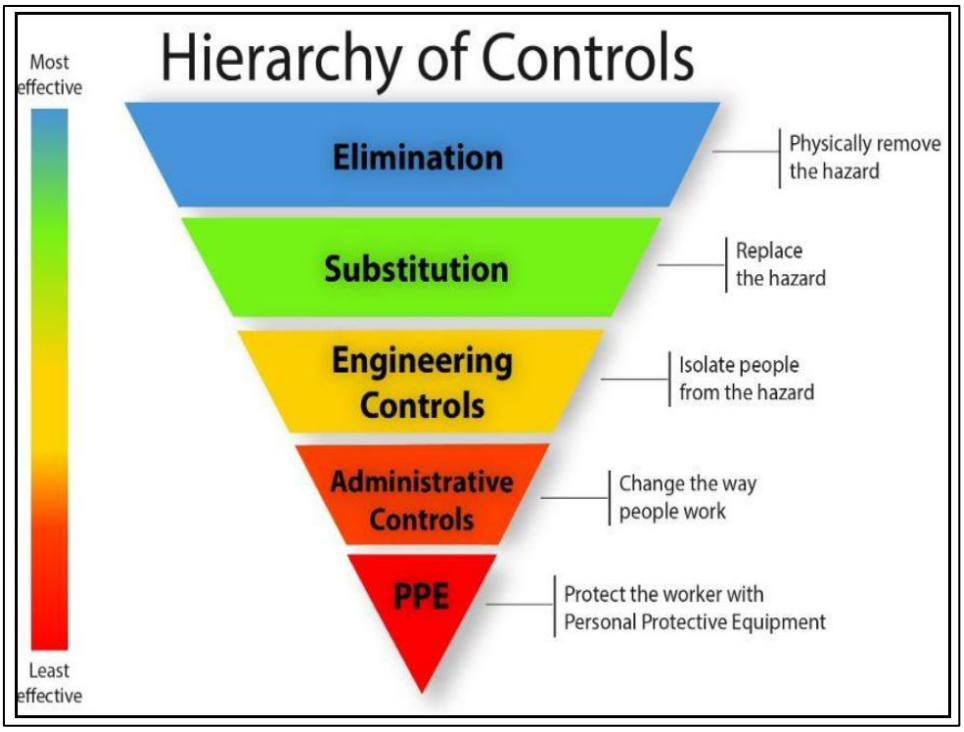


Figure 1: Hierarchy of Controls

Roles and Responsibilities

- 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 control to complete the works following the national rules and regulations and WB's E&S standards Guideline. • Ensure zero harm or no accidents or incidents at the sites. • 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 work with no harm or zero accident/incident under the project activities. • Regularly hold health and safety training, preferably toolbox talk (TBT), before commencing the work 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 responsible parties at the working sites. • To foster 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 biannually. • To check or verify the OHS accident or incident record book at the field sites. • If required, make a 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 to the site or access to be limited for only unauthorized people to avoid community health and safety risks. • Frequently visit the sites and check the status of OHS issues on the spot, etc.
Workers	• To comply with the requirements of the 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 have personal contact with each other for her/his own safety and the safety of others on the construction site.

Risk Screening, Evaluation, And Impact Identification

Risks Screening/Identification

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): The 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 a project manager, a site supervisor, OHS officer/specialist, and engineers to conduct a 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 the World Bank.
- Risk assessment: Conducting risk assessment on the job sites using subsequent method statements.

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 risk assessment and procedural statements in terms of workplace health and safety issues and the quality of work. The Project Manager will ultimately review the materials to confirm the health and safety of female workers and ensure gender integration when completing the risk assessment.

Table 2: Degree of Risk Significance

Step 1: SIGNIFICANCES 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 that, could happen frequently.	Likely, it 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 the Project Manager or other competent authority is essential.
5= Acceptable Risks	Precautions 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

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:									
Sl #	**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

Sources of Risks

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, Machinery operation, 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

The possible mitigation measures to reduce, avoid and or lessen the impacts on occupational health and safety are 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 the 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 signs should be posted at the sites, and
  - Flagman 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.
  - An emergency exit plan should be developed to escape from the site during emergencies.
  - Assembling points should be fixed on the working sites and drills should be carried out occasionally to train the workers to respond 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, the 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, kerosene, 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 other 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.

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 Accidents

- 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.

APPENDIX-6: EMERGENCY RESPONSE AND DISASTER MANAGEMENT PLAN

Pre-Emergency Planning

During the pre-emergency planning stage, identifying anticipated disaster risks and how to respond to this odd situation could help protect people, resources, materials, and as well as nearby communities to respond quickly. The following issues should be addressed or considered during the pre-planning stage:

- Hazard Identification or assessment.
- Identifying the emergency resources available at the sites.
- Develop communication strategies during the disaster period.
- Administering the plan
- Collecting and making available the emergency numbers of local fire departments, local police stations, 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

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

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 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

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.

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

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.

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

Without a proper re-entry process or control over the re-entry issues, new emergencies will occur when workers or residents return to their work 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 an Emergency

A reliable communication system is an important key to making 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 the 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 stations name as Fire Brigade stations.

Assembly Points

The Evacuation Assembly Point (EAP) should be an open area away from the building and out of the way of responding to 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.

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.

To activate the assembly point, every morning before commencing work, Toolbox talk (TBT) and mock drills for the 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

Typical emergency situations at the sites will follow 5 steps such as prevention, mitigation, preparedness, response, and recovery[11] 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

[11] https://www.stlouis-mo.gov/government/departments/public-safety/emergency-management/about/Steps-of-Emergency-Management.cfm

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, flagman 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, 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

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:**

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	Refueling dredging equipment/ vehicle during dredging activities.
Contractor Diesel Fuel (Temporary	Single-Walled	Mobile Refueler	Construction Facility	Refueling 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 occurs. 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 activity 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.

Emergency Response Equipment

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 exercises will be carried out at the sites during the dredging/post-dredging period. It will help enhance the capacity of workers to respond to the emergency with the way of interactive, realistic methods and handle 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

A list of emergency communications will be posted in the emergency drill sites and construction areas to respond to emergency quickly which is follows:

Table -3: Emergency Contact Number for Communication

Sl #	Name	Emergency no.
1	National emergency cell	999
2	Local police station (Officer in Charge, Mirsharai Thana)	01713373644
3	Mirsharai Fire station	01901021577
4	Local Hospital	01851333111

Risk Assessment and Emergency Response

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

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.

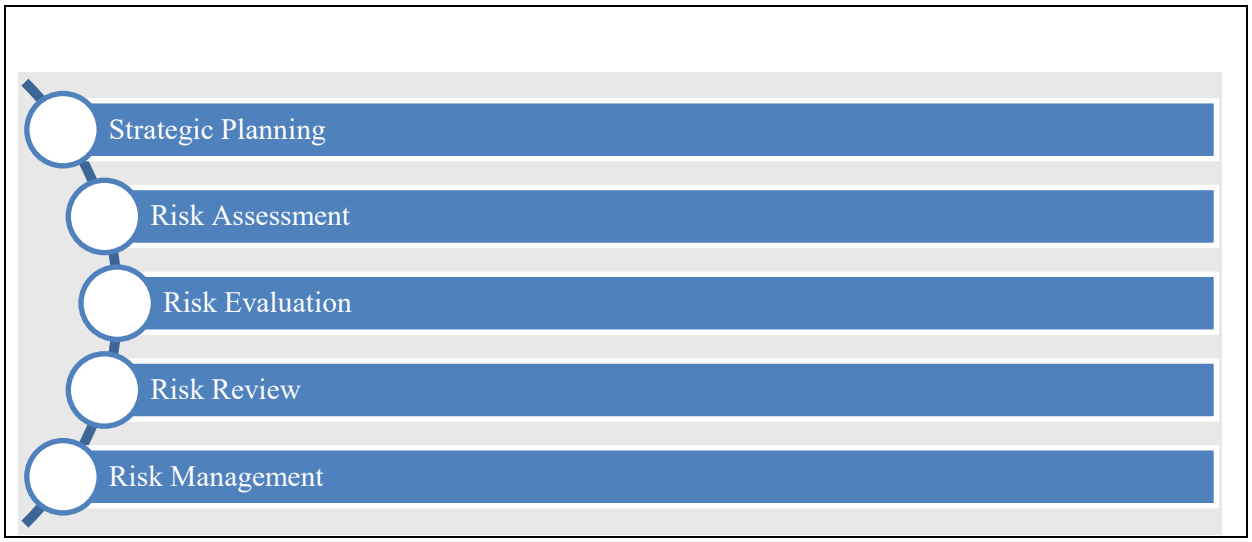


Figure 2: Flow Chart of Risk Management

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 occur from:

Source: Environmental Assessment for Fouzderhat-Sitakunda-Mirsharai Gas Distribution Network Upgradation Project, Chattogram of Karnafuli Gas Distribution Company Limited (KGDCL), March 2023.

APPENDIX-7: 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 species [13].

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 Bangladesh[14].

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 slops 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.

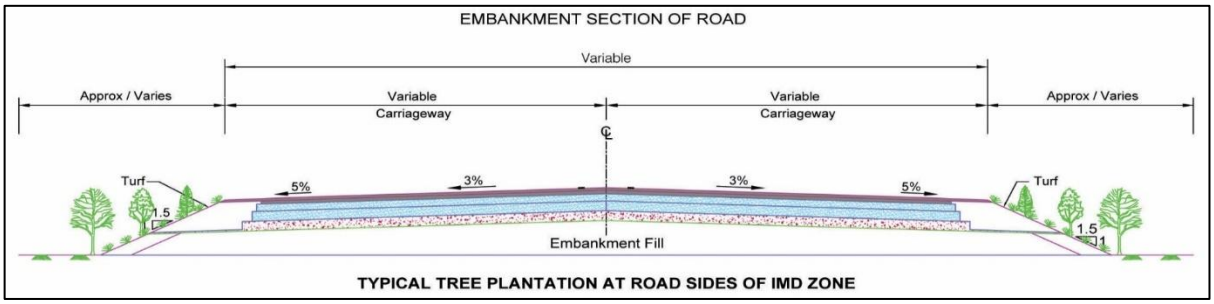


Figure 1: Typical road site plantation design

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, NOx & 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	*Acacia mangium*	Fabaceae	Timber	2.5m
2	Akashmoni	Akashmoni	*Acacia moniliformes*	Fabaceae	Timber	2.5m
3	Siris	Raintree	*Albizia lebbeck*	Fabaceae	Timber	2.5m
4	Kathal	Jack fruit	*Artocarpus heterophyllus*	Moraceae	Fruit Bearing/ Timber	3.5m
5	*Bean*	black mangrove	*Avecenia alba*	*Aviceniaceae*	Timber	2.5m
6	Neem	Neem	*Azadirachta indica*	Meliaceae	Medicinal	2.5m
7	Shimul	Red silk cotton tree	*Bombax ceiba*	Malvaceae	Flower	2.5m
8	Tal	Palm	*Borassus flabellifer*	Arecaceae	Fruit Bearing	2.5m
9	Radachura	Peacock	*Caesalpinia pulcherrima*	Fabaceae	Ornamental flower	2.5m
10	Pepey	Papaw	*Carica papaya*	Caricaceae	Fruit Bearing	2m
11	Karamcha tree	Karamcha tree	*Carissa carandas*	Apocynaceae	Fruit bearing	2m
12	Sonalu	Golden shower tree	*Cassia fistula*	Fabaceae	Fuel	2.5m
13	Jhao Ghas	Beach She-oak	*Casuarina equisetifolia*	Casuarinaceae	Timber	2.5m
14	Jambura	Jambura	*Citrus grandis*	Rutaceae	Fruit Bearing	3.5m
15	Narikel	Narikel	*Cocos nucifera*	Palmae	Fruit Bearing	3.5m
16	Krichnachura	Royal poinciana	*Delonix regia*	Fabaceae	Ornamental flower	2.5m
17	Gewa	Milky mangrove	*Excoecaria agallocha*	Euphorbiaceae	Timber	2.5m
18	Bot	Banyan	*Ficus benghalensis*	Moraceae	Aesthetic	2.5m
19	Dumur	Ficus tree	*Ficus benjamina*	Moraceae	Fruit bearing	2.5m
20	Gamari	Gamari	*Gmelina arborea*	Verbenaceae	Timber	2.5m
21	Rongon	Jungle geranium	*Ixora coccinea*	Rubiaceae	Ornamental flower	2m
22	Ipil Ipil	Lead Tree	*Leucaena leucocephala*	Fabaceae	Fuel	2m
23	Litchi	Litchi	*Litchi chinensis*	Sapindaceae	Fruit Bearing	3.5m
24	Aam	Mango	*Mangifera indica*	Anacardiaceae	Fruit Bearing	3.5m
25	Safeda	Safeda	*Manilkara zapota*	Zapotaceae	Fruit Bearing	3.5m
26	Bokul	Bokul	*Mimusops elengi*	Sapotaceae	Ornamental flower	2m
27	Kadam	Burflower	*Neolamarckia cadamba*	Rubiaceae	Ornamental flower/Fuel	2.5m

Sl. No.	Local Name	English name	Species Name	Family	Uses	Distance (m) between each sapling
28	Olives	Olives	*Olea europaea*	Oleaceae	Fruit Bearing	3.5m
29	Khejur	Date	*Phoenix sylvestris*	Palmae	Juice	2.5m
30	Debdaru	Pseudo Ashoka	*Polyalthia longifolia*	Annonaceae	Timber	2.5m
31	Peyara	Guava	*Psidium guajava*	Myrtaceae	Fruit Bearing	2m
32	Ashoka	Ashoka tree	*Saraca asoca*	Fabaceae	Ornamental flower	2.5m
33	Amra	Hog Plum	*Spondius pinnata*	Anacardiaceae	Fruit Bearing	3.5m
34	Mahagony	Mahagony	*Swietenia mahagony*	Meliaceae	Timber	3.5m
35	Jaam	Black Berry	*Syzygium cumini*	Myrtaceae	Fruit Bearing	3.5m
36	Jamrul	Jamrul	*Syzygium samarengense*	Myrtaceae	Fruit bearing	3.5m
37	Tentul	Tentul	*Tamarindus indica*	Leguminosae	Fruit Bearing	2.5m
38	Segun	Teak	*Tectonia grandis*	Lamiaceae	Timber	2.5m
39	Arjun	Arjun tree	*Terminalia arjuna*	Combretaceae	Medicinal	2.5m
40	Bohera	Bohera	*Terminalia bellirica*	Combretaceae	Medicinal	2.5m
41	Kathbadam	Kathbadam	*Terminalia catapa*	Combrataceae	Timber/Shed	2.5m
42	Horitoki	Horitoki	*Terminalia chebula*	Combretaceae	Medicinal	2.5m
43	Boroi	Jujube	*Zizyphus mauritiana*	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 x1 m spacing 10,000 trees are required and at 1 x 2 m only 5,000 trees are required. The spacing of trees hasbeen 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	*Heritiera fomes*	*Malvaceae*	Timber	2m
2	Gewa	Milky mangrove	*Excoecaria agallocha*	Euphorbiaceae	Timber	2m
3	Passur	Passur	*Xylocarpus mekongensis*	*Meliaceae*	Timber	2m
4	Dhundul	Dhundul	*Xylocarpus granatum*	*Meliaceae*	Timber	2m
5	Kankra	Upriver Orange Mangrove	*Bruguiera sexanula*	*Rhizoporaceae*	*Timber*	2m
6	Khalshi	Black mangrove	*Aegiceras corniculatum*	*Primulaceae*	Timber	2m
7	Shingra	Sialang tree	*Cynometra ramiflora*	*Fabaceae*	Timber	2m
8	Goran	Goran	*Ceriops decandra*	*Rhizophoraceae*	Timber	2m

Sl No	Local Name	English name	Species Name	Family	Uses	Distance (m) between each sapling
9	Baen	Indian mangrove	*Avecennia officinalis*	*Aveciniaceae*	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 occurafter 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 shorterthan 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 anychanges should be made to improve results. This should be done the first 8-12 months. Count the numberof 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.

APPENDIX-8: TRAFFIC MANAGEMENT PLAN

Introduction

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

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, particularly in IMD zone including part of Precinct F.

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.

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 in Precinct F (IMD Zone and Housing Facilities)

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 do not create 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 avoid passing through the Precinct F (IMD Zone and Housing Facilities), 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 promises. 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 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

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.

Table 2: 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

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.

APPENDIX-9: KII, FGD AND STAKEHOLDER CONSULTATIONS

A. KEY INFORMANT INTERVIEWS

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, school teacher, 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 bellow:

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 pipe line
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 pipe line.

KII with Farm Manager

Md. Motasim Bella (Hafiz) Farm Manager Fish Seed Multiplication Farm Mirsharai, Chattagram Mobile:01677-515999 Date:11.12.2023	

Sl. No	Questions	Answers/Comments
1	How many fishermen families live in Ichhakhali and Maghadia Union?	There are 56 fishermen families live in Osmanpur under Ichhkhali 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, Chattagram 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 Ichhakhali Central Mosque Ichhakhali Union Mirsharai, Chattagram 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 spear among the locals.

KII with BEZA Officials

Md. Ferdous Wahid Assistant Engineer (Civil) & Focal Person National Special Economic Zone (NSEZ) Mirsharai, Chattagram 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 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 need 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 a priority basis.

