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

NSEZ DEVELOPMENT PROJECT (PRIDE)

Environmental and Social Impact Assessment (ESIA)

For

Land Development of Part Precinct F (IMD Zone and Housing Facilities) of the NSEZ-BEZA

Volume I: Main Report

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ACRONYMS AND ABBREVIATIONS

AOI	Area of Influence
APHA	American Public Health Association
AQ	Air Quality
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCSIR	Bangladesh Council of Scientific and Industrial Research
BEPZA	Bangladesh Export Processing Zone Authority
BEZA	Bangladesh Economic Zone Authority
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biological Oxygen Demand
NSEZ	National Special Economic Zone
Cd	Cadmium
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
Cu	Cupper
DoE	Department of Environment
ECA	Ecologically Critical Area
ECC	Environmental Clearance Certificate
ECR 2023	Environment Conservation Rules 2023
ESIA	Environmental and Social Impact Assessment
ESMoP	Environmental and Social Monitoring Plan
ESMP	Environmental and Social Management Plan
ESSs	Environment and Social Standards
EZs	Economic Zones
GBV	Gender Based Violence
GHG	Greenhouse Gas
GOB	Government of Bangladesh
GRM	Grievance Redress Mechanism
GW	Groundwater
HIV/AIDS	Human Immunodeficiency Virus, / Acquired Immunodeficiency Syndrome
HSE	Health, Safety, and Environment
IMD	International Master Development
IUCN	International Union for Conservation of Nature
KII	Key Informant Information
LMP	Labor Management Procedure
MoEFCC	Ministry of Environment, Forest and Climate Change
NBSAP	National Biodiversity Strategies and Action Plans
NEMAP	National Environmental Management Action Plan
NGOs	Non-Governmental Organizations
NL	Noise Level
NOC	No Objection Certificates
NOx	Oxides of Nitrate
OHS	Occupational Health and Safety
Pb	Lead
PD	Project Director
PIU	Project Implementation Unit
PMO	Prime Minister's Office
PMU	Project Management Unit
PPE	Personal Protective Equipment
PRIDE	Private Investment and Digital Entrepreneurship
PSDSP	Private Sector Development Support Project
SOx	Oxides of Sulphate
STD	Sexually Transmitted Disease
SW	Surface Water
ToR	Terms of Reference
TSS	Total Suspended Solids
VCs	Valued Components
Zn	Zinc

EXECUTIVE SUMMARY

1. PROJECT BACKGROUND

The Bangladesh Economic Zone Authority (BEZA) is developing a large industrial city, the National Special Economic Zone (NSEZ) on 33,000 acres of land located in Mirsharai and Shitakunda Upazilla of Chattogram District and Sonagazi Upazila of Feni District. A master plan of the NSEZ was prepared under the Private Investment & Digital Entrepreneurship (PRIDE) project financed by the World Bank. This World Bank's project is supporting the development of the NSEZ, which will be built with state-of-the-art infrastructure and utilities to help the economic zone become more environmentally friendly, addressing climate change and environmental objectives with an emphasis on green technology and climate resilience processes. As part of that initiative, the NSEZ, under the World Bank Group-financed PRIDE project, has proposed a sub-project to develop low-lying lands of part of Precinct F (for a green and resilient economic zone called IMD (International Master Development) and Housing facilities of the NSEZ.

2. SUB-PROJECT LOCATION

The sub-project includes the land development of part of Precinct F, comprising IMD (12 and 13 Zones), Zone 5, and Zone 18, for the proposed housing facilities of 1560 acres. The location of the sub-project site is in Mirsharai Upazila of Chattogram district, 12 km west of the Dhaka-Chittagong National Highway. Chattogram City is located 60 km to south, while Mirsharai Railway Station is 11.5 km west of the site. The Shah Amanat International Airport at Chattogram is about 79 km away, and the seaport at Chattogram is located 67 km south of the sub-project site.

3. SUB-PROJECT COMPONENT

Low-lying lands of about 1560 acres will be developed in the sub-project by filling with dredging materials. The area includes part of Precinct F, comprised of the IMD (Zone 12 and Zone 13 of 550 acres), 350 acres in Zone 5, and 660 acres in Zone 18. The land development will be done by dredging materials from the Sandwip Channel to fill about 1560 acres of land. The demand for the dredged material is estimated to be about 15.85 Million Cubic-meter for the landfilling of the four zones. The Cutter Suction Dredger (CSD) is found to be more feasible than other dredgers for dredging the dredged materials from the Sandwip channel.

4. PURPOSE AND OBJECTIVES OF THE ENVIRONMENTAL AND SOCIAL ASSESSEMENT

The Environmental and Social assessment (ESIA) study aimed to determine the potential environmental and social impacts caused by dredging and landfilling activities to reclaim the lands of 1560 acres in the sub-project location and identify the possible mitigation measures to lessen or avoid the adverse impacts of dredging activities following the World Bank (WB) Environmental and Social Standards (ESS) Guidelines and the Bangladesh Environmental Conservation Rules (ECR) 2023 and other applicable rules and regulations. The study also includes an alternative analysis for determining suitable dredging locations with minimal significant impacts on the marine ecosystem for landfilling in the sub-project areas.

5. APPROACH AND METHODOLOGY

To conduct this ESIA of the proposed sub-project, a review of relevant literature on policy, legal, and administrative frameworks is considered with a focus on environmental quality and discharge standards, health and safety concerns, protection of sensitive areas and endangered species, land use controls, and so on. The significance of impacts from the proposed sub-project was then assessed based on sub-project activities, stakeholder consultations, site-specific information, location, geographical conditions, and secondary and primary data collection. The sub-project's Valued Components (VCs) of impacts are identified that include Environmental and Social important aspects qualitatively and quantitatively, and the required mitigation measures have been proposed to reduce and /or to offset within acceptable limits as per national and international applicable regulations, including the World Bank's ESF. The detailed environmental and social management plan and monitoring plan were developed to ensure compliance with the proposed measures during land development.

6. POLICY AND LEGAL FRAMEWORK

In the ESIA study for the sub-project, the national safeguard acts and policies, particularly the ECR-2023 and World Bank's Environmental and Social Standards (ESS-1 to ESS-10), along with their relevance to the sub-project, were analyzed, and institutional requirements were recommended as well.

7. SUB-PROJECT CATEGORIZATION

The sub-project consists of the landfilling of about 1560 acres of area and is anticipated to use a significant volume of dredged materials. As per national policy, this sub-project is categorized as a Red Category, following the ECR 2023, Schedule-1*, Item no. 33: Land development, more than 25 acres*. According to environmental and social screening, the sub-project can be deemed a ***Substantial Risk*** as per the World Bank's Risk category.

8. ENVIRONMENTAL AND SOCIAL BASELINE CONDITION

Due to the sub-project activities dredging, installation of pipelines, landfilling, compaction of lands, draining out of dredged water, construction labor camps, yards, etc., have the potential to affect the existing environmental and social parameters such as land use pattern, local air quality, noise level, surface and groundwater quality, soil and sediment quality, occupational health and safety, community health and safety, local traffic and transport, aquatic and terrestrial ecosystems may be affected. To assess the baseline conditions of these parameters during the ESIA study, air quality, noise level and vibration, surface water quality, groundwater quality, sediment quality, and soil quality samples were analyzed in the government-accredited laboratory. The results indicate.

- **Air Quality**: Key parameters (NOx, O_3, CO, SO_2, PM_{10}, $PM_{2.5}$) were within limits set by the Air Pollution (Control) Rules 2022.
- **Noise and Vibration**: Daytime and nighttime noise levels, as well as vibration levels, conformed to the Noise Pollution Control Rules 2006.
- **Surface Water**: Four samples collected from Sandwip Channel locations L-5, L-7, L-8, and L-9 met DoE standards (ECR 2023).
- **Groundwater**: Three samples taken from depths of 550–700 feet in the subproject area complied with DoE standards.
- **Soil and Sediment**: Four sediment samples from the Sandwip Channel showed clay content ranging from 22.87% to 43.64%, silt from 38.32% to 53.91%, and sand from 2.46% to 33.94%. Heavy metal concentrations (Zn, Cd, Cu, Hg, Pb) were below detectable toxicity thresholds, indicating the dredged material is suitable for land reclamation without adverse impacts.

The sub-project area features diverse habitats, including mudflats, offshore areas, salt pans, croplands, aquaculture ponds, beaches, settlements, and rivers. Each terrestrial ecosystem supports various plant species, with maximum species identified through close photographs and collected specimens. The Phytoplankton abundance has high productivity on the Sandwip Channel. Zooplankton species composition is similar across Sandwip Channel sites. Overall, benthic organism abundance is 2-10 times lower than in previous studies of other Bangladeshi estuaries (Noman et al., 2019; Ullah et al., 2020)[1], likely due to changing environmental conditions and anthropogenic activities like dredging.