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

Sl. No	Questions/Topic	Answers/Comments
1	What is 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 datelined 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)?	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 for landfilling to the Part of Precinct F (IMD zone and Housing Facilities)?	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
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)?	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), 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)?	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 Laision 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, Chattagram 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, Chattagram 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 Ichhakhali
Union : Ichhakhali
Upazila: Mirsharai
District: Chattagram
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). 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). 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: Ichhakhali
Upazila: Mirsharai
District: Chattagram
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). 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 to land development of the part of Precinct F (IMD Zone and Housing Facilities). Because there is no agricultural land, fish culture and roads between the Economic Zone and Sandwip Channel

B. FOCUS GROUP DISCUSSIONS

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

FGD with Local Community

Village: Char Sarat, Upazila: Mirsharai, District: Chattagram
Date: 9.12.2023
Place: Shop of Mosharof Member

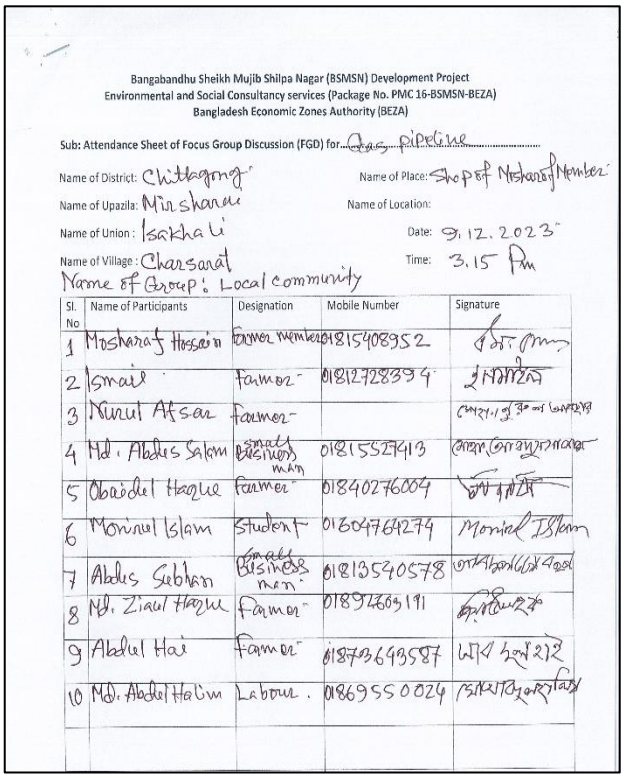
The FGD was conducted at the tea stall of former UP member Mosharof Hossain of Charsarat village of Mirsharai Upazila. There was attended a total of ten participants which represent small business man, student, day labor, Farmer and local leader. The FGD discussion minutes and attendance list are as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

Figure 1: Photographs of FGD with local community at Charsarat of Ichhakhali 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 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-1):



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong — Name of Place: Shop of Mosharaf Member
Name of Upazila: Mirsharai — Name of Location:
Name of Union: Isakhali — Date: 9.12.2023
Name of Village: Charsarat — Time: 3.15 Pm
Name of Group: Local community

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1	Mosharaf Hossain	Former member	01815408952	
2	Ismail	Farmer	01812728394	
3	Nurul Afsar	Farmer		
4	Md. Abdus Salam	Small Business man	01815527413	
5	Obaidul Haque	Farmer	01840276004	
6	Monirul Islam	Student	01604764274	
7	Abdus Sobhan	Small Business man	01813540578	
8	Md. Ziaul Haque	Farmer	01897269191	
9	Abdul Hai	Farmer	01873693587	
10	Md. Abdul Halim	Labour	01869550024	

FGD with Local People

Village: Char Sarat, Upazila: Mirsharai, District: Chattagram
Date: 9.12.2023
Place: Member's Office, Dabarkhali Poient

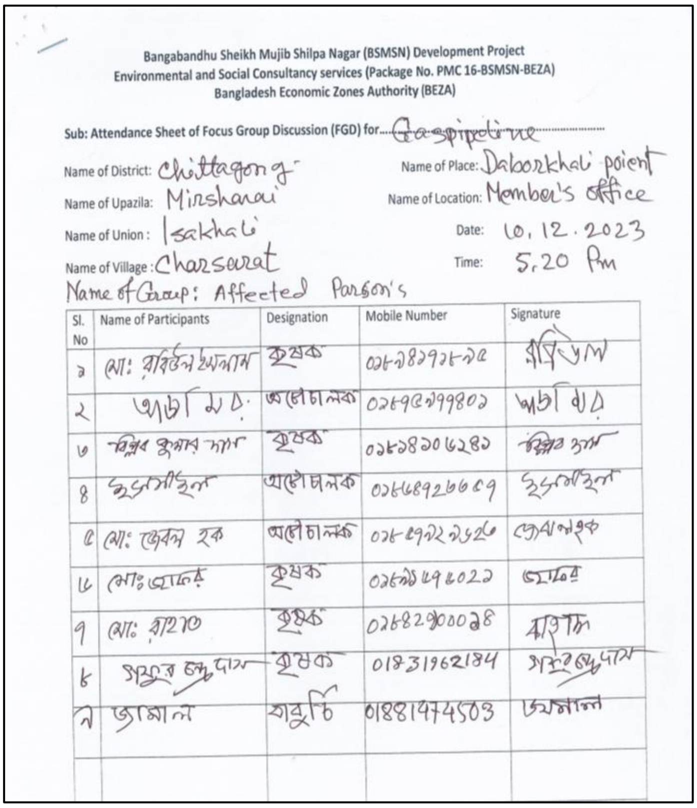
On 10.12.2023, FGD was conducted at Member's Office, Dabarkhali Point of Charsarat village of Mirsharai Upazila. There was attended a total of nine participants which represent farmer, auto driver and cook. The FGD discussion minutes and attendance list are as follows

Figure-2: FGD with local people at Dabarkhali Point of Ichhakhali 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 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-2):



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Upazila: Mirsharai
Name of Union: Isakhali
Name of Village: Charsarat
Name of Place: Dabarkhali poient
Name of Location: Member's office
Date: 10.12.2023
Time: 5.20 Pm
Name of Group: Affected Parson's

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	মো: রবিউল ইসলাম	কৃষক	[illegible]	[signature]
২	[illegible]	অটোচালক	[illegible]	[signature]
৩	বিপ্লব কুমার দাস	কৃষক	[illegible]	[signature]
৪	[illegible]	অটোচালক	[illegible]	[signature]
৫	মো: [illegible] হক	অটোচালক	[illegible]	[signature]
৬	মো: [illegible]	কৃষক	[illegible]	[signature]
৭	মো: [illegible]	কৃষক	[illegible]	[signature]
৮	[illegible] দাস	কৃষক	01831962184	[signature]
৯	জামাল	বাবুর্চি	01881474503	[signature]

FGD with Local People

Village: South Moghadia-Kajirtaluk, Union: Saherkhali, Upazila: Mirsharai, District: Chattagram
Date: 24.01.2024
Place: House of Shukur Ali near about CP Point

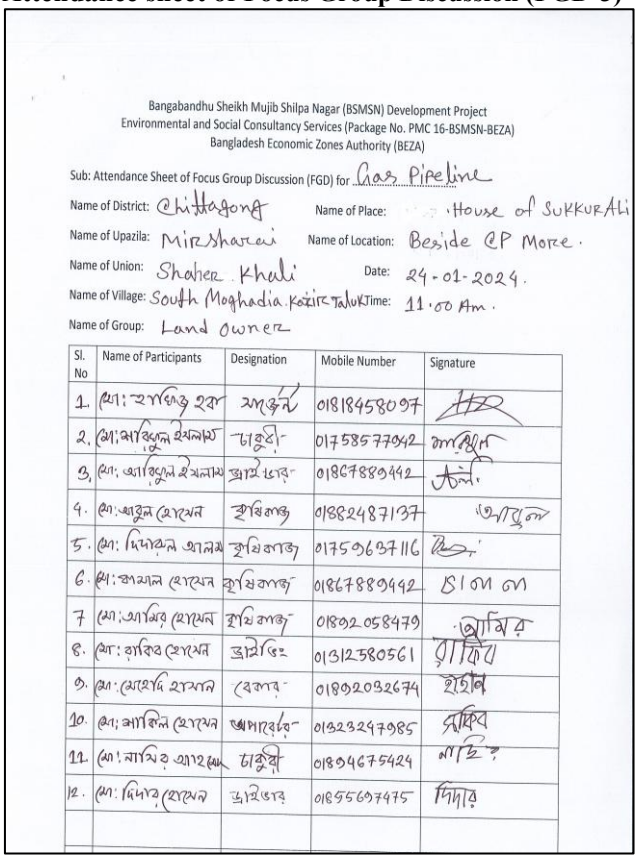
On 24.01.2024, FGD was conducted at the house of Shukur Ali near about CP Point, Village: South Moghadia-Kajirtul, Saherkhali union of Mirsharai Upazila. There was attended a total of twelve participants which represent only landowner/affected persons. The FGD discussion minutes and attendance list are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

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



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy Services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

Sub: Attendance Sheet of Focus Group Discussion (FGD) for Gas Pipeline
Name of District: Chittagong Name of Place: House of SUKKUR Ali
Name of Upazila: Mirsharai Name of Location: Beside CP More.
Name of Union: Shaher Khali Date: 24-01-2024.
Name of Village: South Moghadia. Kazir Taluk Time: 11.00 Am.
Name of Group: Land Owner

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1.	মো: হাফিজুর রহ	সাংবাদিক	01818458097	
2.	মো: আবিদুল ইসলাম	চাকুরি	01758577042	
3.	মো: আবিদুল ইসলাম	ব্যবসা ব্যবসা	01867889442	
4.	মো: আবুল হোসেন	কৃষিকাজ	01882487137	
5.	মো: দিদারুল আলম	কৃষিকাজ	01759637116	
6.	মো: কামাল হোসেন	কৃষিকাজ	01867889442	
7	মো: আমির হোসেন	কৃষিকাজ	01892058479	
8.	মো: রাকিব হোসেন	ড্রাইভিং	01312580561	
9.	মো: মোহেদি হাসান	বেকার	01892032674	
10.	মো: শাকিল হোসেন	আনারোহ	01823297985	
11.	মো: নাসির আহমেদ	চাকুরি	01894675424	
12.	মো: দিদার হোসেন	ড্রাইভার	01855697475	

FGD with Business Group

Ichhakhali Sluicegate Bazar, Upazila: Mirsharai, District: Chattagram
Date: 10.12.2023
Place: Ichhakhali Sluicegate Bazar

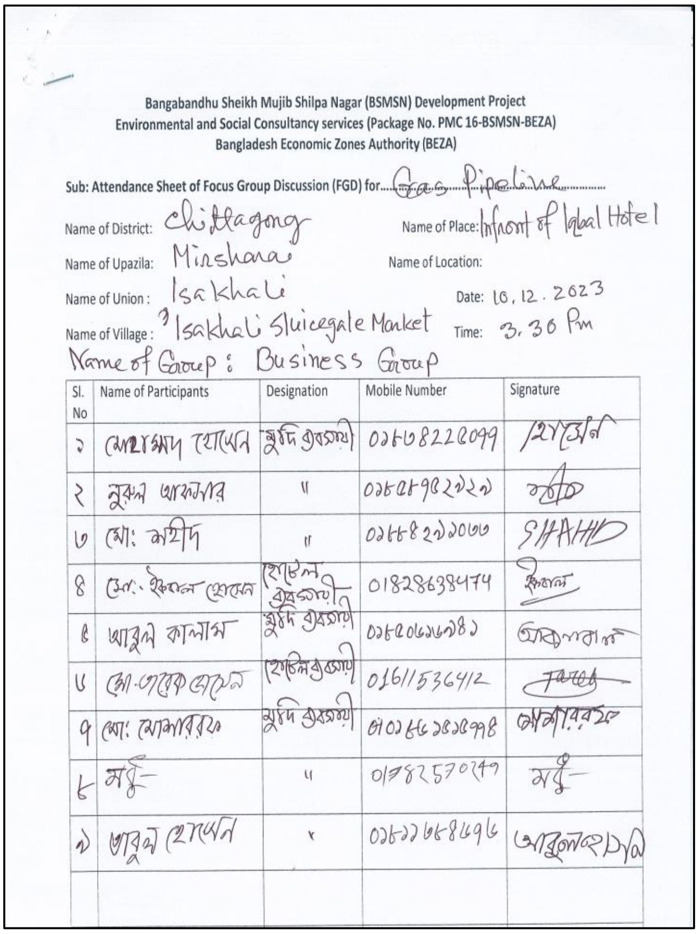
On 10.12.2023, FGD was conducted at in front of Iqbal Hotel & Restaurant, Ichhakhali Sluicegate Bazar Ichhakhali union of Mirsharai Upazila. There was attended a total of nine participants which represent only business man. The FGD discussion minutes and attendance list are as follows

Figure-4: FGD with Business Group at Ichhakhali Sluicegate Bazar of Ichhakhali Union.

Summary of Focus Group Discussion (FGD-4)

- Mohammad Hossion 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 utilites particularly gas connection.
- Abul Kalam said some people may leave the shop without paying money.
- Abul Hossion said the area will improve.
- Md. Tarek Hossion 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 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-4)



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong Name of Place: Infront of Iqbal Hotel
Name of Upazila: Mirsharai Name of Location:
Name of Union: Isakhali Date: 10.12.2023
Name of Village: Isakhali Sluicegate Market Time: 3.30 Pm
Name of Group: Business Group

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	মোহাম্মদ হোসেন	মুদি ব্যবসায়ী	০১৮৩৮২২৫০৭৭	হোসেন
২	নুরুল আফসার	"	০১৮৫৮৭৪২৯২৯	[illegible]
৩	মো: শহীদ	"	০১৮৮৮২৯১০৩৩	SHAHID
৪	মো: ইকবাল হোসেন	হোটেল ব্যবসায়ী	01828638474	ইকবাল
৫	আবুল কালাম	মুদি ব্যবসায়ী	০১৮৫০৬১৬৯৪১	আবুল কালাম
৬	মো: তারেক হোসেন	হোটেল ব্যবসায়ী	01611536412	Tarek
৭	মো: [illegible]	মুদি ব্যবসায়ী	০১৮৮১৫১৫৭৭৪	[illegible]
৮	মর্তু	"	01782570249	মর্তু
৯	আবুল হোসেন	"	০১৮১১৬৮৪৭৬	আবুল হোসেন

FGD with Local Community

Village: Char Sarat, Upazila: Mirsharai, District: Chattagram
Date: 10.12.2023
Place: Shop of Saiful Islam, Dabarkhali Poient

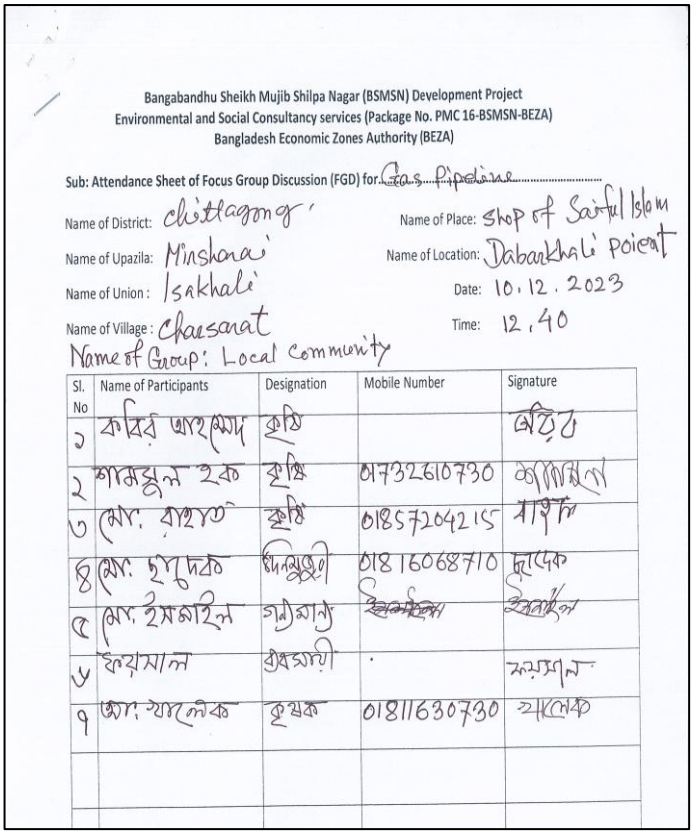
On 10.12.2023, FGD was conducted at the shop of Saiful Islam, Dabarkhali Point, Ichhakhali union of Mirsharai Upazila. There was attended a total of seven participants which represent small business man, day labor, farmer and local leader. The FGD discussion minutes and attendance list are as follows

Figure-5: FGD with local community at Dabarkhali Point of Ichhakhali 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 occure 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 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-5)



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: chittagong
Name of Upazila: Mirsharai
Name of Union : Ichakhali
Name of Village : Charsarat
Name of Place: shop of Saiful Islam
Name of Location: Dabarkhali poient
Date: 10.12.2023
Time: 12.40
Name of Group: Local community

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	কবির আহম্মদ	কৃষি		
২	শামছুল হক	কৃষি	01732610730	
৩	মো: রাহাত	কৃষি	01857204215	
৪	মো: ইসমাইল	দিনমজুর	01816068710	
৫	মো: ইসমাইল	গাড়িচালক		
৬	ফখরুল	ব্যবসায়ী		
৭	আব্দুল খালেক	কৃষক	01811630730	

FGD with Farmer Group

Village: Sariatpara, Union: Maghadia, Upazila: Mirsharai, District: Chattagram
Date: 11.12.2023
Place: Shop of Belal Hossen

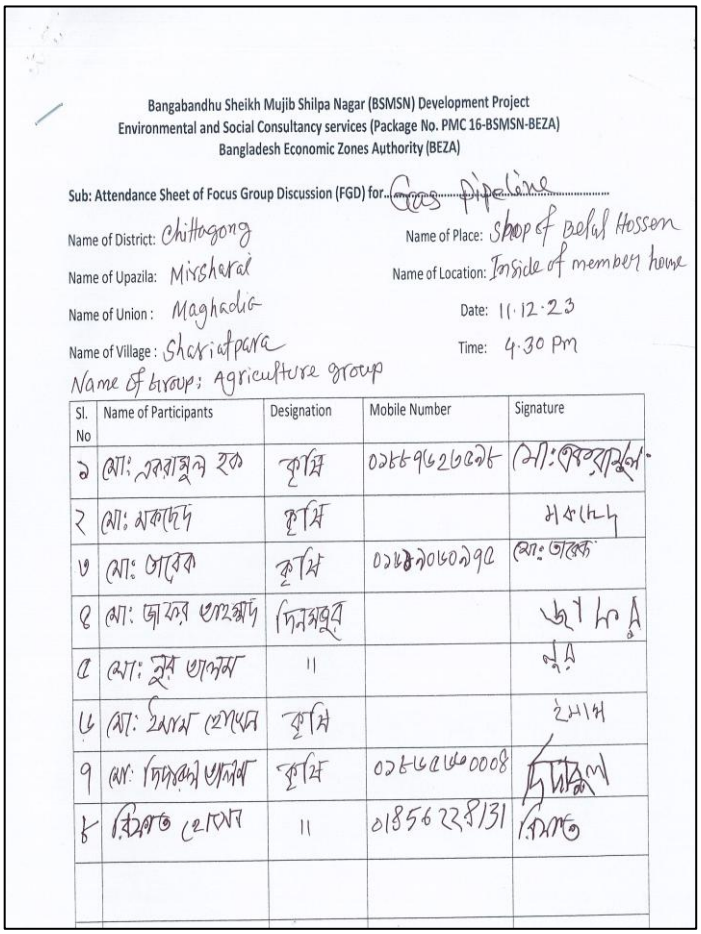
On 11.12.2023, FGD was conducted at the shop of Belal Hossen, Sariatpara (inside of UP Member house) Maghadia union of Mirsharai Upazila. There was attended a total of eight participants which represent only farmers. The FGD discussion minutes and attendance list are as follows