A social economic survey conducted to establish the profile of the study area using a multi-stage sampling method covering 150 households (HHs). Finding indicates: -

- Gender distribution: 51.63% male, 48.37% female.
- Working-age population (15–65 years): 66.04% of the sample.
- Unemployment rate: 3.07%.
- Occupations: agriculture/day labor (25.95%), housewives (38.91%), students aged 14+ (10.84%), small business (5.19%), service holders (4.25%).
- Employment interest: 64.86% expressed willingness to work in BEZA industries.
- Awareness of violence against women: 36.67% reported awareness, with cited incidents including physical violence (34%), dowry-related issues (38%), child marriage (4.67%), and polygamy (22.67%).

Comprehensive details of baseline environmental and socio-economic conditions are provided in **Appendix 1**.

9. ANALYSIS OF ALTERNATIVES

A total of 12 probable dredging locations were selected based on available secondary data, site observations and visualization, assessment, overlay, and creation of geospatial data using Google Earth Pro image. Out of 12 proposed locations, locations no. 11, 12, and 10 are near the Sandwip Channel confluence, and locations no. 9, 8, 7, 6, 5, 4, 3,

[1] **Noman *et al*. (2019).** Phosphorus amendment decreased cadmium (Cd) uptake and ameliorates chlorophyll contents, gas exchange attributes, antioxidants, and mineral nutrients in wheat (*Triticum aestivum*). *Environmental Science and Pollution Research*, 26(3), 2345–2357.

Ullah *et al*. (2018). Climate change could drive marine food web collapse through altered trophic flows and cyanobacterial proliferation. *PLoS Biology*, 16(1), e2003446.

2, and 1 are at the Sandwip Channel downstream. The suitable dredging sites are selected based on a set of specific criteria, mainly avoiding marine ecologically sensitive areas/habitats, biological hotspots, and estuarine mouths, Hilsa breeding ground, distance of dredging locations from the land development site, depth of the seafloor locations, soil condition, erosion, and geology.

Alternative analysis determined that four sites—L-5, L-7, L-8, and L-9—are the most suitable dredging sources, meeting environmental, technical, and logistical criteria. Of these, L-5 is considered the least ecologically sensitive and more viable than the other three locations, according to another alternative analysis.

Sediment availability estimates indicate that the four sites collectively contain approximately 70.74 million m^3 of material at a dredging depth of 5 m, and 35.36 million m^3 at 2.5 m depth. The project's total fill requirement of 15.85 million m^3 could be met from either one site at 5 m depth or two sites at 2.5 m depth, using a high-capacity hydraulic cutter suction dredger. Therefore, the required filling volume of dredged material, can easily suitable dredging sources depending on the depth of the channel bottom cutting and the dredger capacities for producing filling materials.

Without a Sub-Project, or 'No Sub-project Scenario' is also assessed. Without a Sub-project, no opportunity for the area to be established as an Economic Zone, and there might be no industrial infrastructure that would be developed at any cost on the low-lying lands/ char lands. Consequently, there would be no increase in local employment opportunities or regional trade and economic growth. A comparison of "Without Sub-project" and "With Project" Scenarios is also compared and presented in Table 5.4 under section 5.2.7 in Chapter 5: Alternative Analysis.

10. STAKEHOLDER MEETINGS

A total of fourteen (14) KIIs have been done with the primary and secondary stakeholders such as public administrators, representatives of government agencies (BIWTA, DOF, DOE, etc.), local government representatives (Councilor and Members), BEZA officials, elites, teacher, NGO worker, businessmen and influential personalities and other people who have stakes in the project.

A total of fifteen (15) Focus Group Discussions (FGDs) were conducted with different groups, including women groups at Bodiullahpara of Maghadia Union and Charsarat (Gov. Housing) village of Ichakhali Union under Mirsharai Upazila**.** In addition, two (02) public consultation meetings were organized at the Moghadia Union Parishad and Ichakhali Union Parishad to know the participants' opinions about the sub-project intervention.

All participants opined that numerous positive outcomes of the economic zone development would be achieved through this land development. Participants overwhelmingly expressed support for the project, noting its potential to generate substantial employment opportunities, improve connectivity, and foster the development of world-class industries However, they also raised concerns about negative short-term impacts, the participants mentioned construction-related impacts such as air/ dust, noise, and waste pollution, disruption of traffic movement, hampering the drainage system, restriction to land use, conflict between local or migrated labor, risk of sexual exploitation or abuse (SEA/SE) due to the labor influx, etc. They stressed that these issues should be addressed proactively during the land development phase and suggested that the Client should be more attentive to mitigate all these shortcomings during the dredging period.

The utmost demand of the participants was that the employment of local people should be arranged on a priority basis. In this regard, a communication strategic plan to enhance the capacity building of the local community to qualify for employment opportunities within the NSEZ development will be implemented by training, and consultations with the stakeholders. A procurement process is currently underway to appoint a firm for the implementation of the Social and Skill Development Program of the NSEZ. This firm will be responsible for extensive stakeholder consultations regarding the project's relevance, ESIA findings, and feasibility study results. They will also address concerns about dredging and land development impacts, including potential damage to grazing lands, drainage congestion, fishing activities, and any effects on Hilsa fisheries. The appointed Social and Environmental Councilors of the NSEZ will monitor these issues through KII, FGD, and consultations with stakeholders.

A supplementary study is conducted to assess the current status of the Hilsa fish ground at Mayani point of the Shaerkhali canal through field visits, visual inspection, and a public consultation. Findings reaved that Mayani Point, once known as a Hilsa breeding ground, has been significantly affected by the environmental changes, particularly siltation of the canal bed and the construction of sluice gates, which impede Hilsa migration. There was a clear consensus among the local stakeholders and relevant officials that the Hilsa fish breeding ground has not been present in this area since last 4-5 years. Details are Documented in **Volume II, Appendix 11** as a Supplementary study on the present status of the Hilsa fish breeding ground at Mayani point area in Mirsharai,

11. POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The landfilling of the sub-project will impact environmental features of the sub-project area. Removing dredged materials from the riverbed and transporting them to the designated area might disrupt physical and ecological balance. The potential Environmental and Social (ES) impacts are expected to occur during various sub-project activities, such as pipe installation, dredging, and landfilling, and their mitigation measures are outlined below.

Delivery Pipeline Installation:

Due to the installation of the delivery pipe, local noise levels, occupational health and safety, community health and safety, social conflict, and terrestrial and aquatic ecology will be affected. The significance of the impact is low to moderate, short-term, and reversible. Key concerns and mitigation measures include

- **Noise pollution (ESS-3**): The local noise level will be increased due to the movement of pipes, equipment, and workers, affecting the local community and workers. To reduce noise, the pipe route should avoid sensitive receptors, quieter equipment should be used, and workers should wear earplugs as needed.
- **Local Ecosystems (ESS-6):** Clearing vegetation can disrupt terrestrial species by causing habitat loss. To minimize this impact, pipelines should be routed through less vegetated areas, and informing local residents can be an effective measure.
- **Occupational health and Safety (ESS-2):** Workers' health and safety may be at risk from incidents, accidents, and injuries, including musculoskeletal disorders (MSDs), slips, trips, falls, electrical hazardous materials. To reduce these risks, mechanical lifting devices such as cranes and forklifts should be used to lessen manual handling, lockout/tagout procedures should be followed to prevent unexpected events, appropriate PPE should be provided to workers, and other measures outlined in the Occupational Health and Safety Plan (OHSP) (Appendix-5, Vol-II) should be implemented.
- **Community Health and Safety (ESS-4**): Community health and safety could be impacted by pipeline installation along road networks, village areas, and other busy locations. To mitigate this, it is recommended to avoid route pipelines through villages and busy areas and instead use alternative routes and access points for local residents.
- **Social Conflict (ESS-4):** Local disputes may arise if the pipeline installation damages private property, such as fencing, crops, or other assets, especially along roads, village outskirts, and recreational areas. To address this, all private property should be recorded, sensitive areas like villages and busy zones should be avoided, and ongoing consultation with local communities should be maintained.

Dredging:

During dredging works, the identified impacts are mainly due to movement of water vessels, climate change vulnerability (GHG emissions), air quality, noise level, surface water quality, aquatic ecology, occupational health and safety, and community health and safety, etc.

- **Air quality and Noise (ESS-3):** Due to dredging activities, local air quality will decline due to the use of different equipment (such as dredgers, tugboats, barges, and other support vessels) that typically rely on diesel engines, and will emit PM, NOx, SOx, CO, and VOC. To lessen the impact, using newer, more efficient dredging equipment with lower emissions can significantly reduce air pollution, like hydraulic Cutter suction dredgers. Using low noise generating equipment and dredging techniques such as slow dredging speeds and optimized cutter head designs, and regular monitoring can reduce noise levels at the working areas, etc. However, impacts on air and noise and surface are localized and temporary, so insignificant impacts due to dredging activities.
- **Surface water quality (ESS-3):** Dredging operations will increase turbidity and concentrations of suspended solids (TSS) that will affect the surface water quality. To mitigate the impact, selecting dredging methods such as hydraulic dredging with cutter suction heads is the best solution, and avoiding dredging during spawning or breeding seasons of Hilsa fish, with regular monitoring of surface water quality, is needed.
- **Aquatic ecology (ESS-6):** Dredging may have an adverse ecological impact on plankton numbers and benthic communities by upsetting seafloor ecosystems. Generally, habitat alteration and sediment disturbance will likely result in a decline the biodiversity, especially in maritime ecosystems. Increased turbidity can have several negative effects on the aquatic ecosystem, such as inhibiting photosynthesis, which will reduce the productivity of the aquatic plants and phytoplankton. Even though some species might see temporary decreases, other communities might eventually reform. But it is expected that the impact of dredging would be localized and

confined to a small area, and because of that, the impact might not be that significant. In Addition, some studies have reported that dredging or /and sand mining can alter the benthos community composition (Newell et al. 2002; Sutton and Boyd 2009)[2]. Cutter suction dredgers can be used to prevent excessive turbidity, to save aquatic marine ecology.