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 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-6)



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Upazila: Mirsharai
Name of Union: Maghadia
Name of Village: Shariatpara
Name of Place: Shop of Belal Hossen
Name of Location: Inside of member house
Date: 11.12.23
Time: 4.30 PM
Name of Group: Agriculture group

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	মো: নুরাবুল হক	কৃষি	০১৮৮৭৬২৬৫৯৮	মো: ইকরামুল
২	মো: মকসেদ	কৃষি		মকসেদ
৩	মো: তারেক	কৃষি	০১৮৯৯০৬০৯৭৫	মো: তারেক
৪	মো: জাকির হোসেন	দিনমজুর		জাকির
৫	মো: ইমাম হোসেন	"		ইমাম
৬	মো: ইমরান হোসেন	কৃষি		ইমরান
৭	মো: দিদারুল আলম	কৃষি	০১৮৬৫৬৬০০০৪	দিদারুল
৮	রিয়াজ হোসেন	"	০১৮৫৬২২৪১৩১	রিয়াজ

FGD with Labor Fource Group

Village: Noyapara, Union: Saherkhali, Upazila: Mirsharai, District: Chattagram
Date: 23.01.2024
Place: House of Soleman near about Noyapara Zame Mosque

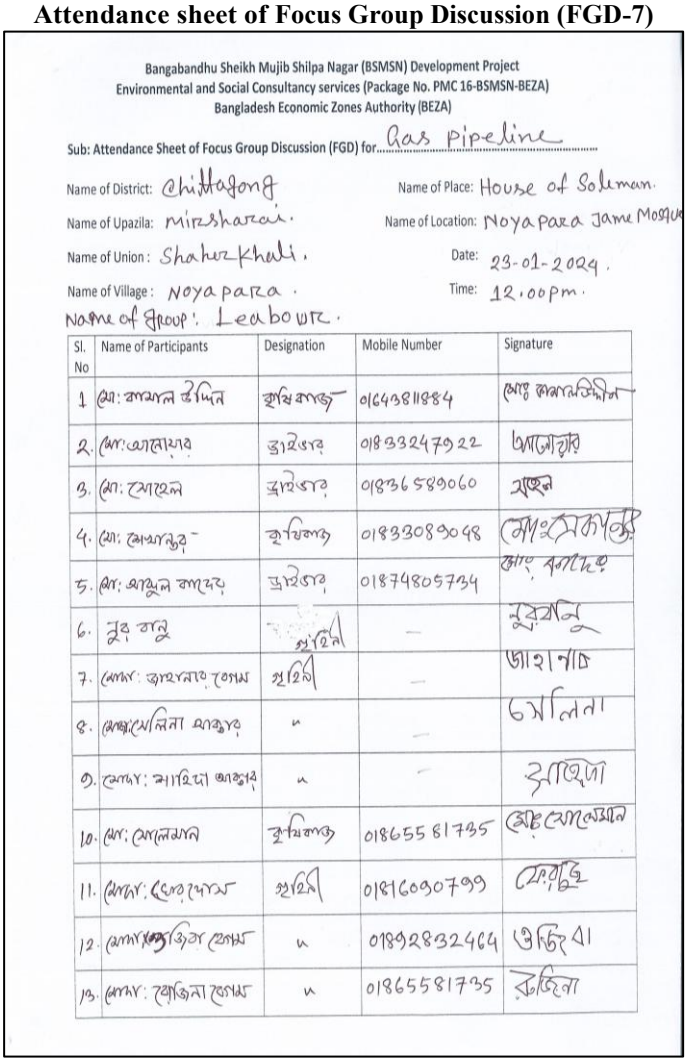
On 23.01.2024, FGD was conducted at the house of Soleman near about Noyapara Zame Mosque, Village: Noyapara, Saherkhali union of Mirsharai Upazila. There was attended a total of thirteen participants which represent only labor force. The FGD discussion minutes and attendance list are as follows

Figure-7: FGD with labor force at Noyapara of Saherkhali 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. Anowar 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)



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong — Name of Place: House of Soleman.
Name of Upazila: Mirzsharai. — Name of Location: Noyapara Jame Mosque
Name of Union: Shahurkhali. — Date: 23-01-2024.
Name of Village: Noyapara. — Time: 12.00pm.
Name of Group: Labourer.

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1	মো: কামাল উদ্দিন	কৃষিকাজ	01643811884	
2	মো: আনোয়ার	ড্রাইভার	01833247922	
3	মো: সোহেল	ড্রাইভার	01836589060	
4	মো: জাহাঙ্গীর	কৃষিকাজ	01833089048	
5	মো: আবুল কাশেম	ড্রাইভার	01874805734	
6	নুর নবী	গৃহিনী	—	
7	বেগম: রোকসানা হোসেন	গৃহিনী	—	
8	বেগম: সেলিনা আক্তার	"		
9	বেগম: শাহিদা আক্তার	"	—	
10	মো: সোলেমান	কৃষিকাজ	01865581735	
11	বেগম: হেনা হোসেন	গৃহিনী	01816090799	
12	বেগম: [illegible]র হোসেন	"	01892832464	
13	বেগম: রোজিনা হোসেন	"	01865581735	

FGD with Fisharmen

Village: Sarkerpara, Union: Maghadia, Upazila: Mirsharai, District: Chattagram
Date: 12.12.2023
Place: House of Shishuram Das

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 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-8)

Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Upazila: Mirsharai
Name of Union: Maghadia
Name of Village: Sarkertola
Name of Place: Shishuram Das House
Name of Location: Inside of Abtorab Bazar
Date: 12.12.2023
Time: 11.00 AM
Name of Group: Fishery group

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	শিশুরাম দাস	চেয়ারম্যান	01838681704	শিশুরাম
২	দিপন দাস	"	01307871233	দিপন দাস
৩	বাদল দাস	"	01818836016	বাদল দাস
৪	গৌর চান	"	01833504744	গৌরাঙ্গ দাস
৫	রতন দাস	"	01811888302	রতন
৬	দিপন দাস	"	01810295891	দিপন
৭	পরিমল দাস	"	01826358002	পরিমল
৮	অর্জুন দাস	"	01852420864	অর্জুন
৯	ফকির চান	"	01824727042	ফকির চান
১০	প্রসাদেস দাস	"	01830406231	প্রসাদ
১১	চিত্তরঞ্জন তলাদার	"	01821177936	চিত্ত

FGD with Fishermen Group

Village: Badiullahpara, Union: Moghadia, Upazila: Mirsharai, District: Chattagram
Date: 25.01.2024
Place: House of Misir Ahmed near about Ahmed Member's house

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)

- 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 Chanel.
- 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
- Md. Nizam Uddin said we want gas connection

Attendance sheet of Focus Group Discussion (FGD-9)

Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy Services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong | Name of Place: House of Misir Ahmed
Name of Upazila: Mirsharai | Name of Location: Beside the Ahmed Member Home.
Name of Union: Moghadia. | Date: 25-01-2024.
Name of Village: Bodiullah Parra | Time: 3.00 pm.
Name of Group: Fisher men.

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1	মো: মিসির আহমদ	কৃষি	01883436956	মিছির
2.	মো: নাইম ইসলাম	কৃষি লেবার	01760610448	Nayem
3	মো: ইলিয়াস	জেলে	01827334429	মো: ইলিয়াছ
4.	মো: করিম	ড্রাইভার	01846861166	করিম
5.	মো: রাজিব হোসেন	কৃষি+দোকান	01643680240	Rajib
6.	মো: মোশারফ	জেলে	01731168305	মোশারফ
7.	মো: আজিজুল হক	কৃষি	01879903703	আজিজুল
8.	মো: নিজাম উদ্দিন	জেলে	01815570027	নিজাম

FGD with Women Group

Village: Badiullahpara, Union: Maghadia, Upazila: Mirsharai, District: Chattagram
Date: 11.12.2023
Place: House of Mafij Shoudagor

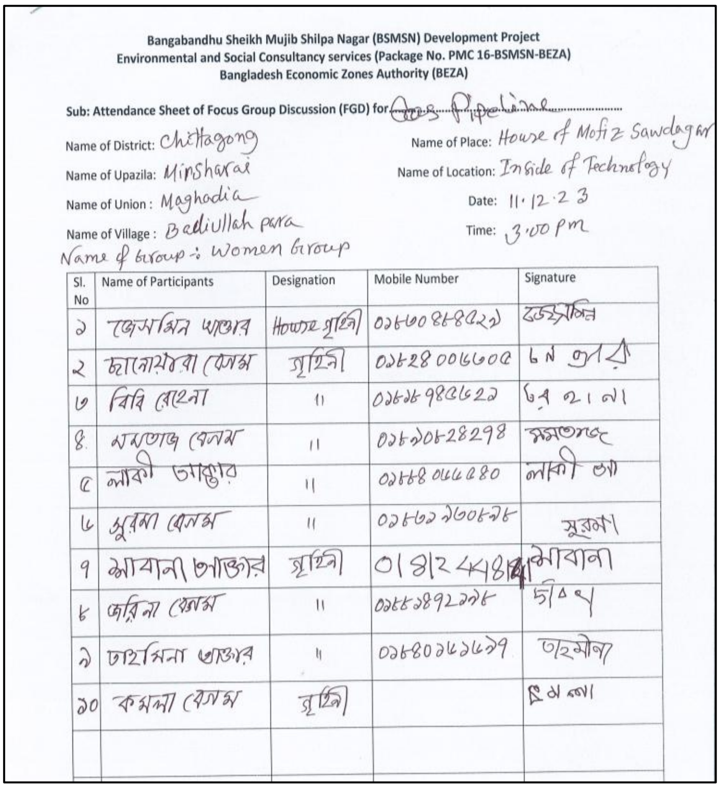
On 11.12.2023, FGD was conducted at the house of Mafij Shoudagor, Bodiullahpara (inside of Technology) Maghadia union of Mirsharai Upazila. There was attended a total of ten participants which represent only women. The FGD discussion minutes and attendance list are as follows

Figure-10: FGD with women group at Bodiullahpara 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)



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Place: House of Mofiz Sawdagar
Name of Upazila: Mirsharai
Name of Location: Inside of Technology
Name of Union: Maghadia
Date: 11.12.23
Name of Village: Badiullah para
Time: 3.00 pm
Name of Group: Women Group

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	জেসমিন আক্তার	House গৃহিনী	০১৮৬০৪৮৪৫২১	জেসমিন
২	আনোয়ারা বেগম	গৃহিনী	০১৮২৪০০৬৬০৫	[illegible]
৩	বিবি রেহেনা	"	০১৮১৮৭৪৫৬২১	[illegible]
৪	মমতাজ বেগম	"	০১৮১০৮২৪২৭৪	মমতাজ
৫	লাকী আক্তার	"	০১৮৮৪০৬৬৫৪০	লাকী আ
৬	সুরমা বেগম	"	০১৮৬১১৬০৮১৮	সুরমা
৭	শাবানা আক্তার	গৃহিনী	[illegible]	শাবানা
৮	জরিনা বেগম	"	০১৮৮১৪৭২১১৮	[illegible]
৯	তাহমিনা আক্তার	"	০১৮৪০১৬১৬৭৭	তাহমীনা
১০	কমলা বেগম	গৃহিনী		[illegible]

FGD with Women Group

Village: Char Sarat, Upazila: Mirsharai, District: Chattagram
Date: 14.02.2024
Place: House of Ekramul Haque

On 14.02.2024, FGD was conducted at the house of Elramul Haque of Charsarat (Gov. Housing) village, Ichhakhali 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 Ichhakhali 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 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-11)

Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong — Name of Place: Charsarat (Govt. Housing)
Name of Upazila: Mirsarai — Name of Location: Ekramul's House.
Name of Union: Ichakhali — Date: 14.02.2024
Name of Village: Charsarat. — Time: 11:00Am
Name of Group: Women.

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1	[illegible]	[illegible]	01872784499	[illegible]
2	[illegible]	[illegible]	01314305459	[illegible]
3	[illegible]	[illegible]	01792184781	[illegible]
4	[illegible]	[illegible]	01792184781	[illegible]
5	[illegible]	[illegible]	01867916639	[illegible]
6	[illegible]	[illegible]		[illegible]
7.	[illegible]	[illegible]		[illegible]
8.	[illegible]	[illegible]	01883855744	[illegible]
9.	[illegible]	[illegible]	01883855744	[illegible]
10.	[illegible]	[illegible]	01872784499	[illegible]

FGD with Women Group

Village: Badiullahpara, Union: Maghadia, Upazila: Mirsharai, District: Chattagram
Date: 13.01.2024
Place: Besides of Eunus Member's house

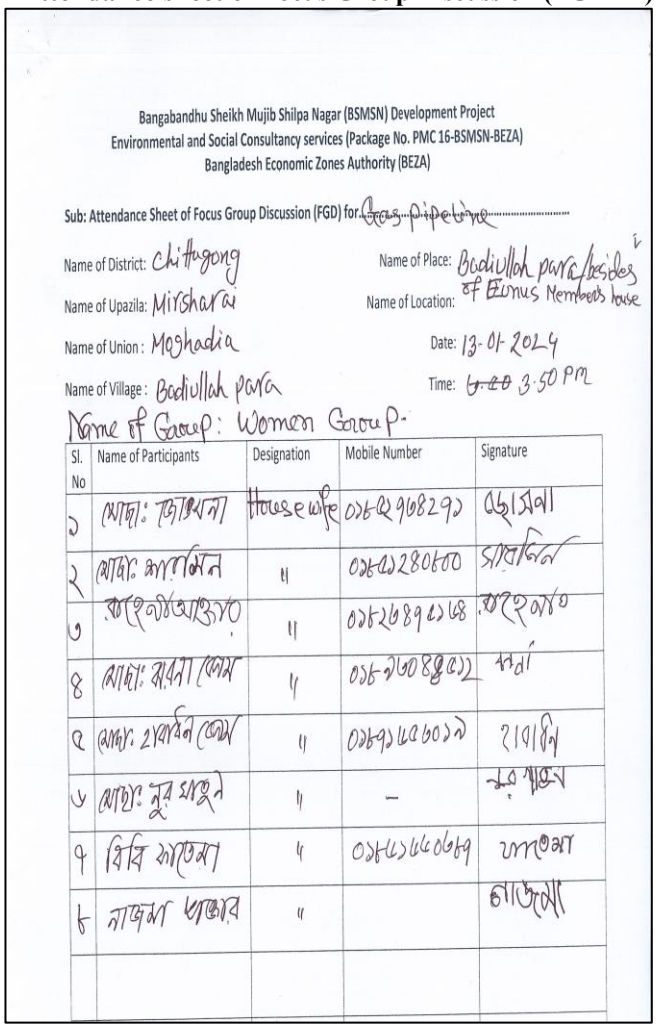
On 13.01.2024, FGD was conducted at besides of Eunus Member's house, Village Badiullahpara, Maghadia union of Mirsharai Upazila. There was attended a total of eight participants which represent only women. The FGD discussion minutes and attendance list are as follows

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 truble. 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 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-12)



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Upazila: Mirsharai
Name of Union: Maghadia
Name of Village: Badiullah para
Name of Place: Badiullah para besides of Eunus Member's house
Name of Location:
Date: 13-01-2024
Time: ~~9.00~~ 3.50 PM
Name of Group: Women Group.