- **Hilsa fish breeding ground:** The Hilsa fish breading ground is predicted at the confluence of the Sandwip channel and the Feni River (Muhuri River), which is around 5 km upstream from the nearest suitable dredging point of L-9, and other three locations are located far away. So, it is assumed that the Hilsa fish breeding zone will remain unaffected by the dredging activities. Besides, impact of dredging would be localized and confined to a small area and because of that, the impact might not be that significant. Hilsa migration, triggered by monsoon-related changes in water flow and temperature. freshwater stretches with soft sediment, moderate current, and ample food supply for spawning. Hilsa fish tend to move in deeper zones near the bottom of the water bodies during migrations from the Bay of Bengal into freshwater rivers. Dredging activities are expected to have no impact during migration through the Sandwip Channel because of dredging will be at shallow depth. The Hilsa fish breeding season is from September to October, with a peak in October and early November. A secondary peak is observed in February or March, or March to April. The Government of Bangladesh enforces a 22-day fishing ban during peak spawning seasons (September–October and February–April) to protect Hilsa. Dredging should be avoided during these spawning periods, and cutter suction dredgers used to minimize turbidity and protect aquatic ecology.
- **Mayani Point Breeding Ground:** Another Hilsa breeding ground located at Mayani point in the Shaerkhali canal inside Mirsharai plain land, previously designated by notified in the Gazette in 2014 by the DoF (Department of Fisheries). has been silted up. A supplementary study finding indicates that Mayani Point, once known as a Hilsa breeding ground, has been significantly affected by environmental changes, particularly siltation and the construction of sluice gates, which impeding Hilsa migration. Therefore, the dredging activities will not have an impact on the Hilsa breeding ground in this location
- **Climate change vulnerability (ESS-3):** Dredging can exacerbate shorelines erosion and increase the frequency and severity of coastal flooding. For reducing this impact, integrated climate change adaptation strategies such as using hydraulic or cutter suction dredgers and other measures mentioned in **Appendix-7** (environmental management measures and greenery plan), Vol-II should be applied, etc.
- **Occupational Health and Safety (ESS-2):** OHS risks associated with dredging activities can lead to serious injuries, illnesses, and even fatalities if not properly managed, such as drowning, accidental falls, slips, falling objects, etc. However, to protect workers' health and safety, should use safety harnesses, guardrails, life jackets, adequate lighting, non-slip surfaces, and monitor weather conditions are crucial. The contractor must follow the Occupation Health Safety Pan (Appendix 5, Vol-II). and monitor the weather conditions at site the Emergency Response and Disaster Management Plan, (**Appendix-6**, **Vol-II**).
- **Community Health and Safety (ESS-4):** Noise and navigation restrictions during dredging may affect local fishers, boaters, and commercial shipping. To minimize disruption, scheduling should consider community needs, and dredging zones should be clearly marked with buoys and warning signs.
- **Erosion and Sedimentation (ESS-1):** Dredging activities may create channel /river embankment erosion in most cases, due to over-excavation of fill materials and improper operation of the dredgers, which is needed to be controlled. In addition, consideration of the sedimentation process of the channel with the trend of accretion and erosion is also a major factor. To mitigate bank erosion, it is necessary to introduce high-tech dredging methods that minimize sediment resuspension, such as hydraulic dredging with a cutter suction dredger. The Contractor should do dredging sequentially with two dredgers (small and medium capacity) and shallow cutting depths will reduce erosion risks. Morphological studies indicate the Sandwip Channel is naturally accretion-prone, and embankment protection via the Super Dyke further mitigates erosion risks, suggesting long-term impacts will be insignificant. Erosion and Accretion based morphological study of this ESIA indicated that the coastal morphology of the Sandwip Channel is accretion-prone alongside the NSEZ as shown in **Figure 5-7** and **Figure 5-8.** Another study of the Coastal Morphology Model (CMM) also indicates that the right bank of the

[2] **Newell *et.al* (2002).** Ultraviolet insolation drives seasonal and diurnal space weather variations. *Journal of Geophysical Research: Space Physics*, 107(A10), 1305. https://doi.org/10.1029/2001JA000296
Sutton *et al.* (2009) Effects of extraction of marine sediments on the marine environment 1998-2004. ICES Coop Res Rep 297:180.

Sandwip Channel at Mirsharai is accretion-prone, as shown in **Figure 5-9.** The embankment protection via the Super Dyke further mitigates erosion risks, suggesting long-term impacts will be insignificant.

Landfilling:

Due to landfilling activities, the major impacts will be the change of land use patterns, climate change vulnerability, air pollution, noise pollution, surface and groundwater pollution, soil erosion and soil pollution, water logging and drainage congestion, impacts on local ecosystems both terrestrial and aquatic ecology, risks on occupational health and safety, possibility of recruitment of child labor, labor influx and working conditions, employment generation, community health and safety, waste generation, GBV and SEA/SH, social conflict and road traffic safety issues, etc.

- **Changes of Land use (ESS-1):** Local land use will be permanently changed in the landfilling areas. Thus, it is necessary to establish buffer zones around agricultural lands, wetlands, and mangrove areas to reduce disturbances that can help to minimize this risk.
- **Air Quality (ESS-3):** GHG emissions will pollute the local air quality, and land reclamation can increase the carbon footprint like dredging materials will cause fugitive dust due to handling, stockpiling, and earthwork such as leveling, grading, excavation, compaction, and movement of vehicles, machinery, and generators (point and area sources). These will have impacts on the environment but are temporary and proper mitigation can minimize these effects.

  Water logging, Drainage congestion, and Water quality contamination (ESS-3): Water logging and drainage will occur only for unplanned dredging materials management in the landfilling site. This may occur at sites by discharges of dredge materials, which lead to drainage congestion and are susceptible to waterlogging in the landfilling areas. Groundwater quality may deteriorate due to the percolation of rain or contaminated surface water into the ground. Moreover, the leachate and effluent from dredging activities could contaminate ground water quality due to the infiltration of the saline seawater into freshwater bodies. Different types of liquids, such as water drained out from dredging material, and effluent from toilets, and kitchen, and solid waste from the labor camp will be generated in the landfilling sites. To reduce the risk, proper drainage infrastructure, solid waste management, stormwater drains, and regular water quality testing are essential, as outlined in the Drainage Management Plan and Dredging Management/Land Development Plan (**Appendices 3 and 4, Vol-II**). Silt fences and retention ponds must be used to protect groundwater. However, a proper drainage system can help avoid local flooding or waterlogging in the sub-project areas.

  Surface water contamination will occur due to surface run-off and liquid waste released from the labor camps. To lessen this impact, dredge materials should be managed at the site properly, construction of storm water drains, cross dam, and adequate toilet facilities with leachate management are required and regular testing of the surface water quality is essential. It is necessary to ensure that no sewage or wastewater penetrates the groundwater, and dredging materials are kept within the landfilling site only by silt fence or retention ponds, etc. for protection of groundwater resources.
- **Soil erosion and soil pollution (ESS-3)**: It may occur due to the release of dredging materials to the surrounding areas and used oil, spillage, and sewerage generation from labor camps, and surface runoff by heavy rainfall, etc. To mitigate the problem, it is necessary establishing buffer zones around agricultural lands, wetlands, and mangrove areas to reduce disturbances and protect the ecosystems, implementing erosion control measures such as silt fences and sediment traps to prevent sediment runoff into water bodies, and providing cross dams as appropriate etc., In addition it should be ensured that both hazardous and non-hazardous waste disposal follow the Waste Management Plan (referred to as WMP **Appendix 2, Vol-II**).To mitigate these impacts, the contractor should ensure proper waste management occurred at the site by following the Waste Management Plan (WMP) in **Appendix 2, Vol-II**.
- **Terrestrial and Aquatic Ecology (ESS-6):** Landfilling will affect vegetation and approximately 844 trees in Zones 12 and 13 will be felled. Compensatory tree planting at a 1:3 ratio should be implemented alongside the road. Environmental Enhancement Measures and Greenery Plan (Appendix 7, Vol-II). Changes in flora and fauna composition are expected, with biodiversity initially declining but gradually recovering as new native species establish. The region's biodiversity may initially decrease, but it will return eventually. Improving ecological recovery and resource availability in the future is expected as a natural way.
- **Occupational Health and Safety (ESS-2):** Workers' health will be at risk due to handling the construction materials. To reduce the risks, workers should be provided with on-the-job training on OHS issues and supplied with appropriate PPE for all workers; safe drinking facilities, sanitary toilets are required. A toolbox meeting (TBM)/ and Toolbox Talking (TBT) should be carried out on OHS issues before starting to work at the site, and

other measures specified in the Occupational Health and Safety Management Plan (OHSP) in **Appendix 5, Vol-II.** During natural hazards like cyclones, storm surges, tidal surges, and heavy rains, the landfilling activities should be stopped. An Emergency Response and Disaster Management Plan (ERDMP) shall be implemented, as documented in **Appendix 6, Vol. II**. Implementation of Environmental and Social Code of Practice as shown in **Appendices 10**, Vol-II should be ensured at site.

- **Labor Influx and Child labour (ESS-2):** It is estimated that around 30-35 workers will be required at the landfilling and dredging sites. The local people are not familiar with working on this type of job. Contractors can usually hire workers from other districts. Due to Labor influx, transmissible diseases (e.g., HIV/AIDS, COVID-19) and others etc. can be outbreaks in the areas and put the workers' health at risk. To control and mitigate this risk, awareness campaigns at the sites and ensure Labor Management Plan (LMP) is fully complied (following the LMP of the PRIDE Beza[3]) and recruiting child labor is strictly prohibited at the site ,etc.
- **Community Health and Safety, Traffic and Transport (ESS-4):** The community health and safety will also be at risk due to dust blowing, increased noise level, hazardous materials and waste generation, construction vehicle movement and labor influx, etc. To reduce this risk, employment opportunities for local people, regular monitoring and working hours should be limited only in the daytime etc. Local traffic volume will be increased in the landfilling sites due to the movement of construction vehicles and key land leveling equipment includes bulldozers for initial grading and shaping, motor graders for fine leveling, and compactors like rollers and plate compactors for achieving the desired soil density, which will impede the local people's movement in and around the working areas and lead to traffic accidents or incidents. Local traffic volume will be increased in the landfilling sites will impede the local people's movement in and around the working areas and lead to traffic accidents or incidents To mitigate accidental risk at the site is required to allocate traffic management personnel with proper PPE, flags, signal lights, etc., on the roads. Ensure the speed of vehicles (maximum limit 25-30 km/hr); and other measures as per the Traffic Management Plan (TMP) as in **Appendix 8, Vol-II**.

Social Conflict, GBV, SEA/SH (ESS-2 and ESS-4): Changes in land and water quality may affect local livelihoods dependent on grazing and fishing. Health and safety risks from construction may cause community tensions, especially between migrants and local workers. Gender-based violence (GBV), sexual harassment, and abuse risks require proactive training, awareness campaigns, and strict monitoring by contractors, the Design Supervision Consultant (DSC), and NSEZ's gender/social counselor, following World Bank best practices. Vessel and heavy vehicle movement may also disrupt local traffic systems

The land under this sub-project is owned by the BEZA. Thus, land acquisition and resettlement would not be required. It is anticipated that the sub-project will not cause any impact on ethnic minority groups of people, since there is no ethnic minority adjacent to the sub-project location. No physical and cultural resources within 5 km of the site were observed. However, a chance-finding procedure should be practiced during construction works to scan through the area for any physical and cultural resources.

Overall, the sub-project will bring potential benefits to the quality of life and livelihood of the people. It is envisaged that the development of economic zones will enhance the economic growth of the area, particularly improving the socio-economic integration of the area. Industrial development will create employment opportunities, women's empowerment, education, and literacy rate

12. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) for the sub-project is a comprehensive measure to offset the sub-project's adverse environmental and social impacts during construction activities like excavation, landfilling, dewatering, and compaction for the land development. This plan closely adheres to several Environmental and Social Standards (ESS) of the World Bank. The ESMP seeks to preserve environmental integrity, advance social well-being, and guarantee complete compliance with the national laws and regulations, and the World Bank standards.

Key subproject activities, such as dredging, equipment mobilization, and labor involvement are a few examples of sub-project activities that could potentially interfere with land usage, soil erosion and sedimentation, water logging and drainage congestion, surface and ground water pollution, impacts on ecosystem and biodiversity. Other potential effects include workers' and community health and safety, employment generation, child labor, air quality, noise and vibration, utility, machinery, energy consumption, solid waste and traffic congestion, biodiversity economic

[3] Labor Management Procedure (LMP), Private Investment and Digital Entrepreneurship (PRIDE) Project, Bangladesh Economic Zones Authority (BEZA), February 2020 .
https://documents1.worldbank.org/curated/en/141611582829764921/pdf/Revised-Labor-Management-Procedures-Bangladesh-Private-Investment-amp-Digital-Entrepreneurship-Project-P170688.pdf

displacement, and GBV/SEA/SA, social conflict. To address these risks, a set of mitigation measures are suggested in the ESMP.

The probable sources of various types of waste throughout the dredging activities for land development will be from the labor camps, the generation of a variety of trash, including food waste, lubricating oil, waste oil, and others. The implementation of a waste management plan is necessary to control the waste generation and mishandling, During the dewatering and compaction processes, waterlogging may occur in and around the sites and pollute the groundwater and surface water, which endanger the local environmental settings. Groundwater quality will deteriorate due to percolation of the leachate and effluent from dredging activities, rain or contaminated surface water into the ground. Surface water contamination will occur due to surface run-off and liquid waste released from the labor camps, as well as the discharge of dredged, drained-out water into, and the infiltration of the saline seawater into freshwater bodies. It is important to control existing drainage systems and water quality to protect natural water bodies and avoid drainage congestion. To control soil erosion, appropriate silt fences, sediment basins/ trap should be considered. Also, use the supporting structures underneath the pipelines like bamboo sticks while installation of pipelines. Regular monitoring of the effectiveness of the control measures will be undertaken. The implementation of a comprehensive drainage management plan and a dredging management and land development plan are crucial for dredging drain-out water and effective stormwater and wastewater management also safeguarding the surrounding environment.

To address these issues, the ESMP recommends:

- Implementing erosion control measures such as silt fences and sediment traps.
- Using bamboo support under pipelines during installation to prevent ground disturbance.
- Establishing and maintaining effective drainage systems to manage stormwater and prevent flooding.
- Applying the Drainage Management Plan (DMP) and Dredging Management/Land Development Plan (DMLDP) in Appendices 3 and 4 (Vol-II), and the Waste Management Plan in Appendix 2 (Vol-II).

To mitigate all these problems, the separate plans for Waste Management, Drainage Management, and Dredging Management/ Land Development plan are prepared to focus on this sub-project and are documented in **Appendices 2, 3, and 4**, respectively, in **Volume II**.

To safeguard marine and terrestrial biodiversity, the dredging operations need to avoid the adverse impacts on marine ecosystems, especially disturbance on mother Hilsa fish during their breeding seasons. The dredging activities should be restricted during the spawning or breeding periods of the Hilsa fish as declared by the government.

Furthermore, dredging should be limited to designated areas to reduce habitat loss and increased water turbidity, and yearly ecological assessments shall be carried out to track effects. Strict regulations are to be applied during landfilling and excavation to protect terrestrial and marine biodiversity, soil quality, and land stability.

The workers must wear PPE and closely follow an OHSP plan to lower health hazards and guarantee safety on the job as outlined in **Appendix 5**, and an ERDMP in **Appendix 6**, for any emergency preparedness measures to guarantee prompt and efficient reactions to any disasters**.** In addition to developing a greener and resilient NSEZ Industrial City based on the recently approved Master Plan, an EEMGP in **Appendix 7** and a TMP in **Appendix 8,** and ESCoPs in **Appendix 10** are documented in the **Volume II** to be followed by the contractor during implementation of ESMP.

Disseminating of information to the local population regarding the limiting access to dredging sites, and hiring flagmen to oversee interactions between the sub-project and the community, to handle community safety, traffic management, etc. With distinct indicators and techniques for evaluating adherence to social and environmental criteria for the ESMP is included in the Environmental and Social Monitoring Plan (ESMoP), which is comprehensive for this sub-project. Site clearing, stakeholder involvement, air and noise pollution, water quality, soil pollution, waste management, and biodiversity preservation are some of these indicators. Daily, monthly and quarterly analytical monitoring are part of the monitoring process, and they include gathering information on the quality of the air and water, estimating noise levels, and keeping tabs on the production and disposal of waste, etc., are required to track the pollution load at sites due to land development of the targeted area. The detailed monitoring plan with testing parameters, frequency and locations is presented in **Table 8.2** in Chapter 8

It is expected that the proper execution of the ESMP would lead to the project's successful conclusion with the least negative effects on the surrounding environment and communities. Furthermore, it is anticipated that the stringent monitoring and stakeholder engagement procedures would foster confidence in the local community, guaranteeing their energetic involvement and support for the sub-project. However, all these impacts are likely to be insignificant in the context of the implementation of the land development under this sub-project through adopting the mitigation and monitoring measures as highlighted in the ESMP and ESMoP of this ESIA study. Ultimate, the ESMP will

support sustainable development by striking a balance between social responsibility, environmental preservation, and economic progress.