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	মোছা: জোছনা	Housewife	০১৮২৭৬৪২৭১	
২	মোছা: শারমিন	"	০১৮৩২৪০৮০০	
৩	[illegible]	"	০১৮২৬৪৭৫১৬৪	
৪	মোছা: রাবেয়া বেগম	"	০১৮৯৬০৪৪৫১২	
৫	মোছা: রেহানা বেগম	"	০১৮৭১৫৫৩০১৯	
৬	মোছা: নুর খাতুন	"	–	
৭	বিবি ফাতেমা	"	০১৮১৬৫০৮৮৭	
৮	নাজমা আক্তার	"		

FGD with Local Community

Village: Charsarat (IMD Zone), Union: Ichhakhali, Upazila: Mirsharai, District: Chattagram
Date: 14.02.2024
Place: House of Tarek

On 14.02.2024, FGD was conducted at the house of Tarek in IMD Zone Village Charsarat, Ichhakhali 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 Ichhakhali 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)

Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Upazila: Ichakhali
Name of Union: Mirsarai
Name of Village: Charsarat.
Name of Place: Charsarat. (Zone-12.IM
Name of Location: Tareks House.
Date: 14/02/2024.
Time: 03:00 Pm

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1.	বেগম: তাসলিমা	গৃহিণী	01829110561	তাছলিমা
2.	বেগম: মাহমুদা আক্তার	"	01327477385	মাহমুদা
3.	বেগম: নিলুফার ইয়াসমিন	"	01866646267	নিলু ইয়াসমিন
4.	সালেহা খাতুন	"	01990426035	সালেহা খাতুন
5.	বেগম: রোকসানা বেগম	"	01872084067	রোকসানা
6.	মো: তারেক	দিনমুজুর	01327477385	তারেক
7.	মনোয়ারা বেগম	গৃহিণী	01849328529	মনোয়ারা
8.	তাহমিনা খাতুন	"	-	তাহ

FGD with Students (School Girls) Group

Village: Charsarat, Union: Ichhakhali, Upazila: Mirsharai, District: Chattagram
Date: 25.01.2024
Place: Banglabazar Model High School, Charsarat

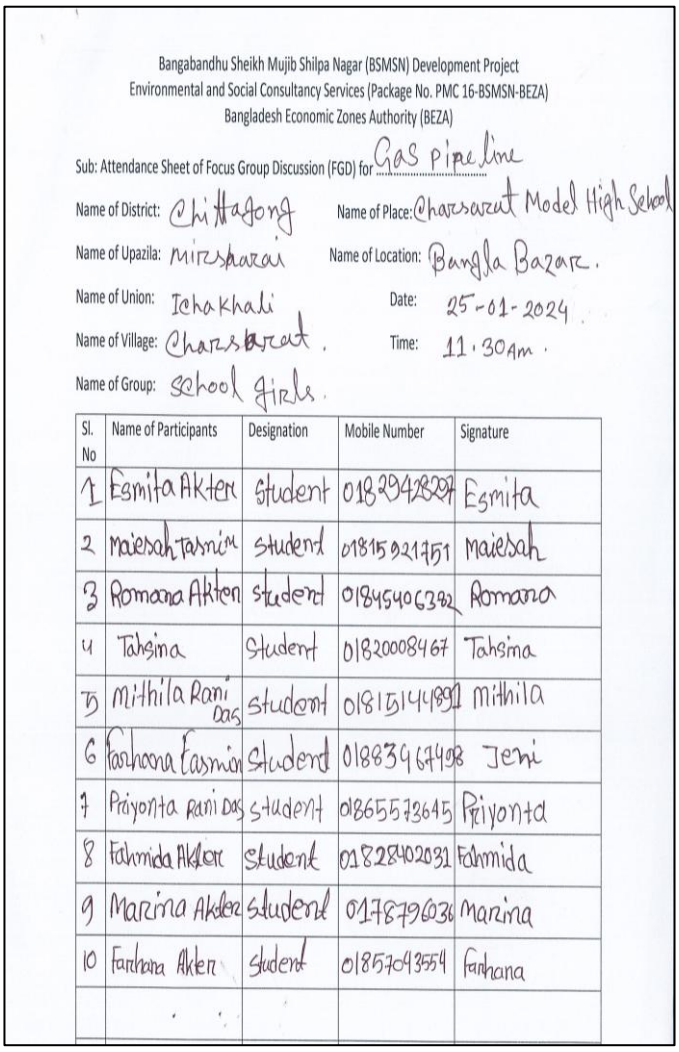
On 25.01.2024, FGD was conducted at Banglabazar Model High School, Village: Charsarat, Ichhakhali union of Mirsharai Upazila. There was attended a total of ten participants which represent only students. The FGD discussion minutes and attendance list are as follows

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

Summary of Focus Group Discussion (FGD-14

Attendance sheet 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.



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy Services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong Name of Place: Charsarat Model High School

Name of Upazila: Mirsharai Name of Location: Bangla Bazar.

Name of Union: Ichakhali Date: 25-01-2024

Name of Village: Charsarat. Time: 11.30Am.

Name of Group: School girls.

Sl. No	Name of Participants	Designation	Mobile Number	Signature
1	Esmita Akter	Student	01829428297	Esmita
2	Maiesah Tasnim	Student	01815921751	Maiesah
3	Romana Akter	Student	01845406382	Romana
4	Tahsina	Student	01820008467	Tahsina
5	Mithila Rani Das	Student	01815144891	Mithila
6	Farhana Easmin	Student	01883467498	Jeni
7	Priyonta Rani Das	student	01865573645	Priyonta
8	Fahmida Akter	Student	01828402031	Fahmida
9	Marina Akter	Student	01787960	Marina
10	Farhana Akter	student	01857043554	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

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 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-15)

Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

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

Name of District: Chittagong
Name of Place: Badiullah para Govt. Primary school
Name of Upazila: Mirsharai
Name of Location:
Name of Union: Moghadia
Date: 13-01-2024
Name of Village: Badiullah para
Time: 3.00 pm
Name of Group: Student Group

Sl. No	Name of Participants	Designation	Mobile Number	Signature
১	মো: ফারভেজ	ছাত্র	01791521825	Farvez
২	তারেক হোসেন	"	01624932860	[illegible]
৩	মো: সজিব	"	01994036139	Sojib
৪	মো: এমরান হোসেন	"	01816071749	Amran
৫	মেহেদী হাসান	"	[illegible]	Meheidi
৬	মো: আলফাজ	"	[illegible]	Afaz
৭	মো: আরমান হোসেন	ছাত্র	[illegible]	[illegible]

C. PUBLIC CONSULTATION MEETINGS

PCM - 01

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 **Table 2:**

Table 2: Topics summary of the Consultation Meeting

Sl. No	Name, designation and mobile number	Topics and discussions
1	Md. Jahangir Hossin Chairman, Moghadia 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, BEZA has made a list of victims. • BEZA 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	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 impacted due to urbanization. Mr. Arif Ullah Chowdhury suggested to develop reforestration program. • 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. • In terms of employment, he suggested setting quotas for the people of the area.
4	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 upazilas. The upazilas 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 vegetables can be grown there. • In this regard, cooperation will be given to the affected areas due to the economic zone by BEZA authority.
5	Nasim Al Mahmud Upazila Senior upazila Fisheries Officer, Mirsharai, Chattogram Mobile-01723834974	Mr. Nasim Al Mahmud said • The fisheries sector is and will be temporariliy affected due to dredging. As a result of dredging, fish are not available in the dredging area like before during land filling activities. And fishes have moved far away from the dredging area. • 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 fishing in the sea are not interested in alternative work

		• Those who fishing in the Sandwip Channel are poor and helpless, so they should be compensated and try to create alternate livelihood.
6	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 • Proper initiatives should be taken to ensure that the garbage does not fall into the sea.
7	Sanjib Barua Social Counsilor, BEZA Mobile-01819884061	Mr. Sanjib Barua said • Land development activities will create employment for the local people • Increasing people due to implementation of the project boost the local economy
8	Mahfuja Khatun Social Counsilor, 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”
9	Joynal Abedin Local Elite Mobile-01818949731	BEZA authorities said that there will be a university here. We are requested to implement this.
10	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 both positively and negatively. • The size of the land has been reduced due to the acquisition of land in the Economic Zone • 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 unsatisfied. • 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 • The homeless of this area should be rehabilitated in this area • Priority should be given to the local people in case eployment based on their qualification. • Given priority and encourage to the local woman for the employment.

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

Pictures of Public Consultation Meeting

Chairman of Moghadia Union Parishad present in the public consultaiton

Senior Upazila Fisheries Officer makes his Openion

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

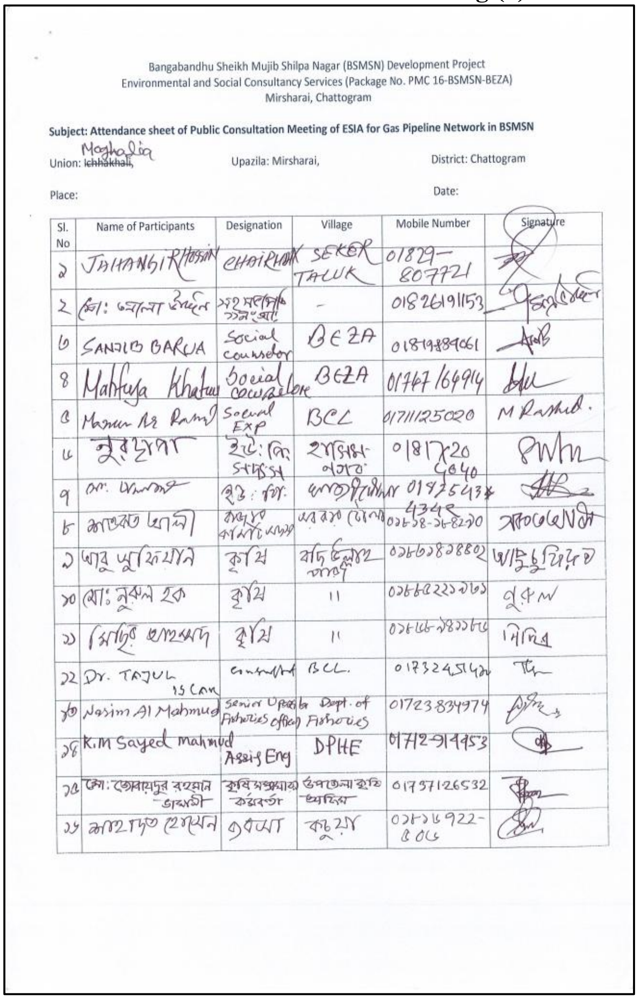
Social Expert Mamun Ar Rashid is discussing in the public consultation

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

Figure 16: Photographs of the consultation meeting

Attendance sheet of Consultation Meeting (1):



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy Services (Package No. PMC 16-BSMSN-BEZA)
Mirsharai, Chattogram

Subject: Attendance sheet of Public Consultation Meeting of ESIA for Gas Pipeline Network in BSMSN

Union: ~~Ichhakhali~~ Maghadia   Upazila: Mirsharai,   District: Chattogram

Place: Date:

Sl. No	Name of Participants	Designation	Village	Mobile Number	Signature
১	JAHANGIR HOSSAIN	CHAIRMAN	SEKER TALUK	01819-807721	
২	[illegible]	[illegible]	-	01826191153	
৩	SANJIB BARUA	Social counselor	BEZA	01819484061	
৪	Mahfuza Khatun	Social counselor	BEZA	01767164914	
৫	Mamun Ar Rashid	Social Exp	BCL	01711125020	
৬	[illegible]	[illegible]	[illegible]	01817204040	
৭	[illegible]	[illegible]	[illegible]	[illegible]	
৮	[illegible]	[illegible]	[illegible]	[illegible]	
৯	[illegible]	কৃষি	[illegible]	[illegible]	
১০	[illegible]	কৃষি	"	[illegible]	
১১	[illegible]	কৃষি	"	[illegible]	
12	Dr. TAJUL ISLAM	Consultant	BCL	0173245145	
১৩	Nasim Al Mahmud	Senior Upazila Fisheries officer	Dept. of Fisheries	01723834974	
১৪	K.M Sayed Mahmud	Ass't Eng	DPHE	01712914453	
১৫	[illegible]	[illegible]	[illegible]	01757126532	
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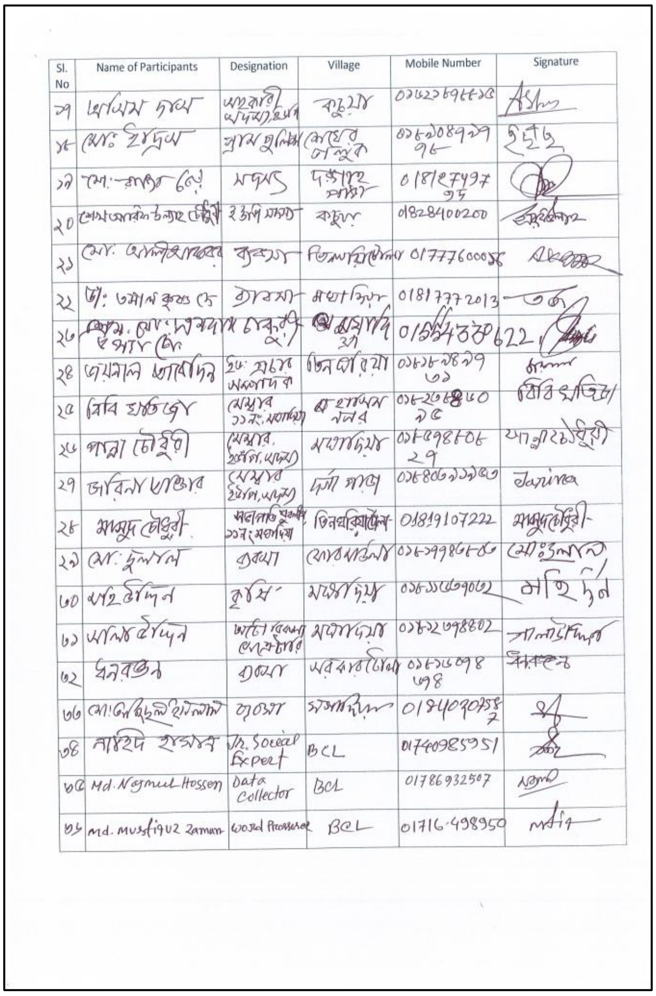

Sl. No	Name of Participants	Designation	Village	Mobile Number	Signature
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২০	[illegible]	[illegible]	[illegible]	01828400200	
২১	[illegible]	[illegible]	[illegible]	01777600058	
২২	[illegible]	[illegible]	[illegible]	01817772013	
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২৬	[illegible]	[illegible]	[illegible]	[illegible]	
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২৮	[illegible]	[illegible]	[illegible]	01819107222	
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৩০	[illegible]	কৃষি	[illegible]	[illegible]	
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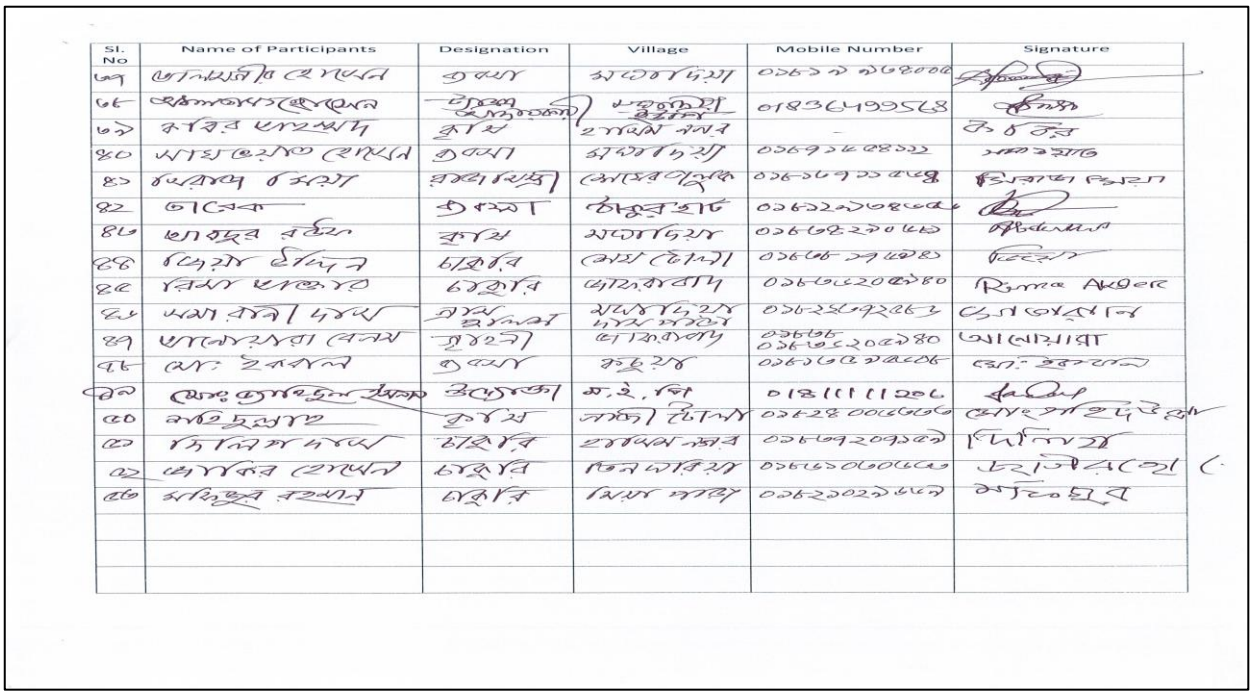
৩২	[illegible]	[illegible]	[illegible]	[illegible]	
৩৩	[illegible]	[illegible]	[illegible]	[illegible]	
৩৪	[illegible]	Jr. Social Expert	BCL	01740985951	
৩৫	Md. Nazmul Hossen	Data Collector	BCL	01786932507	
৩৬	Md. Mustafizur Zaman	[illegible]	BCL	01716-498950	



Sl. No	Name of Participants	Designation	Village	Mobile Number	Signature
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PCM - 2

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

On 12/02/24 Ichhakhali 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 and social impact assessment of International Master Developer (IMD) Zone under 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 are described below: **Table 3:**

Table 3: Topics summary of the consultation meeting for IMD Zone

Sl. No	Name, designation and mobile number	Topics and discussions
1	Md. Nurul Mostofa Chairman, Ichhakhali 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	• 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 • Bamonsundor 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 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 • Finaly 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. • Bamonsundor 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 • 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 stablished in coastal areas of three upazilas. The upazilas 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 Counsilor, 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 suport
7	Md. Nurul Mostofa Chairman, Ichhakhali UP, Mirsharai, Chattagram Mobile No-001819099699	Mr. Jahangir Hossin said- • Due to the economic zone, especially the residents of Charsarat village under Ichhakhali 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. • Bamansunder 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

Pictures of Public Consultation Meetings:

	
Chairman of Moghadia Union Parishad is speaking	UP Member is speaking

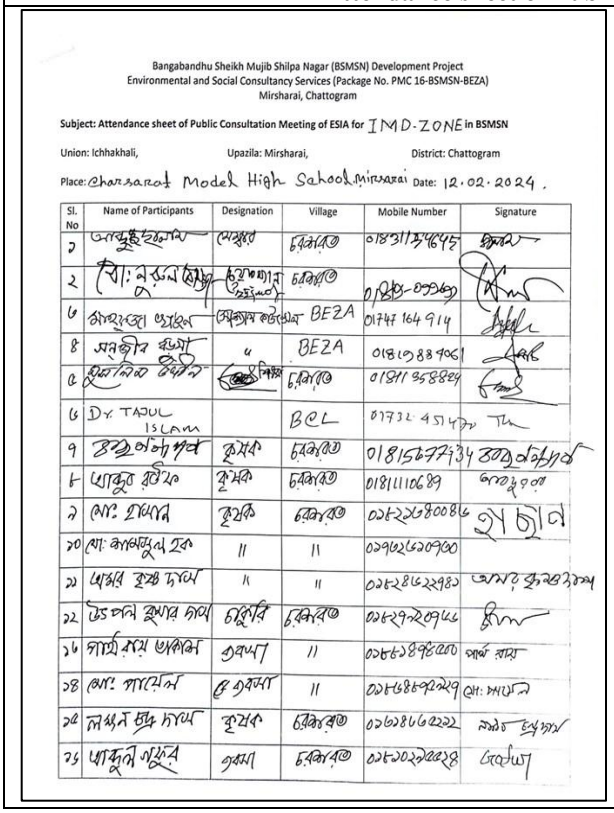
Social Councillor at NSEZ is speaking

Social Elite is speaking

Social Expert Mamun Ar Rashid is speaking in the question

Ecologist Dr. Tajul Islam in the question and answer session

Attendance sheet of Public Consultation Meeting (2):



Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project
Environmental and Social Consultancy Services (Package No. PMC 16-BSMSN-BEZA)
Mirsharai, Chattogram

Subject: Attendance sheet of Public Consultation Meeting of ESIA for IMD-ZONE in BSMSN

Union: Ichhakhali, Upazila: Mirsharai, District: Chattogram

Place: Charsarat Model High School, Mirsarai Date: 12.02.2024.