13. INSTITUTIONAL CAPACITY, IMPLEMENTATION ARRANGEMENT, AND MONITORING

The BEZA has a diversified, knowledgeable, and skilled set of manpower to manage such kinds of sub-projects. The Project Implementation Unit (PIU) of the PRIDE Project, under BEZA, will be responsible for incorporating environmental and social (ES) specifications into the bid documents, including the Occupational Health and Safety (OHS) Plan, Waste Management Plan (WMP), Traffic Management Plan (TMP), Drainage Management Plan (DMP), and the Stakeholder Engagement Plan, in line with PRIDE project requirements. The PIU will also oversee all contractor activities related to the subproject.

The BEZA will appoint a Design and Supervision Consultant (DSC) or Construction Supervision Consultant (CSC), and their qualified Environmental and Social specialists will daily monitor the contractors' activities in compliance with the ESMP and ESMoP and review the contractor's report on the implementation of the ESMP and will also ensure ESMP and ESMoP are properly implemented throughout the land development phase.

Before construction works begin, the Contractor will prepare a site-specific Construction Environmental and Social Management Plan (C-ESMP) based on the ESMP. The plan must include Management Strategies and Implementation Plans (MSIPs) containing different plans, like management plans, such as occupational health and safety management, waste management, drainage management plan, emergency response, traffic management, and stakeholder engagement, greenery plan, as well as an environmental and social code of practices in consistent with the site-specific identified impacts. etc.

Throughout the construction period, PIU-BEZA will maintain greater accountability for the social and environmental challenges. The contractor's performance in implementing ESMP provisions and complying with the World Bank Environmental and Social Framework (ESF) and Department of Environment (DoE) requirements will be evaluated independently. A third-party monitoring agency will also be engaged to verify environmental and social performance.

A third-party monitoring agency will be appointed to independent monitoring the environmental social impacts during sub-project implementation.

Capacity building will be integral to successful ESMP implementation. Training will be provided to contractors, workers, DSC personnel, and PIU/PMC staff on ESMP and ESMoP procedures, mitigation strategies, occupational and community health and safety, waste management, emergency response, traffic management, biodiversity conservation, and stakeholder engagement

The estimated cost of ESMP for this sub-project will be around 14.52 million for two years.

14. CONCLUSION & RECOMMENDATIONS

The implementation of Land Development of Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ sub-project is expected to bring significant technical, economic, social, and environmental benefits as well as some negative effects. To ensure minimum environmental and social impacts for the land development, sufficient effective measures during the land development activities of delivery pipeline installation, dredging, and landfilling are recommended in the ESMP of this ESIA report in **Table 8-1.**

An alternatives analysis identified four suitable dredging locations (L-5, L-7, L-8, and L-9) out of twelve potential sites in the Sandwip Channel. These sites were selected based on their low ecological sensitivity, distance from the fill area, and minimal anticipated impacts on marine biodiversity.

Hilsa breeding zones will not be affected because the selected dredging locations are far away (more than 5 km) from the identified Hilsa breeding zone at confluence of Feni River and Sandwip Channel and the dredging locations are selected downstream of the Hilsa breeding zones, so, turbidity and other disturbances (e.g., underwater noise and vibration) resulting from dredging activities will not affect the Hilsa breeding areas. Furthermore, these impacts would not be significant, because dredging would be localized and confined to a small area as temporary. Nevertheless, it is recommended to avoid dredging during Hilsa spawning/breeding seasons.

The sediment depositional process in the study areas of Mirsharai and Sandwip channel is higher than other areas (Refers to Chapter 5) sites—Sonadia, Jaliardwip, and Subrang, and available low available draft (shallow depth areas), due to its anticlockwise oceanic circulation. The right bank of the Sandwip Channel at Mirsarai is accretion-prone and morphological changes are less pronounced while the left bank of the Sandwip Channel is mainly accretion prone and north-eastern part is comparatively less accretion prone. So long term impacts will

be insignificant and reversible. However, to mitigate this anticipated problem, it is suggested to use high tech dredgers (suction cutter dredger), engage two dredgers at a time with minimum interval in the shallow depth areas to fill target volume and other mitigation measures suggested in Chapter 7.

In the short term, dredging operations may temporarily increase turbidity and concentrations of suspended solids (TSS) that will affect the surface water quality and excessive underground noise, and vibration will generate which will disturb the aquatic species for the regular movement. However, long-term impact is insignificant due to hydrological characteristics e.g., higher depositional rate, and low draft in nature of the Sandwip Channel (selected dredging sites). To mitigate the temporary impact, selecting dredging methods such as hydraulic dredging with cutter suction heads (which is producing low underground noise and vibration) is the best solution, and avoiding dredging during spawning or breeding seasons of Hilsa fish, and with regular monitoring of surface water quality, is needed.

At the infilling sites water logging and erosion problems will occur as potential risk due to discharges of dredge materials. These can be managed through erosion control measures such as sedimentation traps, silt fences and cross dams to control sediment runoff into water bodies, and temporary drainage systems should be ensured to avoid waterlogging, as well as prevent flooding. Without such controls, there is a risk of surface water contamination and groundwater pollution through leachate infiltration and improper waste handling. To address this, it is recommended to implement erosion and sediment control measures, along with the specific actions outlined in the Drainage Management Plan (DMP), Dredging Management/Land Development Plan (DMLDP) in Appendices 3 and 4 (Vol-II), and the Waste Management Plan (WMP) in Appendix 2 (Vol-II).

1. INTRODUCTION

1.1. BACKGROUND OF THE PROJECT

1. To promote sustainable development goals, the Government of Bangladesh (GOB) has started a program to provide industrial land and infrastructure, hoping to attract more private and foreign investment. The National Special Economic Zone (NSEZ) is the flagship, SMART City /Economic Zone project for Bangladesh and a 'game changer' in economic zone design and development. Bangladesh Economic Zone Authority (BEZA) is developing a large industrial city in the NSEZ in phases on an area under the World Bank-financed Public Sector Development Support Project (PSDSP) at Mirsharai in the Chattogram district. Total proposed land of 33,805 acres with a 25 km coastline along the Sandwip Channel on the Eastern side of the Bay of Bengal. The eastern side of the area is bounded by an old embankment while a new super dyke at the western side along the sea has been constructed. Most of the lands of the NSEZ are low-lying lands and reclaimed land. The land elevation on the site varies from -3.33-m MSL to the highest point at +8.7 meters (m) MSL.

2. BEZA has a plan to develop a green and resilient economic zone called IMD (International Master Development) with green infrastructure, housing facilities, cutting-edge smart technology, and innovation. The entire area is low-lying in nature and free from any settlement. One may conclude that the IMD zone is an essential site for the NSEZ project's development and that landfilling is a key priority for the IMD zone's development. Dredged sediments from the Sandwip Channel will be used for landfilling. The structural characteristics, resilience, and diversity of the channel may all be impacted in different ways by these dredging activities.

1.2. COMPONENTS OF THE PROJECT

3. The World Bank's Private Investment & Digital Entrepreneurship (PRIDE) project is supporting the development of the NSEZ, which will be built with state-of-the-art infrastructure and utilities to help the zone become more environmentally friendly, addressing climate change and environmental objectives with an emphasis on green technology and climate resilience processes. As part of that initiative, the NSEZ under the World Bank Group, financed the PRIDE Project has proposed several sub-projects, like road networks, gas pipeline networks, water supply facilities, surface water treatment plan, and land reclamation. One of them is a land development sub-project to develop a green and resilient economic zone called IMD (International Master Development) and housing facilities, and other infrastructure. The land development will be within the part of Precinct F (IMD Zone 12 and Zone 13), Zone 5, and Zone 18 for housing facilities in Ichakhali union of Mirsharai Upazilas under Chattogram district, as shown in **Figure 1-1**, is considered a sub-project under the World Bank-Financed PRIDE Project. There are no settlers within the sub-project region, which is low-lying, barren lands.

1.3. NEED FOR THE SUB-PROJECT

4. The National Special Economic Zone Development Project is important for several key reasons such as economic advancement, infrastructure enhancement, industrial diversification, regional progress, and foreign investment attraction of the country**.** The NSEZ project aims to play a pivotal role in this endeavor by establishing a modern industrial hub capable of attracting both domestic and international investments. To achieve this goal, the lands within the NSEZ area are required to be developed or reclamation, since most lands in the NSEZ are low-lying and char lands. Therefore, the land development in the Part of Precinct F (IMD Zone and Housing Facilities) using dredged materials is one of the key components and is considered a sub-project under the World Bank-financed PRIDE Project in the NSEZ.

5. The major objectives of the sub-project are to meet the demand for large land development from the low-lying char lands as committed by the BEZA for the construction of several factories, industries, housing facilities, and other structures in the NSEZ areas, expedite and stimulate rapid economic growth to foster a greater variety of enterprises, promote industrial output and export promotion, and increase employment generation in the NSEZ areas, etc.