Sl. No	Name of Participants	Designation	Village	Mobile Number	Signature
১	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
২	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৩	[illegible]	[illegible]	BEZA	01747 164 914	[illegible]
৪	[illegible]	"	BEZA	018[illegible]	[illegible]
৫	[illegible]	[illegible]	[illegible]	01841 [illegible]	[illegible]
৬	Dr. TAJUL ISLAM		BCL	01732 [illegible]	[illegible]
৭	[illegible]	কৃষক	চরসারাত	018[illegible]	[illegible]
৮	[illegible]	কৃষক	চরসারাত	01811[illegible]	[illegible]
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১৩	[illegible]	গৃহিণী	"	[illegible]	[illegible]
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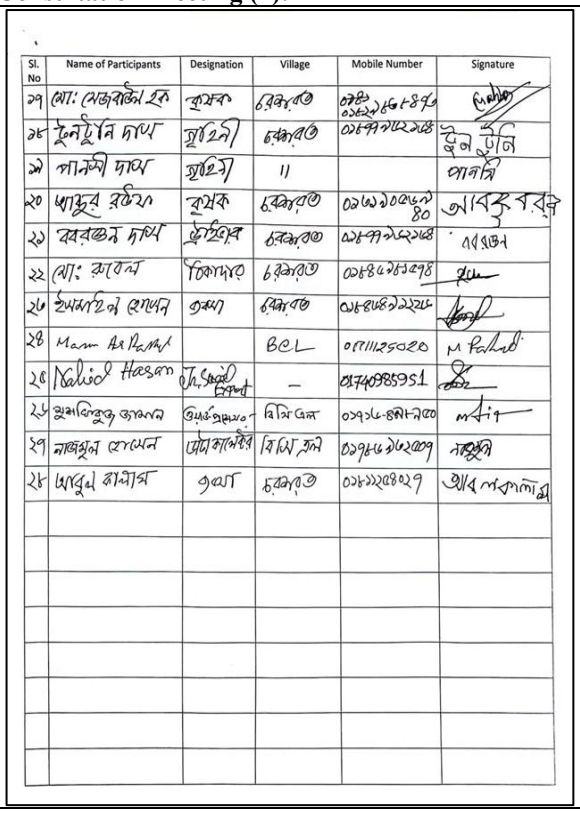

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২০	[illegible]	কৃষক	চরসারাত	[illegible]	[illegible]
২১	[illegible]	ছাত্রছাত্রী	চরসারাত	[illegible]	[illegible]
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২৩	[illegible]	গৃহিণী	চরসারাত	[illegible]	[illegible]
২৪	Mam Ariful		BCL	01711125020	[illegible]
২৫	Nalid Hasan	[illegible]	–	01740985951	[illegible]
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২৮	[illegible]	গৃহিণী	চরসারাত	[illegible]	[illegible]

Roles, Responsibilities and Resources for Stakeholder Engagement

Resources

The management, coordination and implementation of the SEP and its integral tasks will be the responsibility of dedicated team members within BEZA PIU, its regional offices and local sub-contractors. The project will ensure necessary logistics and budget to implement the SEP as per above mentioned discussion. The contact information of BEZA is given on the right.

Description	Contact details
Company:	Bangladesh Economic Zones Authority
To:	Manager (Admin)
Address:	Biniyog Bhaban 9th Floor Sher E Bangla Nagar, Dhaka-1207, Bangladesh
E-mail:	manager.admin@beza.gov.bd
Website:	www.beza.gov.bd
Telephone	02-9632467

Management functions and responsibilities

The stakeholder engagement activities will be incorporated into the project management system with the formation of PIU where one social development specialist (National), Social Development Officer (Field level), Design and Supervision consultancy firm will assist in implementing the day-to-day activities.

The roles and responsibilities of the organization are presented below:

The Project Implementation Unit (PIU) will be responsible for the preparation and physical implementation of the project. This unit will be under the oversight of the Project Director and GM (Planning and Development) of BEZA, comprising the following staff: Project Director, GM (Planning and Development), Procurement Officer, Social Development Specialist and an Environmental Specialist.

The Social Councilor who is part of the PIU be responsible for managing all social development aspects of the BEZA. The Social Specialist will oversee all planned stakeholder engagement activities and those in the process of being implemented. Responsibilities of the Social Specialist include the following:

- Develop, implement, and monitor all stakeholder engagement strategies/plans for the Project/ESIA;
- Oversee all stakeholder engagement-related activities for the Project;
- Manage the grievance mechanism;
- Interact with related and complementary support activities that require *ad hoc* or intensive stakeholder engagement (community development and land acquisition/resettlement planning and implementation);

- Liaise with the project directors/BEZA to ensure that stakeholder engagement requirements/protocols are understood; and
- Proactively identify stakeholders, project risks and opportunities and inform the PM / senior management to ensure that the necessary planning can be done to either mitigate risk or exploitopportunities.

The Social Development Officer (Field) who is part of the PIU be responsible to manage all socialdevelopment aspects of the BEZA. The Social Officer will oversee all planned stakeholder engagement activities or in process of being implemented in the field. He/she will be responsibleto assist the Social Specialist (National)

Design and Supervision Consultant shall be recruited to provide institutional capacity and support to the Project Implementation Unit (PIU) with: (a) overall project management and supervision including procurement, design, and contract management; and (b) oversee the overall implementation, monitoring, and reporting of safeguards aspects such ESMPs, LMP, SEP and RAPs. After familiarizing themselves with the project area through reading and consultations with the BEZAProject Unit, the consultants will design appropriate questionnaires intended for data collection at project location levels. The consultations will be on-going and an integral part of the project as set out in this SEP.

In order to advance the Project, the PIU will work collaboratively with some of government departments and stakeholders such as (i) RHD, (ii) KGDCL, (iii) Power division, (iv) BEZA (Admin & Finance), (v) PGCB, (vi) CPA and relevant organization who is working in the city. The roles and responsibilities, their interest and potential influence, and the internal coordination and communication arrangements are summarized below.

Sample Grievance Registration Form

Grievance Form: Bangladesh Economic Zones Authority			
Grievance reference number (to be completed by Project):			
Contact details (may be submitted anonymously)	Name (s):		
	Address:		
	Telephone:		
	Email:		
How would you prefer to be contacted (check one)	By mail/post: ☐	By phone: ☐	By email ☐
Preferred language	☐ Bangla	☐ English	
Provide details of your grievance. Please describe the problem, who it happened to, when and where it happened, how many times, etc. Describe in as much detail as possible.			
What is your suggested resolution for the grievance, if you have one? Is there something you would like BEZA or another party/person to do to solve the problem?			
How have you submitted this form to the project?	Website ☐	Email ☐	By hand ☐
	In person ☐	By telephone ☐	Other (specify) ☐
Who filled out this form (If not the person named above)?	Name and contact details:		
Signature			
Name of BEZA official assigned responsibility			
Resolved or referred to GRC1?	☐ Resolved	☐ Referred	If referred, date:
Resolved referred to GRC2?	☐ Resolved	☐ Referred	If referred, date:
Completion			
Final resolution (briefly describe)			
	Short description	Accepted? (Y/N)	Acknowledgement signature
1st proposed solution			
2nd proposed solution			
3rd proposed solution			

APPENDIX-10: 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, ruse 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 gas emission	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, flumes, 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 laoburs.
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 pumped from the collection tank once a day and should be brought to the common septic tank for further treatment.

Activity	Impacts	Mitigation Measures/ Management Guidelines
		• 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. • Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.

Activity	Impacts	Mitigation Measures/ Management Guidelines
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 in-organic waste collecte 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 wastge disposal site through approved verndor. • 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. Ther 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. • 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		

Activity	Impacts	Mitigation Measures/ Management 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 dieses, 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		
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.

Activity	Impacts	Mitigation Measures/ Management Guidelines
		• 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.

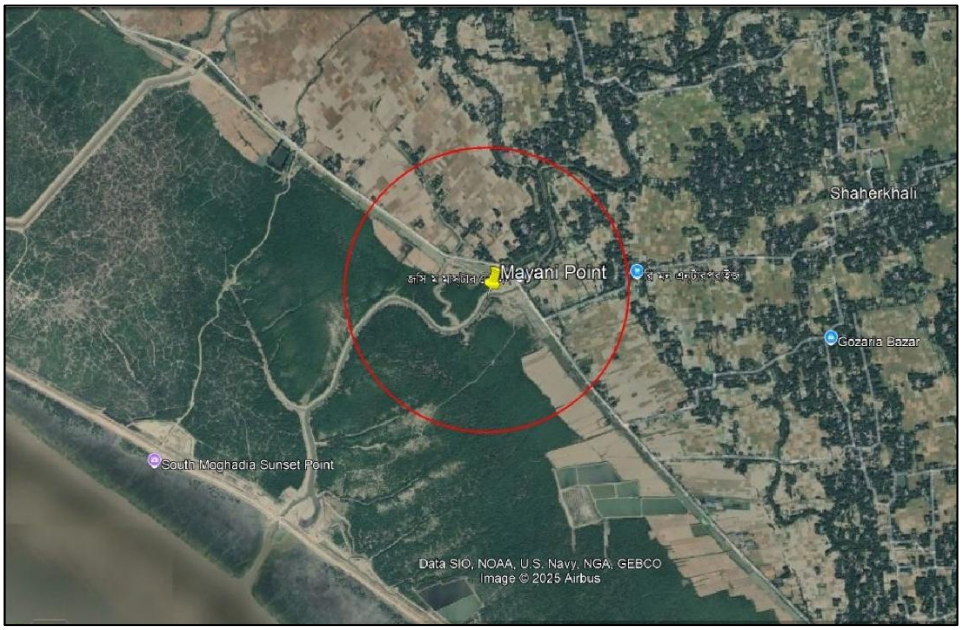
APPENDIX-11: SUPPLEMENTARY STUDY ON PRESENT STATUS OF THE HILSA FISH BREEDING GROUND AT MAYANI POINT AREA IN MIRSHARAI

1. INTRODUCTION

A supplementary study was carried out to confirm whether the Mayani Point area located at the Shaerkhali canal in Mirsharai, is a potential Hilsa breeding ground or not. Mayani Point was recognized as a Hilsha spawning and breeding ground by the GoB gazettes in 2014. Whereas in the preliminary study, it was observed that no presence of the Hilsha breeding ground at the Mayani point of the Shaerkhali canal.

2. LOCATION

The Mayani Point area is situated in the Shaerkhali canal, within the Shaerkhali and Mayani Unions under Mirsharai Upazila of Chattogram District. This canal is connected with the Sandwip Channel, and the Mayani point is located at about four (3) km away from the channel. There are two fishermen clusters near Mayani Point at Joynagar and Mirza Nagar villages.



Map- Mayani Point area in Shaerkhali Canal Under Mirsharai Upazila.

3. STUDY METHODOLOGY

The assessment was carried out through the following steps

- Visits alongside the canal from the start of the canal from the channel to Myanai point.
- Consultations: Interviews were conducted with local people and community members. The consultants facilitated a Focus Group Discussion (FGD) with local fishermen and conducted six Key Informant Interviews (KIIs), including current and former Upazila Fisheries Officers, and an officer from the Bangladesh Fisheries Research Institute (BFRI).
- Visual Google imager

4. SITE OBSERVATION

Observations were carried out during the site visit of the Mayani point, in Mirsharai Upazila in Chittagong District on 13-14 July, 2025. Mayani Point was officially recognized as a Hilsha spawning and breeding ground by gazettes in 2014. Recent visits indicate no Hilsha fish observations within the Shaerkhali canal, which connects to Mayani point. The primary reasons identified are the severe siltation at the Mayani point area of the canal and the presence of sluice gates. These sluice gates, located on the super dyke and at the end of the Shaerkhali canal, impede the natural flow of water from the Sandwip channel. This restriction, in turn, limits Hilsha migrations from the Sandwip channel into the canal during high and low tides.

Photographs on Existing Status of Mayani Point Area






5. CONSULTATION WITH RELEVANT OFFICERS AND LOCAL PEOPLE

Local fishermen have confirmed that the area is silted and that Hilsa breeding no longer occurs there. A former Hilsa fish landing center in the area has been inactive for the past three years due to these issues. Local residents also reported not observing Hilsa in the Shaerkhali canal, including Mayani Point, for over a decade. According to local people, Hilsa is now typically found in the deeper parts of the Sandwip channel, though their abundance there is also reportedly impacted, affecting local fishermen and markets. Some fishermen attribute the decline in Hilsha fish due to catches in the Sandwip channel by khaski nets entire whole the year.

Summary of Focus Group Discussion (FGD)

The FGD was held on July 13, 2025, with 15 participants at a tea stall near the Shaerkhali Old Sluicegate Area in South Maghadia, Shaerkhali, Mirsharai (near Mayani Point). The GPS location was 22.705355° N, 91.541429° E.

Key points from the FGD include:

- The distance from Mayani Point to the Sandwip Channel through Shaerkhali canal is approximately four kilometres.
- Currently, no Hilsha fish have been observed in the Shaerkhali canal, including Mayani Point.
- The Mayani Point area is partially silted
- The establishment of sluice gates on the Super dyke and at the end of the Shaerkhali canal obstructs the movement of fish in the Shaerkhali canal during high and low tides from the Sandwip channel.
- Furthermore, the depth of the Shaerkhali canal has been reduced due to siltation and a lack of proper maintenance, which hinders the migration of the mother Hilsa fish from the Sandwip channel to Shaerkhali canal.

Place:	Tea Stall at Shaerkhali Old Sluicegate Area
Date:	13/7/2025
Participants:	15 Persons

Summary of the FGD

- Mayani point to the Sandwip Channel through the Shaerkhali canal is around four km
- At present, there have been no Hilsha fish observed in the Shaerkhali canal, including Mayani point
- At present Mayani point area is partially silted so Hilsha breeding is not observed by local people.
- There are two fishermen clusters near the Mayani point at the Joynagar and Mirza Nagar villages, and they are not aware of this breeding ground.
- Due to the establishment of a sluice gate on the Supe dyke and at end point of the Sharekhali canal, the movement of the fishes are obstructed in the Sharekhali canal during high and low tide from the Sandwip channel. Furthermore, the depth of the Sharekhali canal is reduced due to siltation and a lack of proper maintenance of the canal, so the mother Hilsa fish can migrate from the Sandwip channel to the Sharekhali canal

Photographs of FGD

Attendance Sheet of FGD

National Special Economic Zone (NSEZ) Development Project
Environmental and Social Consultancy services (Package No. PMC 16-BSMSN-BEZA)
Bangladesh Economic Zones Authority (BEZA)

Sub: Attendance Sheet of Focus Group Discussion (FGD) for: with Fishermen

Name of District: Chittagong
Name of Upazila: Mirsarai
Name of Union: Shaerkhali
Name of Village: Dakkin Mogadia

Name of Place: Shaerkhali Rtd
Name of Location: Sluice gate
Date: 13/7/25
Time: 12 pm

Sl.No.	Name of Participants	Designation	Mobile Number	Signature
১.	[illegible]	fisherman	01886914668	[signature]
২.	[illegible]	"	"	
৩.	[illegible]	"	01814149251	[signature]
৪.	[illegible]	[illegible]	01575714726	[signature]
৫.	[illegible]	[illegible]	01856202306	[signature]
৬.	[illegible]	[illegible]	01827461118	[signature]
৭.	[illegible]	[illegible]	01820133179	[signature]
৮.	[illegible]	"		
৯.	[illegible]	"	01888242658	[signature]
১০.	[illegible]	"	01871654138	[signature]
১১.	[illegible]	[illegible]	—	[signature]
১২.	[illegible]	"	—	[signature]
১৩.	[illegible]	"	01620137030	[signature]
১৪.	[illegible]	"	01820224504	[signature]
১৫	[illegible]	"	01824839375	[signature]

6. SUMMARY OF THE KEY INFORMANT INTERVIEWS (KIIS)

Senior Upazila Fisheries Officer, Mirsharai, Chattogram

An interview with Md. Arifur Rahman, Senior Upazila Fisheries Officer (SUFO) in Mirsharai for the past six months, was conducted on July 13, 2025, at his office. He stated he was not informed about the presence of a Hilsa breeding ground at Mayani Point, and no specific activities are being conducted to protect it. He also noted that due to the sluice gate on the Super dyke, the proper connection between the Sandwip channel and the Bamansundar, Shaerkhali, and Dumkhali canals is interrupted, resulting in very few fish in these canals.

Former Senior Upazila Fisheries Officer, Mirsharai, Chattogram

Mr. Nasim Al Mahmud, who served as SUFO in Mirsharai Upazila for the last four years, was interviewed via phone on July 13, 2025. He confirmed that during his tenure, he visited the area but did not observe Hilsa in the Shaerkhali canal. According to him, Mayani Point has not been considered a Hilsa breeding ground in recent years, and no initiatives were taken by the Department of Fisheries or the Bangladesh Fisheries Research Institute (BFRI) to protect it.