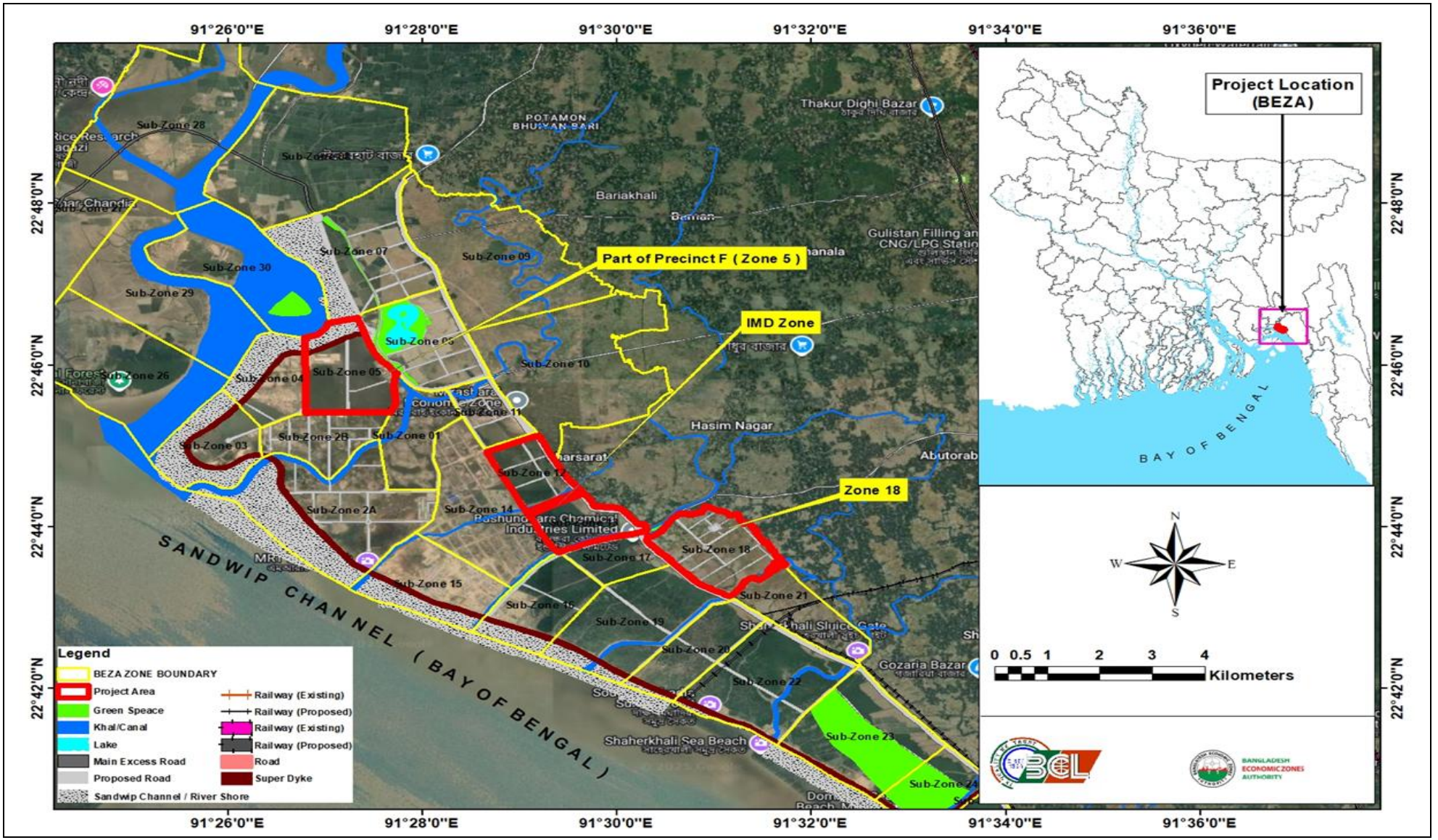


Figure 1-1 : Location map of the sub-project study area (Source: Google Earth Imagery)

1.4. OBJECTIVES OF THE ESIA STUDY

6. The ESIA study aimed to determine the potential environmental and social impacts caused by dredging and landfilling activities for land development in part of Precinct F (IMD Zone-12, Zone-13), Zone 5, and Zone 18 for housing facilities within NSEZ. Identifying the possible mitigation measures to lessen or avoid the anticipated adverse impacts following the World Bank Environmental and Social Standards (ESS) Guidelines and the Bangladesh Environmental Conservation Rule (ECR) 2023 and other applicable rules and regulations. An alternative analysis for determining suitable dredging locations as non-significant impacts on the marine ecosystem for landfilling in the sub-project areas.

1.5. APPROACH AND METHODOLOGY

7. The environmental and social assessment was conducted through field investigations, analytical testing, and stakeholder consultations following the ECR 2023 and World Bank Environment and Social Standards (ESSs), 2018. In addition, the relevant reports and the legal requirements for the project were also reviewed, and according to the TOR, the ESIA report was prepared.

8. However, the ESIA technique adheres to the overall impact assessment approach following the screening, scoping, and contextual analysis, stakeholders' opinions, existing national rules and regulations, World Bank's Environmental and Social Standards and other international rules and regulations, quantifying the risks matrices and potential impacts with potential mitigation measures, disclosure, etc. (Figure 1-2). Additionally, strategies to mitigate the potential risks were developed and established, along with an environmental and social management plan and monitoring plan. The significance of the impacts is derived from the likelihood and intensity of the impacts. The magnitudes of different parameter impacts (duration, reversibility, extent, likelihood) have been determined by the WB's potential risk categories (High, Substantial, Moderate, and Low), etc.

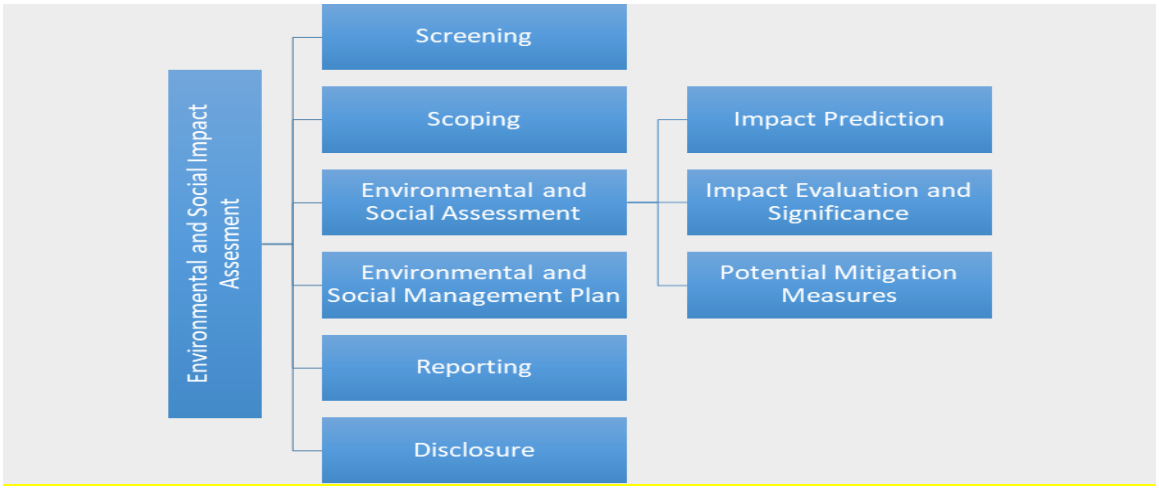


Figure 1-2: ESIA Study Process

Step-1: Screening

9. The screening process was mainly:

- Desk review of pertinent documents and information on the sub-project site and surrounding areas;
- Reconnaissance of the sub-project site, surrounding areas, approach road, and initial conversations with local stakeholders.
- Conversations with the Department of Environment (DoE), Bangladesh Forest Department (BFD), BEZA, BIWTA, Bangladesh Water Development Board, etc., to stay updated on regulatory requirements and other details;
- Results of screening by using a checklist identified the magnitude of impacts and the sub-project categorization (**Annexure -1**).
- A preliminary mapping of stakeholders to identify important stakeholders from the local levels of the community, government, and pertinent government and non-governmental organizations.

Step-2: Scoping

10. The scoping process considered the following issues:

- Discussion with BEZA, BWDB, DOE, and other relevant stakeholders to define scopes for the impact assessment.
- Planning and implementation of mitigation and monitoring.

- Reporting for the project that will satisfy the World Bank, Government of Bangladesh (GoB), and BEZA requirements.
- In accordance with the Environmental Conservation Rule 2023 (ECR 2023) and the World Bank's Environmental and Social Framework, Environmental and Social Standards (ESS-1 to 10) are considered based on the type, scale, and working methods of the sub-project.
- Consultations with the primary and secondary stakeholders, etc.
- Identification of the Valued Components (VCs) for analysis of the environmental and social impacts. The VCs include environmental and social components (ES) on the specific physical environment, ecological, economic, and social attributes that may be potentially impacted by the proposed sub-project activities, etc.

Step-3: Baseline Data Collection

11. The NSEZ project area is too large; the total land of the NSEZ-BEZA is about 33,805 acres with a 25 km coastline along the Sandwip Channel. However, the land development in the IMD zone under this sub-project is located within Zones 12, 13, 18, & 5, and covers an area of around 1560 acres in Ichakhali union of Mirsharai Upazila under Chattogram District. To determine the sub-project's anticipated impacts, Environmental and Social baseline data are collected within the Area of Influence (10 km radius), which includes major land features such as sensitive habitats, settlements, cultural sites, water bodies, and other areas of environmental and social value. Environmental quality parameters are tested analytically in accredited laboratories.