BFRI Officer

Dr. Amirrul Islam, Senior Scientific Officer at BFRI, was interviewed via phone on July 13, 2025. He stated that without reassessing the area, the breeding and spawning status cannot be confirmed. He also mentioned plans to develop a Development Project Proforma (DPP) for a project to reassess the status of Hilsa breeding and spawning grounds in Bangladesh at the government level.

Local Fishermen and People

Md. Farukh Hossen, a local fisherman, was interviewed on July 13, 2025, at the Shaerkhali Old Sluicegate Area. He reported that the old sluicegate area near Mayani Point, once a fish landing center, has been inactive for the last three years due to the establishment of a new sluice gate on the Super dyke and siltation in the Shaerkhali canal. He also stated he had not observed Hilsa fish in the canal for the last few years.

Md. Hasan Uddin, another local fisherman, interviewed on July 13, 2025, in South Moghadia, Shaerkhali Union, noted a decrease in fisheries resources over the last decade, despite an increase in the number of professional fishermen. He also observed that the bank of the channel was gradually silting.

Md. Nurunnabi, a local businessman, was interviewed on July 13, 2025, in Shaerkhali. He confirmed that the old sluicegate area was once a fish landing center, including for Hilsa that came from the deeper portion of the Sandwip Channel.

It is noted that even local people are not aware of the Mayani point as a Hilsha spawning and Breeding ground. Details of the KII, FGS with photographs given below.

1. KII with Senior Upazila Fisheries Officer (SUFO) Mirsharai, Chattogram

Name: Md. Arifur Rahman Occupation: SUFO Cell No.: 01769459374 Place of interview: Office Date: 13.07.2025	

Md. Arifur Rahman has been working as Senior Upazila Fisheries Officer (SUFO) in Mirsharai for the past 6 months. The summary of the discussion is given below:

- He has not been informed about the presence of the Hilsha fish breeding ground at Mayani
- No activities have been taken for the Mayani point to protect the Hilsha fish breeding ground.
- Due to the Sluice gate on Super dyke, the proper connection with the Sandwip channel to Bamansundar, Shaerkhali, and Dumkhali canal are interrupted, so a very few fish are available in these canals

2. KII with Ex-Senior Upazila Fisheries Officer Mirsharai, Chattogram

Name: Mr. Nasim Al Mahmud
Occupation: SUFO
Cell No.: 01723834974
Place of interview: Over the phone conversation

Date: 13.07.2025

Mr. Nasim Al Mahmud has been SUFO in Mirsharai Upazila since 2021. He has a clear understanding of Mayani's point.

- During his tenure as a SUFO, he visited the area but did not find Hilsha in the Shaerkhali canal
- The Mayani point is not considered a breeding ground of Hilsha over the last few years, and has not taken any initiative from the Department of Fisheries and the Bangladesh Fisheries Research Institute (BFRI) to protect the breeding ground and save the mother Hilsha fish.

3. KII with BFRI's Officer

Name: Dr. Amirrul Islam
Occupation: Senior Scientific Officer
Cell No.: 01716581532
Place of interview: Over the phone conversation

Date: 13.07.2025

- Without reassessing the area, we cannot say the breeding and spawning status of the area.
- We plan to develop a DPP for a project for reassess the status of Hilsha fish breeding and spawning ground in Bangladesh

4. KII with Local Fisherman

Name: Md. Farukh Hossen Occupation: Fisherman Cell No.: 01829688761 Place of interview: Shaerkhali Old Sluicegate Area Date: 13.07.2025	

- Old sluicegate area near Mayani point is presently used as a fish landing center, but due to the establishment of a new sluice gate on the Super dyke and siltation in the Shaerkhali canal the fish landing center has been lying idle for the last three years.
- He did not find Hilsha fish in the canal for the last few years.

5. KII with Local Fisherman

Name: Md. Hasan Uddin Occupation: Fisherman Cell No.: 01836257059 Place of interview: South Moghadia, Shaerkhali Union Date: 13.07.2025	

- Fisheries resources have decreased over the last decade, but the number of professional fishermen are increased
- He also reported that bank of the channel has been silted gradually.

6. KII with Local shop owner

Name: Md. Nurunnabi Occupation: Businessman Cell No.: 01732451471 Place of interview: Shaerkhali Date: 13.07.2025	

- Once old fish landing centre was located at the sluicegate area, and huge Hilsha fish used to come here from deep portion of the Sandwip Channel.

7. CONCLUSION

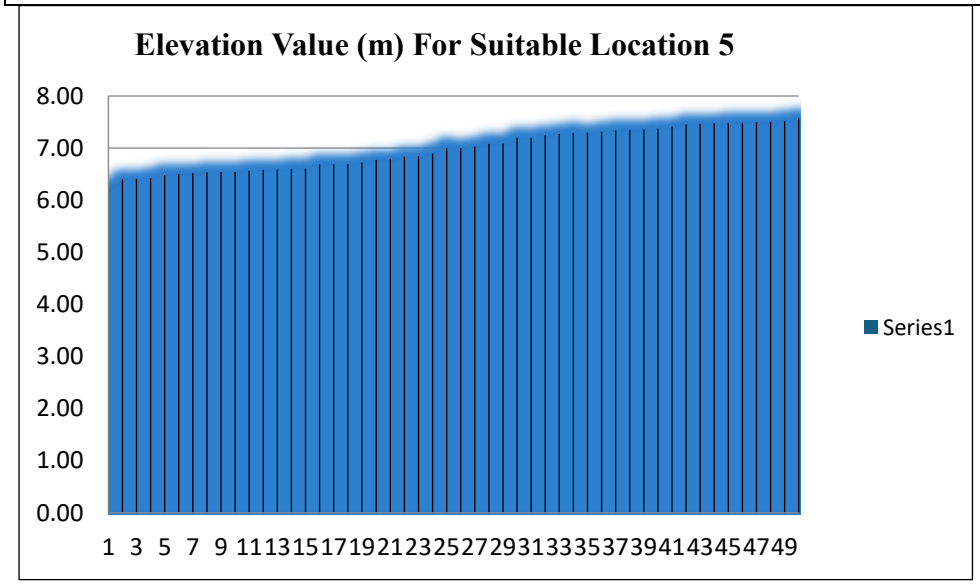
Mayani Point's once known as a Hilsa breeding ground, has been significantly affected by the environmental changes, particularly siltation and the construction of sluice gates, which impede Hilsa migration. There is a clear consensus among the local stakeholders and relevant officials that the Hilsha fish breeding ground has not been present in the area for the last 4-5 years.

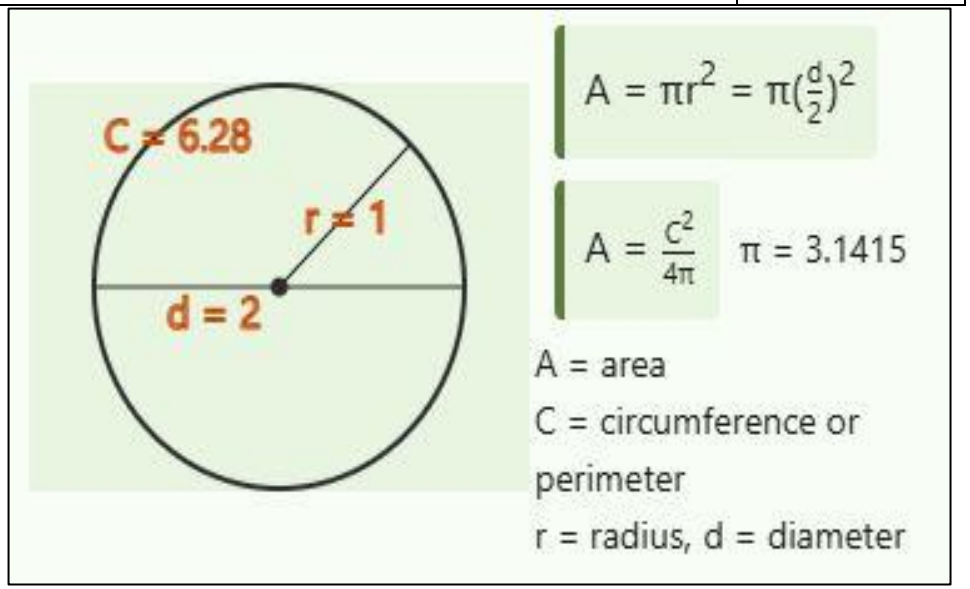
APPENDIX-12: DREDGING/CUTTING VOLUME WITHIN 1KM RADIUS FROM THE SUITABLE LOCATIONS

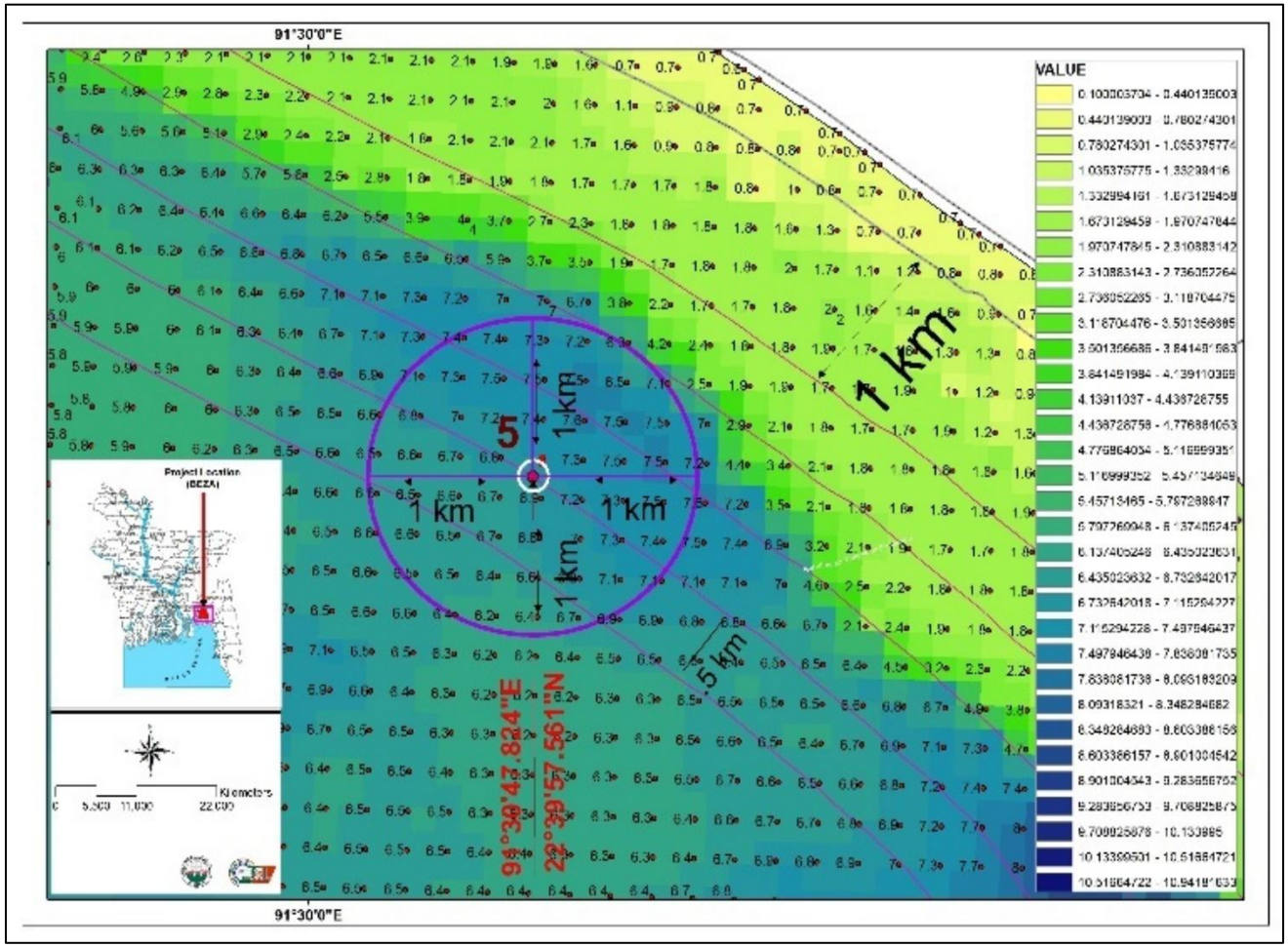
Dredging/cutting volume within 1km radius of Suitable Location 5											
Sl No	**Sl. Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m)h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
71	5	22.6580	91.5111	6.23	6.23	0.00	5	5.00	5.75	3,140,000	18,039,945
84	5	22.6579	91.5135	6.40	6.23	0.17	5	5.17			
102	5	22.6581	91.5086	6.41	6.23	0.18	5	5.18			
34	5	22.6602	91.5111	6.42	6.23	0.19	5	5.19			
48	5	22.6603	91.5087	6.49	6.23	0.26	5	5.26			
63	5	22.6626	91.5088	6.51	6.23	0.28	5	5.28			
27	5	22.6713	91.5188	6.52	6.23	0.29	5	5.29			
78	5	22.6604	91.5063	6.53	6.23	0.30	5	5.30			
39	5	22.6672	91.5041	6.54	6.23	0.31	5	5.31			
79	5	22.6649	91.5064	6.54	6.23	0.31	5	5.31			
30	5	22.6602	91.5136	6.56	6.23	0.33	5	5.33			
98	5	22.6626	91.5064	6.58	6.23	0.35	5	5.35			
26	5	22.6650	91.5040	6.59	6.23	0.36	5	5.36			
152	5	22.6671	91.5065	6.60	6.23	0.37	5	5.37			
74	5	22.6648	91.5089	6.61	6.23	0.38	5	5.38			
54	5	22.6625	91.5112	6.69	6.23	0.46	5	5.46			
132	5	22.6579	91.5159	6.69	6.23	0.46	5	5.46			
112	5	22.6671	91.5089	6.70	6.23	0.47	5	5.47			
116	5	22.6647	91.5113	6.72	6.23	0.49	5	5.49			
44	5	22.6624	91.5136	6.77	6.23	0.54	5	5.54			
104	5	22.6694	91.5066	6.78	6.23	0.55	5	5.55			
138	5	22.6601	91.5160	6.84	6.23	0.61	5	5.61			
67	5	22.6670	91.5114	6.85	6.23	0.62	5	5.62			
11	5	22.6647	91.5137	6.90	6.23	0.67	5	5.67			

Dredging/cutting volume within 1km radius of Suitable Location 5											
Sl No	**Sl. Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m)h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
10	5	22.6693	91.5090	7.00	6.23	0.77	5	5.77			
19	5	22.6624	91.5161	7.00	6.23	0.77	5	5.77			
31	5	22.6669	91.5138	7.03	6.23	0.80	5	5.80			
36	5	22.6600	91.5184	7.08	6.23	0.85	5	5.85			
47	5	22.6716	91.5066	7.09	6.23	0.86	5	5.86			
52	5	22.6692	91.5114	7.19	6.23	0.96	5	5.96			
124	5	22.6646	91.5161	7.20	6.23	0.97	5	5.97			
99	5	22.6736	91.5164	7.25	6.23	1.02	5	6.02			
181	5	22.6669	91.5162	7.27	6.23	1.04	5	6.04			
109	5	22.6623	91.5185	7.29	6.23	1.06	5	6.06			
89	5	22.6716	91.5091	7.30	6.23	1.07	5	6.07			
68	5	22.6645	91.5186	7.32	6.23	1.09	5	6.09			
164	5	22.6737	91.5140	7.34	6.23	1.11	5	6.11			
82	5	22.6622	91.5209	7.35	6.23	1.12	5	6.12			
43	5	22.6692	91.5139	7.35	6.23	1.12	5	6.12			
169	5	22.6738	91.5116	7.38	6.23	1.15	5	6.15			
170	5	22.6738	91.5091	7.41	6.23	1.18	5	6.18			
28	5	22.6668	91.5186	7.45	6.23	1.22	5	6.22			
81	5	22.6715	91.5115	7.47	6.23	1.24	5	6.24			
88	5	22.6645	91.5210	7.48	6.23	1.25	5	6.25			
154	5	22.6714	91.5139	7.48	6.23	1.25	5	6.25			
50	5	22.6690	91.5211	7.48	6.23	1.25	5	6.25			
66	5	22.6714	91.5164	7.50	6.23	1.27	5	6.27			
126	5	22.6690	91.5187	7.51	6.23	1.28	5	6.28			
20	5	22.6667	91.5211	7.52	6.23	1.29	5	6.29			
114	5	22.6691	91.5163	7.57	6.23	1.34	5	6.34			

Dredging/cutting volume within 1km radius of Suitable Location 5											
Sl No	**Sl. Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m)h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
Dredging/cutting volume within 1km radius of Suitable Location 5											**18,039,945**