- Direct Observations: Direct observations of the presence and diversity of flora and wildlife are made while going along canal banks, across agricultural fields, and through village plantations throughout the Area of Influence (AOI). In addition to direct sightings, animal activity is detected by tracks, footprints, feeding signals, and calls. This exercise often employed suitable field guides and data forms to ensure that information is appropriately recorded. Reconnaissance of the sub-project area, taking note of the settlement pattern and major community and public utilities' infrastructures located along the present alignment.
- Interviews with Locals: Many mammalians and reptilian species are cryptic and unlikely to be discovered by traditional field sampling methods. As a result, experience indicates that conducting interviews with people is a highly successful method for gathering information about local biodiversity. During the field survey, detailed interviews with local inhabitants are conducted to collect information on animal and plant existence, such as occurrences, behavior, breeding, distribution, and seasonal appearance.
- Socio-economic Data Collection: The ESIA study collected socioeconomic data from the sub-project area for social assessment, including household size, household structure, educational attainment, age dependency, access to basic services such as electricity, sanitation, water, and road communications, women's empowerment, employment status, gender status, household income and expenditures, crop cultivation, vegetable cultivation, market opportunity, and so on. Socioeconomic evaluation is conducted following the semi-structured questionnaire by HHs survey on a random basis as a sample survey, considering the HHs who are residing outside of the NSEZ at the periphery of the project site.
- Stakeholders Engagement: Several small group meetings, primarily focus group discussions (FGDs), are held during data collection, followed by public consultation meetings (PCMs) during baseline data collection. However, during the socioeconomic baseline survey, some interviews with local inhabitants are conducted on environmental and social issues, and the status of the gender violence issues in the study area;
- IS Mapping: In the ESIA study, GIS-based maps of existing land use, topography, and physiography are prepared using the most recent cloud-free Landsat 7 ETM+ satellite imagery and confirmed with high-resolution Google Earth pictures.

Step-4: Impact Identification

12. The impacts are identified, assessed, and classified as Low, Moderate, Substantia**l,** and High impacts on the environment and communities in the study region, by the World Bank risk category, as well as ECR 2023 categorization of the project such as Green, Yellow Orange, and Red category depending upon location, size and severity of pollution loads of the project. The impact assessment process is predicted using prediction tools, as described in **Figure 1-3.**

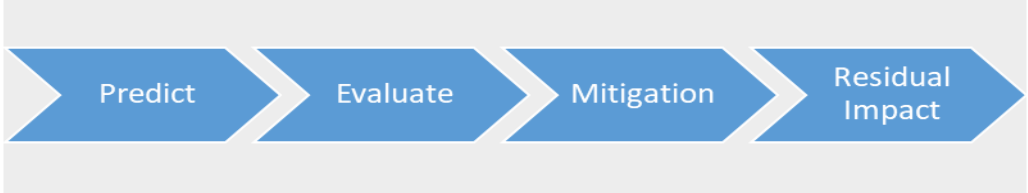


Figure 1-3: Impact Assessment Process

13. Hence, the social impacts identified are to ensure that potential social impacts/concerns are recognized at an early stage of sub-project preparation so that these concerns can be effectively addressed during subsequent stages. The social impact assessment for this project incorporates secondary information along with primary information gathered through household surveys, community consultations, and focus group discussions (FGD's).

14. Finally, assessing the potential environmental and social implications necessitates considerable data on Valued Components (VCs) including physical environment, ecosystems, biodiversity, and socio-economic activity. It is also vital to learn how present environmental processes interact to form a complex ecosystem. This information is used to detect potential environmental changes induced by the sub-project and to offer strategies for avoiding, reducing, or managing such environmental consequences.

Step-5: Qualitative and Quantification, and Evaluation of Impacts

15. A qualitative assessment of potential consequences was conducted using the criteria to determine their significance. Potential consequences were determined based on their size and receptor sensitivity. The project's potential impacts are classified as Low, Moderate, Substantial, and High based on factors such as duration, spatial extent, reversibility, likelihood, and legal standards and professional criteria. The quantitative assessment was assessed based on the magnitude of the anticipated impacts which was scored as Low (0-2), Moderate (3-5), Substantial (6-8), and High (9-10), and in these case consultant's logical judgment is considered. However, the impacts are evaluated based on magnitude, immediacy, sustainability, and reversibility. A 10-point scale is adopted, for example: 1 to 10 for beneficial impacts, 0 for no impact, and 1 to -10 for negative impacts. Chapter 7 presents a detailed impact evaluation.

16. The significant issues highlighted during the Scoping Phase were examined using baseline information. Each issue has either positive or negative impacts on the project or the environment. The ESIA evaluates potential repercussions before and after mitigation measures are adopted, considering direct, indirect, and cumulative implications in the short and long term.

Step-6: Environmental and Social Management Plan Preparation

17. The environmental and social management plan (ESMP) was developed once the impact assessment was completed and mitigation strategies were identified. During the ESMP compilation process, institutional arrangements for the project's environmental and social management were recommended, mitigation and monitoring plans were developed, documentation and reporting protocols were established, training requirements were assessed, and the cost of ESMP implementation was estimated.

Step-7: ESIA Report Preparation

18. Finally, the ESIA report was prepared based on the World Bank Environmental and Social Framework, GoB- ECR 2023, and other relevant regulatory policies.

1.6. ESIA TEAM

19. A multi-disciplinary ESIA team was engaged to collect data, information, baseline study, impact prediction and assessment, and formulation of mitigation measures during the ESIA study. The professional members of the ESIA (Table 1-1) are as follows:

Table 1-1: ESIA Team

Sl. No.	Name of the expert	Position in the team
1	Mrs. Nahid Amin, PhD	Acting Team Leader
2	Md. Kamrul Hasan Bhuiyan	Environmental Expert
4	Dr. Tajul Islam	Ecologist
5	Mr. Mamun Ur Rashid	Social Expert
6	Mr. Md Mustafizur Rahman	Labor and OHS Expert
7	Mr. Shahriar Haque Abir	Junior Environmental Expert
8	Mrs. Sadia Afrine Nitu	Inspector for quality control-
9	Mr. Nahid Hassan	Junior Social Expert

20. Besides the expert team, a junior team was involved in conducting interviews with different types of stakeholders following the semi-structured questionnaire and socio-economic survey at the project areas.

1.7. STRUCTURE OF THE REPORT

21. The general structure of the ESIA report will cover the following issues as shown in Table 1-2.

Table 1-2: Structure of the ESIA Report

Chapter No.	Name of Chapter
Chapter-1	Introduction
Chapter-2	Regulatory Framework
Chapter-3	Description of Proposed Activities
Chapter-4	Environmental and Social Baseline
Chapter-5	Analysis of Alternatives
Chapter-6:	Stakeholder Engagement, Consultation and Outcomes
Chapter-7	Environmental and Social Impact Analysis
Chapter-8	Environmental and Social Management Plan
Chapter-9	Conclusion and Recommendations

1.8. LIMITATION OF THE STUDY

22. This ESIA report has been prepared based on the primary data, field investigation/survey, secondary data from different government agencies Department of Environment (DoE), Bangladesh Meteorological Department (BMD), Bangladesh Bureau of Statistic (BBS), Forest Department (FD), Bangladesh Water Development Board (BWDB), Bangladesh Inland Water Transport Authority (BIWTA) etc., and published journals and books, public consultation, site observation, and assessment of that information. Professional judgment and subjective interpretation of facts and observations have been applied. Additionally, on-site facilities, sources, and alignments are not fixed to date, thus, assessment is made based on preliminary information available from the PIU, PRIDE, BEZA, and all the fields that could be explored.

1.9. SCREENING OF THE SUB-PROJECT

1.9.1.SCREENING AS PER GOB CATEGORIZATION

23. The proposed sub-project land development of part of Precinct F (IMD Zone and Housing Facilities) of NSEZ is categorized as 'Red category' following the ECR 2023, Schedule-1, Item no. 33 (Land development, more than 25 acres). requires an EIA / ESIA study to meet the requirement of the GoB as an obligatory requirement of the DoE for obtaining the Environmental Clearance Certificate (ECC).

1.9.2.SCREENING AS PER WORLD BANK CATEGORIZATION

24. The World Bank screens all projects to determine the nature and extent of the environmental and social assessment needed, based on the type, location, sensitivity, and scale of activity, the nature and magnitude of its environmental and social risks and impacts. The projects are normally classified into four categories: High Risk, Substantial Risk, Moderate Risk, and Low Risk to manage the environmental and social risks and impacts in a manner consistent with the ESSs.