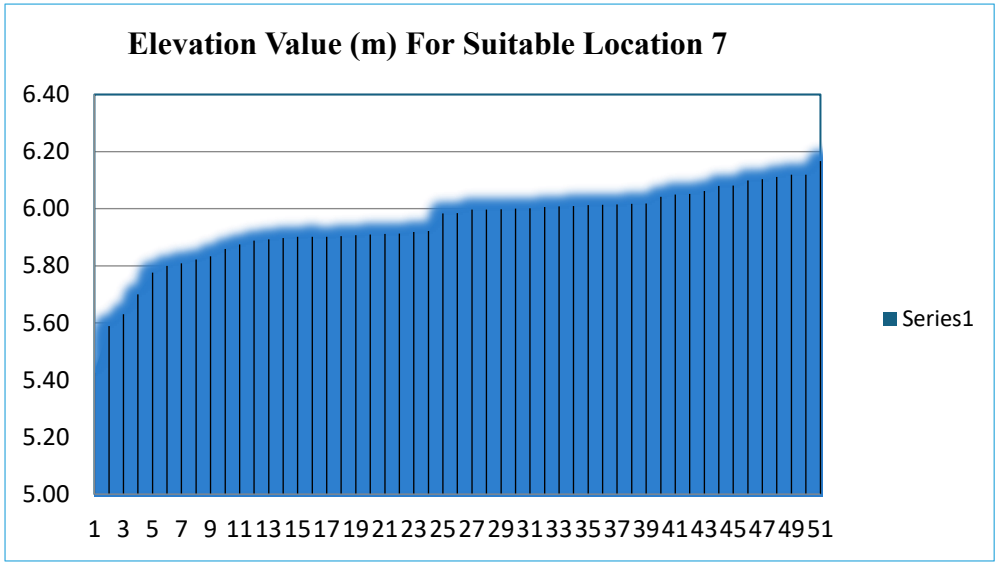


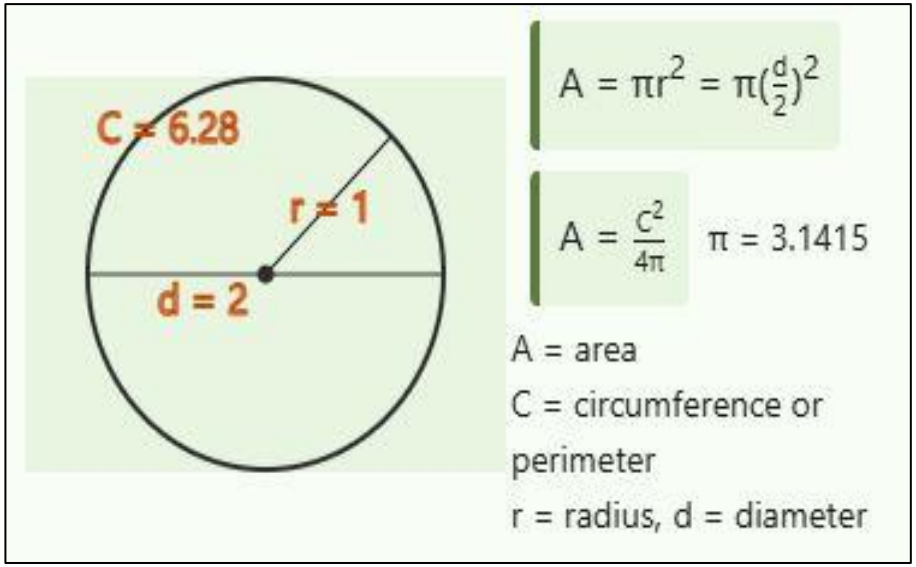

91°30'0"E
VALUE
1 km
1 km
1 km
1 km
5 km
5
Project Location (BEZA)
Kilometers
91°39'47.824"E
21°39'57.561"N
91°30'0"E

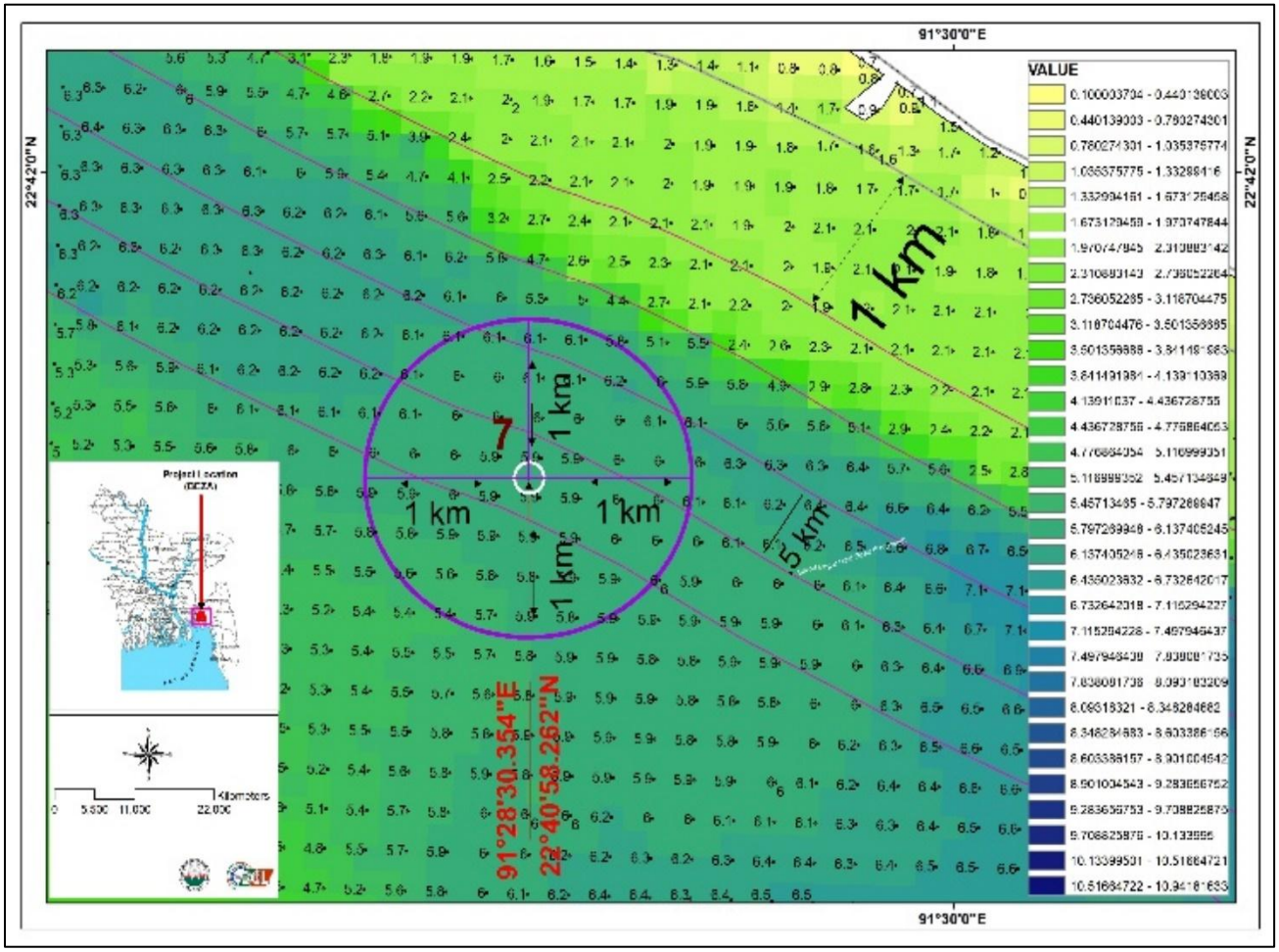
Dredging/cutting volume within 1km radius of Suitable Location 7											
Sl No	**Sl Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m) h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
168	7	22.6749	91.4703	5.43	5.43	0.00	5	5.00	5.51	3,140,000	17,307,073
6	7	22.6772	91.4680	5.59	5.43	0.16	5	5.16			
143	7	22.6772	91.4704	5.63	5.43	0.20	5	5.20			
85	7	22.6748	91.4728	5.70	5.43	0.27	5	5.27			
72	7	22.6795	91.4656	5.78	5.43	0.35	5	5.35			
171	7	22.6771	91.4728	5.80	5.43	0.37	5	5.37			
1	7	22.6747	91.4776	5.81	5.43	0.38	5	5.38			
14	7	22.6795	91.4680	5.82	5.43	0.39	5	5.39			
147	7	22.6770	91.4753	5.83	5.43	0.40	5	5.40			
200	7	22.6794	91.4705	5.86	5.43	0.43	5	5.43			
57	7	22.6748	91.4752	5.87	5.43	0.44	5	5.44			
176	7	22.6793	91.4729	5.89	5.43	0.46	5	5.46			
133	7	22.6770	91.4777	5.89	5.43	0.46	5	5.46			
195	7	22.6818	91.4657	5.90	5.43	0.47	5	5.47			
135	7	22.6816	91.4730	5.90	5.43	0.47	5	5.47			
196	7	22.6793	91.4753	5.90	5.43	0.47	5	5.47			
204	7	22.6815	91.4778	5.90	5.43	0.47	5	5.47			
130	7	22.6815	91.4754	5.90	5.43	0.47	5	5.47			
91	7	22.6769	91.4801	5.91	5.43	0.48	5	5.48			
61	7	22.6792	91.4778	5.91	5.43	0.48	5	5.48			
13	7	22.6837	91.4779	5.91	5.43	0.48	5	5.48			
107	7	22.6817	91.4681	5.91	5.43	0.48	5	5.48			
25	7	22.6838	91.4730	5.92	5.43	0.49	5	5.49			
183	7	22.6838	91.4755	5.92	5.43	0.49	5	5.49			
100	7	22.6860	91.4780	5.98	5.43	0.55	5	5.55			

Dredging/cutting volume within 1km radius of Suitable Location 7											
Sl No	**Sl Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m) h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
9	7	22.6791	91.4802	5.98	5.43	0.55	5	5.55			
187	7	22.6817	91.4705	6.00	5.43	0.57	5	5.57			
142	7	22.6839	91.4706	6.00	5.43	0.57	5	5.57			
186	7	22.6814	91.4803	6.00	5.43	0.57	5	5.57			
49	7	22.6884	91.4708	6.00	5.43	0.57	5	5.57			
129	7	22.6836	91.4803	6.00	5.43	0.57	5	5.57			
153	7	22.6861	91.4731	6.01	5.43	0.58	5	5.58			
55	7	22.6840	91.4682	6.01	5.43	0.58	5	5.58			
60	7	22.6791	91.4826	6.01	5.43	0.58	5	5.58			
191	7	22.6884	91.4732	6.01	5.43	0.58	5	5.58			
141	7	22.6841	91.4658	6.01	5.43	0.58	5	5.58			
115	7	22.6813	91.4827	6.01	5.43	0.58	5	5.58			
90	7	22.6862	91.4707	6.02	5.43	0.59	5	5.59			
163	7	22.6860	91.4755	6.02	5.43	0.59	5	5.59			
179	7	22.6836	91.4828	6.04	5.43	0.61	5	5.61			
201	7	22.6859	91.4804	6.05	5.43	0.62	5	5.62			
87	7	22.6905	91.4781	6.05	5.43	0.62	5	5.62			
41	7	22.6862	91.4683	6.06	5.43	0.63	5	5.63			
117	7	22.6885	91.4683	6.08	5.43	0.65	5	5.65			
101	7	22.6883	91.4756	6.08	5.43	0.65	5	5.65			
157	7	22.6882	91.4780	6.10	5.43	0.67	5	5.67			
73	7	22.6858	91.4828	6.10	5.43	0.67	5	5.67			
161	7	22.6907	91.4708	6.11	5.43	0.68	5	5.68			
32	7	22.6906	91.4733	6.12	5.43	0.69	5	5.69			
127	7	22.6905	91.4757	6.12	5.43	0.69	5	5.69			
58	7	22.6881	91.4805	6.17	5.43	0.74	5	5.74			

Dredging/cutting volume within 1km radius of Suitable Location 7											
Sl No	**Sl Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m) h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
Dredging/cutting volume within 1km radius of Suitable Location 7											**17,307,073**



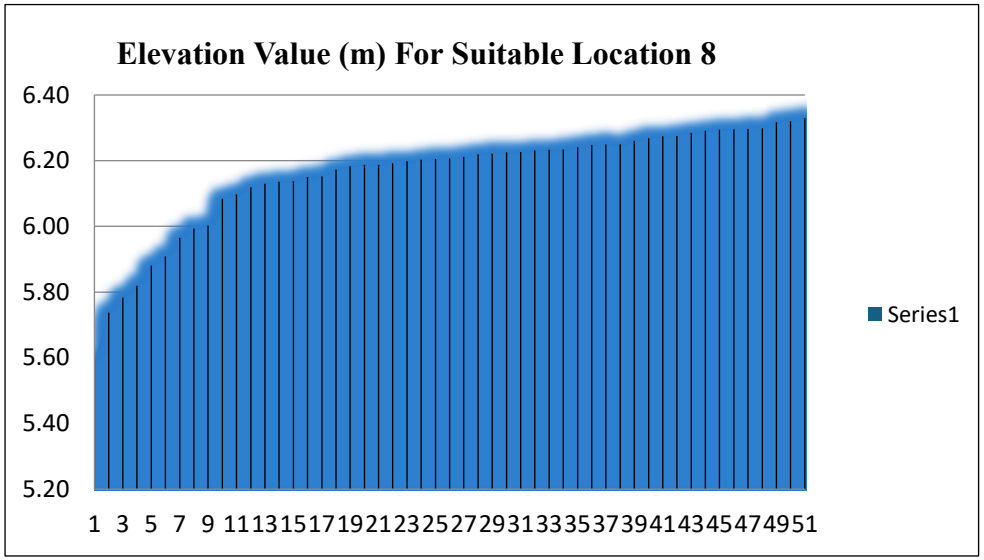


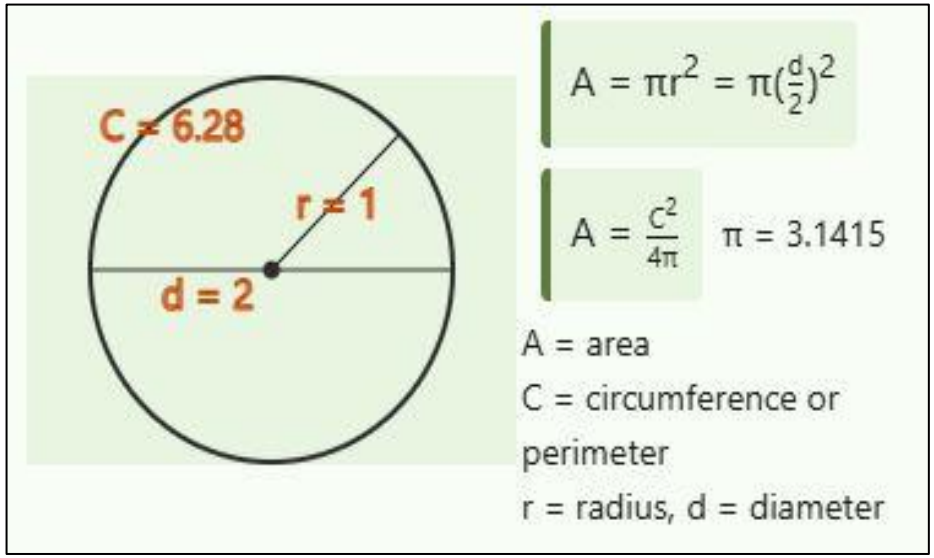

91°30'0"E
22°42'0"N
VALUE
1 km
1 km
1 km
1 km
5 km
91°28'30.354"E
22°40'58.262"N
Project Location (BEZA)
Kilometers
0
5.500
11.000
22.000

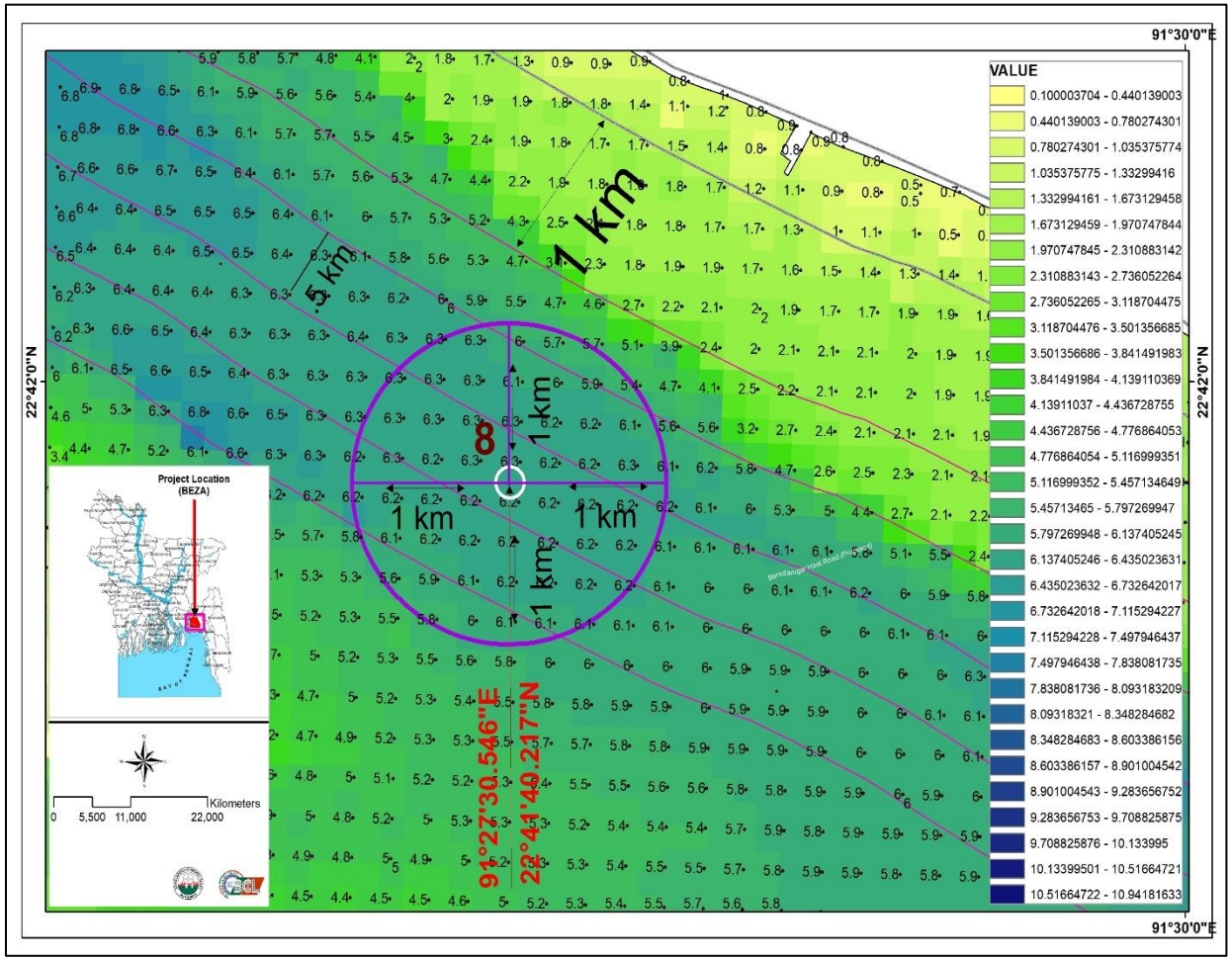
Dredging/cutting volume within 1km radius of Suitable Location 8											
Sl No	**Sl Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m) h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
192	8	22.6890	91.4514	5.59	5.59	0.00	5	5.00			
144	8	22.7022	91.4615	5.74	5.59	0.15	5	5.15			
173	8	22.6866	91.4537	5.78	5.59	0.19	5	5.19			
70	8	22.6913	91.4490	5.82	5.59	0.23	5	5.23			
56	8	22.6999	91.4639	5.88	5.59	0.29	5	5.29			
184	8	22.6889	91.4538	5.91	5.59	0.32	5	5.32			
199	8	22.6866	91.4561	5.97	5.59	0.38	5	5.38			
197	8	22.6999	91.4614	5.99	5.59	0.40	5	5.40			
53	8	22.7023	91.4591	6.00	5.59	0.41	5	5.41			
121	8	22.6888	91.4562	6.08	5.59	0.49	5	5.49			
137	8	22.6865	91.4586	6.10	5.59	0.51	5	5.51			
177	8	22.6912	91.4514	6.12	5.59	0.53	5	5.53			
188	8	22.7000	91.4590	6.13	5.59	0.54	5	5.54	5.57	3,140,000	17,481,254
97	8	22.6976	91.4662	6.14	5.59	0.55	5	5.55			
108	8	22.6864	91.4610	6.14	5.59	0.55	5	5.55			
145	8	22.6958	91.4491	6.15	5.59	0.56	5	5.56			
111	8	22.6911	91.4539	6.15	5.59	0.56	5	5.56			
119	8	22.6935	91.4491	6.17	5.59	0.58	5	5.58			
42	8	22.6888	91.4586	6.18	5.59	0.59	5	5.59			
40	8	22.6911	91.4563	6.19	5.59	0.60	5	5.60			
59	8	22.6887	91.4611	6.19	5.59	0.60	5	5.60			
5	8	22.6908	91.4660	6.19	5.59	0.60	5	5.60			
155	8	22.6886	91.4635	6.20	5.59	0.61	5	5.61			
106	8	22.6909	91.4636	6.20	5.59	0.61	5	5.61			
128	8	22.6954	91.4637	6.20	5.59	0.61	5	5.61			

Dredging/cutting volume within 1km radius of Suitable Location 8											
Sl No	**Sl Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m) h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
156	8	22.6910	91.4587	6.21	5.59	0.62	5	5.62			
96	8	22.6909	91.4611	6.21	5.59	0.62	5	5.62			
103	8	22.6931	91.4636	6.22	5.59	0.63	5	5.63			
2	8	22.6935	91.4515	6.22	5.59	0.63	5	5.63			
193	8	22.6934	91.4539	6.22	5.59	0.63	5	5.63			
64	8	22.6931	91.4661	6.23	5.59	0.64	5	5.64			
194	8	22.6954	91.4613	6.23	5.59	0.64	5	5.64			
110	8	22.6977	91.4614	6.23	5.59	0.64	5	5.64			
65	8	22.6932	91.4612	6.23	5.59	0.64	5	5.64			
165	8	22.6976	91.4638	6.24	5.59	0.65	5	5.65			
118	8	22.6956	91.4540	6.25	5.59	0.66	5	5.66			
134	8	22.6933	91.4564	6.25	5.59	0.66	5	5.66			
125	8	22.6933	91.4588	6.25	5.59	0.66	5	5.66			
62	8	22.6980	91.4516	6.26	5.59	0.67	5	5.67			
38	8	22.6957	91.4516	6.27	5.59	0.68	5	5.68			
75	8	22.6953	91.4661	6.27	5.59	0.68	5	5.68			
189	8	22.6978	91.4589	6.28	5.59	0.69	5	5.69			
94	8	22.6955	91.4589	6.28	5.59	0.69	5	5.69			
33	8	22.7001	91.4566	6.29	5.59	0.70	5	5.70			
159	8	22.6956	91.4564	6.29	5.59	0.70	5	5.70			
83	8	22.7024	91.4542	6.30	5.59	0.71	5	5.71			
37	8	22.6978	91.4565	6.30	5.59	0.71	5	5.71			
16	8	22.6979	91.4541	6.30	5.59	0.71	5	5.71			
86	8	22.7002	91.4517	6.32	5.59	0.73	5	5.73			
158	8	22.7002	91.4541	6.32	5.59	0.73	5	5.73			
22	8	22.7023	91.4566	6.33	5.59	0.74	5	5.74			

Dredging/cutting volume within 1km radius of Suitable Location 8											
Sl No	**Sl Number**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m) h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
Dredging/cutting volume within 1km radius of Suitable Location 8											**17,481,254**






91°30'0"E
22°42'0"N
VALUE
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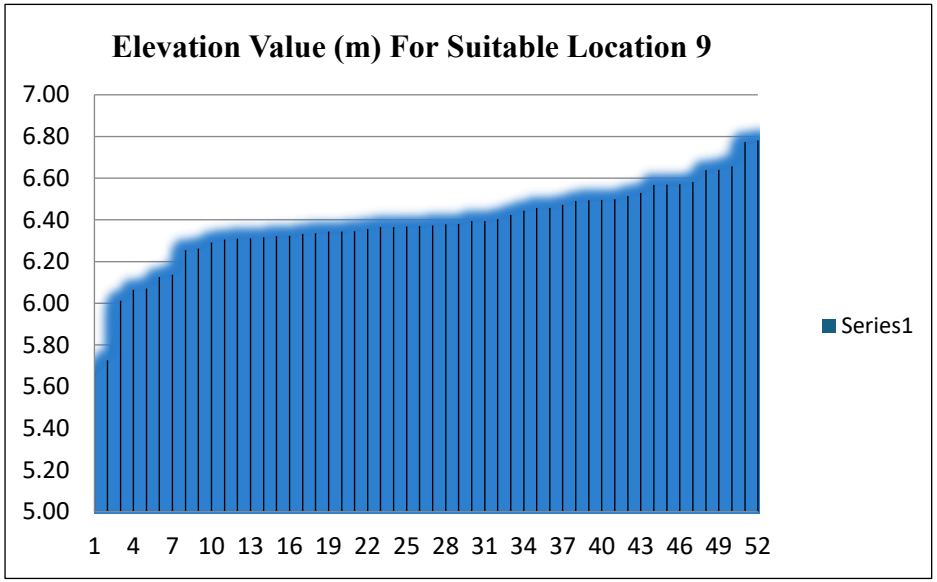
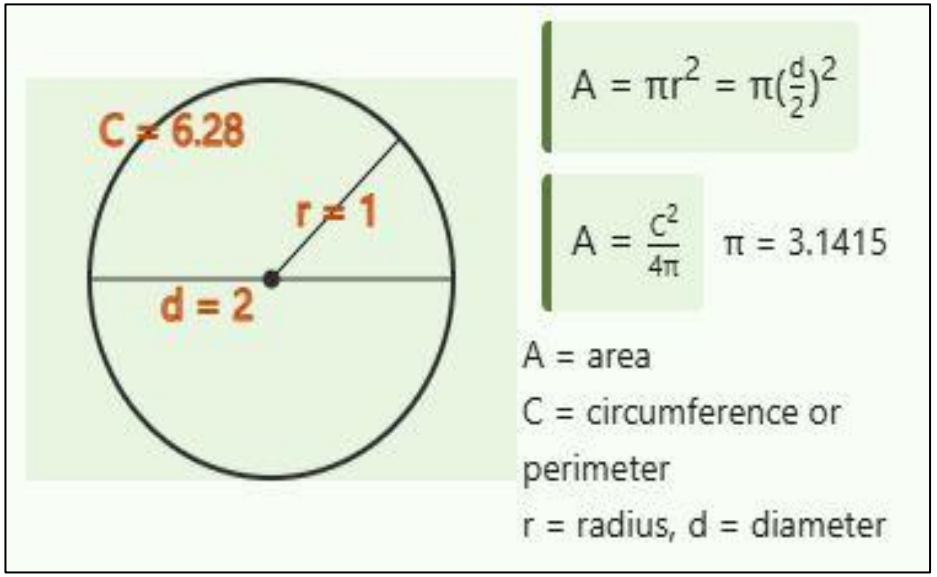
1.035375775 - 1.33299416
1.332994161 - 1.673129458
1.673129459 - 1.970747844
1.970747845 - 2.310883142
2.310883143 - 2.736052264
2.736052265 - 3.118704475
3.118704476 - 3.501356685
3.501356686 - 3.841491983
3.841491984 - 4.139110369
4.13911037 - 4.436728755
4.436728756 - 4.776864053
4.776864054 - 5.116999351
5.116999352 - 5.457134649
5.45713465 - 5.797269947
5.797269948 - 6.137405245
6.137405246 - 6.435023631
6.435023632 - 6.732642017
6.732642018 - 7.115294227
7.115294228 - 7.497946437
7.497946438 - 7.838081735
7.838081736 - 8.093183209
8.09318321 - 8.348284682
8.348284683 - 8.603386156
8.603386157 - 8.901004542
8.901004543 - 9.283656752
9.283656753 - 9.708825875
9.708825876 - 10.133995
10.13399501 - 10.51664721
10.51664722 - 10.94181633
1 km
1 km
1 km
1 km
5 km
Project Location (BEZA)
Kilometers
0 5,500 11,000 22,000
91°27'30.546"E
22°41'40.217"N

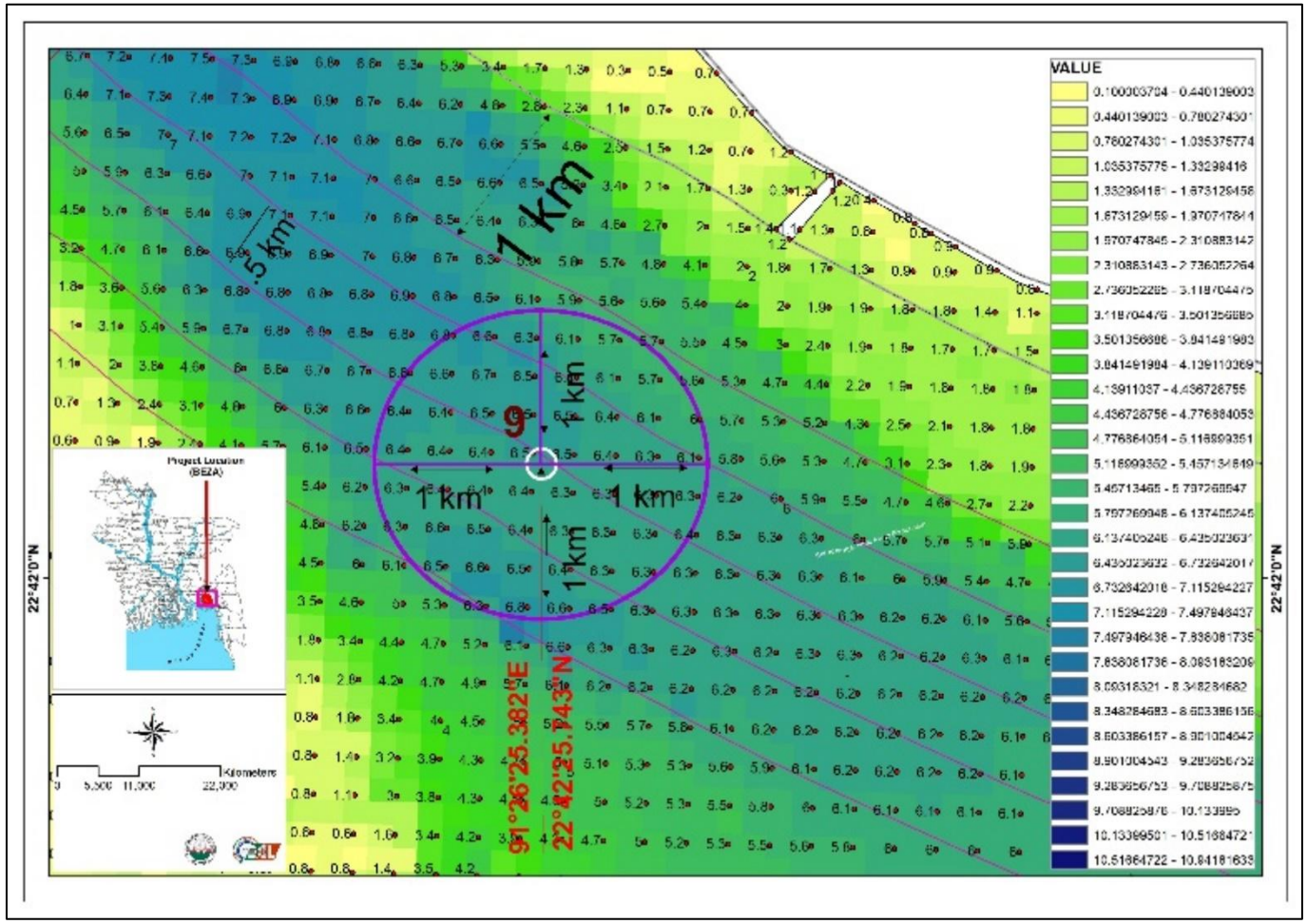
Dredging/cutting volume within 1km radius of Suitable Location 9											
Sl No	**Sl Nummer**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m)h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
149	9	22.7139	91.4449	5.67	5.67	0.00	5	5.00	5.70	3,140,000	17,908,553
167	9	22.7116	91.4472	5.73	5.67	0.06	5	5.06			
93	9	22.7093	91.4496	6.01	5.67	0.34	5	5.34			
172	9	22.7140	91.4424	6.06	5.67	0.39	5	5.39			
146	9	22.7117	91.4448	6.07	5.67	0.40	5	5.40			
182	9	22.7094	91.4472	6.13	5.67	0.46	5	5.46			
46	9	22.7070	91.4495	6.14	5.67	0.47	5	5.47			
3	9	22.7071	91.4471	6.25	5.67	0.58	5	5.58			
178	9	22.7141	91.4400	6.26	5.67	0.59	5	5.59			
21	9	22.7030	91.4324	6.29	5.67	0.62	5	5.62			
190	9	22.7004	91.4469	6.31	5.67	0.64	5	5.64			
136	9	22.7048	91.4494	6.31	5.67	0.64	5	5.64			
51	9	22.7027	91.4445	6.31	5.67	0.64	5	5.64			
122	9	22.6984	91.4371	6.32	5.67	0.65	5	5.65			
7	9	22.7004	91.4444	6.32	5.67	0.65	5	5.65			
69	9	22.7027	91.4421	6.32	5.67	0.65	5	5.65			
18	9	22.7026	91.4469	6.33	5.67	0.66	5	5.66			
123	9	22.7049	91.4470	6.34	5.67	0.67	5	5.67			
180	9	22.7053	91.4325	6.34	5.67	0.67	5	5.67			
202	9	22.7050	91.4422	6.34	5.67	0.67	5	5.67			
166	9	22.7049	91.4446	6.35	5.67	0.68	5	5.68			
35	9	22.7051	91.4397	6.36	5.67	0.69	5	5.69			
185	9	22.7051	91.4373	6.36	5.67	0.69	5	5.69			
203	9	22.7028	91.4397	6.37	5.67	0.70	5	5.70			

Dredging/cutting volume within 1km radius of Suitable Location 9											
Sl No	**Sl Nummer**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m)h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
95	9	22.7074	91.4350	6.37	5.67	0.70	5	5.70			
174	9	22.7094	91.4447	6.37	5.67	0.70	5	5.70			
198	9	22.7117	91.4424	6.37	5.67	0.70	5	5.70			
45	9	22.7052	91.4349	6.38	5.67	0.71	5	5.71			
162	9	22.7005	91.4420	6.38	5.67	0.71	5	5.71			
120	9	22.7075	91.4325	6.39	5.67	0.72	5	5.72			
160	9	22.7072	91.4447	6.39	5.67	0.72	5	5.72			
175	9	22.7097	91.4350	6.40	5.67	0.73	5	5.73			
92	9	22.7074	91.4374	6.42	5.67	0.75	5	5.75			
8	9	22.7098	91.4326	6.44	5.67	0.77	5	5.77			
77	9	22.7072	91.4422	6.46	5.67	0.79	5	5.79			
151	9	22.7073	91.4398	6.46	5.67	0.79	5	5.79			
24	9	22.7095	91.4423	6.47	5.67	0.80	5	5.80			
23	9	22.7029	91.4372	6.49	5.67	0.82	5	5.82			
148	9	22.7006	91.4396	6.49	5.67	0.82	5	5.82			
80	9	22.7096	91.4399	6.50	5.67	0.83	5	5.83			
113	9	22.7096	91.4375	6.50	5.67	0.83	5	5.83			
29	9	22.7118	91.4400	6.51	5.67	0.84	5	5.84			
139	9	22.7007	91.4347	6.53	5.67	0.86	5	5.86			
15	9	22.7029	91.4348	6.57	5.67	0.90	5	5.90			
105	9	22.7120	91.4327	6.57	5.67	0.90	5	5.90			
76	9	22.7006	91.4372	6.57	5.67	0.90	5	5.90			
150	9	22.7120	91.4351	6.58	5.67	0.91	5	5.91			
140	9	22.6982	91.4419	6.64	5.67	0.97	5	5.97			
131	9	22.7141	91.4376	6.64	5.67	0.97	5	5.97			

Dredging/cutting volume within 1km radius of Suitable Location 9											
Sl No	**Sl Nummer**	**Latitude**	**Longitude**	**Elevation Value (m)**	**Lowest Bed level(m)**	**Diff w.r.t lowest Bed level(m)**	**Cutting Depth from lowest Bed Level (-5m)**	**Cutting Depth from bed level (m)**	**Average cutting depth (m)h**	**Cutting Area (Sqm) $A=\pi r^2$**	**Dredging/cutting volume (Cum) V=Axh**
17	9	22.7119	91.4375	6.66	5.67	0.99	5	5.99			
12	9	22.6983	91.4395	6.77	5.67	1.10	5	6.10			
4	9	22.7142	91.4352	6.78	5.67	1.11	5	6.11			
Dredging/cutting volume within 1km radius of Suitable Location 9											**17,908,553**






VALUE
1 km
1 km
1 km
1 km
1 km
91°26'25.382"E
22°42'25.743"N
22°42'0"N
22°42'0"N
Project Location
(BEZA)
Kilometers