25. A risk rating screening of the anticipated environmental and social impacts from the sub-project is carried out to determine whether the sub-project will trigger the potential environmental and social impacts relevant to safeguarding ESSs of the World Bank ESF and presented in **Annexure 1**. It highlights identified risks and impacts, categorizing them as temporary, reversible, or irreversible. The magnitudes of different parameters of impacts have been determined by the WB's potential risk categories (High, Substantial, Moderate, and Low), considering the significance of the impacts having anticipated scores The significance of the impacts was assessed from the scores of 0-8 is low, 8 $^{(+)}$-30 for moderate, 30$^{(+)}$-56 for substantial risks, and 56$^{(+)}$-100 is considered as High risk. The findings indicate that most of the questions answered are 'Yes' with a weightage of 76 for the sub-project and the proposed intervention poses a "Substantial Risk" according to the World Bank Environmental and Social Framework (ESF), particularly due to its geographical location in marine biodiversity areas and the significant land use changes expected from landfilling activities. However, the identified risks and impacts are predictable and expected to be mostly temporary, and the magnitude is substantial. According to the screening based on the WB-ESF, the proposed sub-project intervention can be deemed as a "***Substantial Risk***", which can be effectively mitigated to minimize negative impacts and promote sustainable development following the World Bank's environmental and social standards (ESS) of WB ESF[4]. Therefore, an Environmental and Social Assessment (ESIA) is warranted for this sub-project.

26. However, the screening of environmental and social risks was conducted through a variety of methods, including scoping and contextual analysis, stakeholders' opinions, existing national rules, regulations, World Bank's Environmental and Social Standards Guidelines, and other international rules and regulations, quantifying the risk

[4] Considering the land area of 1560 acres in part of Precinct (IMD Zones 12-13, Zones 5, Zone 18)will be filled with a significant volume (15.85Mcum) of sand dredged from the seashore.

matrices and potential impacts.

1.10. SCOPE OF THIS ESIA

27. This ESIA study is carried out for land development, which includes dredging activities, landfilling, compaction of lands, draining out of dredged water, construction labor camps, yards, etc. The scope of this study comprises the construction phase of land development, since the operation period is out of the scope of work as per the Terms of Reference (TOR) of the contract. The specific scopes are as follows,

- Conducting Environmental and Social Screening (ES) and identifying ES risks.
- Identifying the Valued Environmental and Social Components (VCs), including environmental, ecological, and social issues that might be impacted during the construction phase.
- Identifying environmental baseline conditions that include ambient air quality, noise level, surface water and groundwater quality, soil, and sediment quality, and identifying the types of habitats that could be in danger and the effects on the biological and ecological conditions.
- Assessing the socio-economic conditions of the sub-project site.
- Predicting the potential environmental and social adverse impacts and formulating mitigation measures.
- Assist BEZA in providing capacity-building support on Environmental & Social issues by conducting a full-fledged training Program (for contractors, investors, and workers. Private Economic Zones (PEZ) and other BEZA departments as necessary, based on national legal and administrative frameworks (related law/ policies and procedures) as well as WB ESF and ESSs.
- Assessing the analysis of alternatives for the identification of dredging sources. To undertake Stakeholder consultations in line with the Stakeholder Engagement Plan (SEP5) of BEZA during the preparation of ESIA. To conduct stakeholder consultation meetings with stakeholders at various levels, including project-indirectly affected people, local communities, professionals of the BEZA, governmental agencies, private organizations, and non-governmental organizations etc.
- Preparing an Environmental and Social Management Plan (ESMP) and ES Monitoring Plan based on the identified impacts on VCs and relevant management plans.

[5] BEZA (February 2020) Stakeholder Engagement Plan (SMP) of Bangladesh Economic Zones, Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1. ENVIRONMENTAL AND SOCIAL POLICIES, ACTS, AND LEGISLATIONS IN BANGLADESH

28. The GoB has developed policies, frameworks, acts, and legislation that require environmental and social issues to be incorporated into economic development planning. The key tenets of the various applicable legislations are detailed in the following **Table 2-1.**

2.2. WORLD BANK ENVIRONMENTAL AND SOCIAL FRAMEWORK

29. The World Bank's environmental and social framework is a strategic idea in protecting the world's sustainability regarding its people and resources. The updated World Bank Environmental and Social Framework (ESF), 2018 reflects evolving international standards and best practices in sustainable development and environmental protection. Additionally, the ESF document discusses the relevance and requirements relating to other guidance notes of the World Bank. The ESF covers 10 Environment and Social Standards (ESS)s which are essential tools for ensuring that World Bank-funded projects contribute to positive development outcomes while minimizing potential adverse impacts on people and the environment.

30. Applicable to the proposed sub-project, the World Bank's ESS relevance to the national regulations and their gap analysis are summarized in **Table 2-2**.

Table 2-1: Environmental and Social Related Policies, Acts, and Legislations in Bangladesh

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
1.	National EnvironmentalPolicy, 1992	Key elements of this Policy are: maintaining ecological balance and ensuring sustainable development of the country through protection, conservation, and improvement of the environment; protecting the country from natural disasters; identifying and regulating all activities that pollute and destroy the environment; ensuring environment- friendly development in all sectors; ensuring sustainable and environmentally sound management of the natural resources and promoting active association, as far as possible with all international initiatives related to the environment. The Environmental Policy of 1992 requires specific actions with respect to the industrial sector which are as follows: to carry out corrective measures in polluting industries; to conduct EIAs for all new public and private industrial developments; To ban or find environmentally sound alternatives for the production of goods that cause environmental pollution and to minimize waste and ensure sustainable use of resources by industry.	To ensure sustainable development and environmentally sound management of the natural resources and to meet the DoE/GOB regulatory requirement, this sub-project will follow this policy. To minimize adverse impacts on local air quality, noise levels, soil and water quality, while also protecting the local biological diversity during implementation of the sub-project.
2.	National Environnemental Management Action Plan (NEMAP),1995	NEMAP was developed to achieve the following broad objectives: identification of key environmental issues affecting Bangladesh; identification of actions necessary to halt or reduce the rate of environmental degradation; improvement of the natural environment; conservation of habitats and biodiversity; Promotion of sustainable development and improvement of the quality of life of the people.	Following this plan, the Environmental and Social Impact Assessment (ESIA) and the Environmental and Social Management Plan (ESMP) has been prepared to mitigate the adverse effects on both the natural and social environments resulting from sub-project activities.
3.	National Land use Policy, 2001	Optimum use of land and water depends on planned use of land, water resources and natural environment which are important sources for growth. It is possible to ensure optimum use of scarce land resources by way of integrating the uses of three natural resources. With this end in view, the government has approved National Land Use Policy, Bangladesh. The government has adopted various other national policies and measures to prevent land depletion. These include The National Environmental Policy, Bangladesh Environment Conservation Act, 2005 and Environment Conservation Rules, 1997, and National Forest policy and national Plans.	By implementing this policy in sub-project, land will be utilized efficiently and sustainably through minimizing the impacts to land, water resources and natural environment.
4.	Dredging and Dredged Material Management Policy, 2013	The Dredging and Dredged Material Management Policy of 2013 is a policy framework aimed at regulating dredging activities and managing dredged material in a sustainable and environmentally responsible manner. Dredging refers to the process of excavating sediments and debris from the bottom of water bodies such as rivers, lakes, harbors, and ports to deepen channels, maintain navigation routes, or reclaim land. The policy also emphasizes the importance of conducting regular monitoring and evaluation of dredging projects to assess their environmental impacts and effectiveness in achieving policy objectives. Additionally, it may provide guidance on the development of dredged material management plans, sediment testing protocols, and best practices for the disposal or reuse of dredged material.	This policy is relevant to this sub-project. By implementing this policy, dredging activities and managing dredge materials in a sustainable and environmentally friendly way through assessing the environmental impacts and monitoring and evaluation of effectiveness policy to reduce the distress on natural resources, water, land, and aquatic ecosystems as well as reducing impacts on worker's health and safety.
5.	Bangladesh Climate Change Strategy and	The GOB prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and revised it in 2009. This is a comprehensive strategy to address climate change	By following this plan, the sub-project will promote greenery activities to effectively offset carbon

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
	Action Plan 2009 (amendment 2022)	challenges in Bangladesh. There are 44 specific programs proposed in the BCCSAP under six themes. Establishment of six strategic pillars for action, including (l) food security, social protection, and health, (2) disaster management, (3) protective infrastructure, (4) research and knowledge management, (5) Decreased carbon development, and (6) capacity building and institutional strengthening.	emissions and mitigate the impacts of climate change on the lives and livelihoods in the sub-project areas.
6.	National Land Use Policy, 2001	Deals with several land uses including agriculture (crop production, fishery, and livestock), housing, forestry, industrialization, railways and roads, tea, and rubber and identifies land use constraints in all these sectors.	Sub-project can lead to significant alter in land use, which can have long-term consequences for the environment, local communities, and economic sustainability. By implementing this policy, BEZA can better manage land resources and promote a balanced approach to development.
7.	National Agriculture Policy, 2018	This policy aims to make the nation self-sufficient in food by increasing production of all crops including cereals and ensuring a dependable and secure food system for all. The policy particularly stresses research and development of improved varieties and technologies for cultivation in waterlogged and salinity-affected areas. The policy also recognizes that adequate measures should be taken to reduce water logging and salinity and provide irrigation facilities for crop production. The aims are also to ensure a sustainable agricultural production system, preservation and development of land productivity, and preservation of crop biodiversity.	The importance of aligning proposed sub-project activities with this Policy, particularly focusing on minimizing impacts on agricultural land and ensuring the protection of irrigation systems. It emphasizes the need for adequate measures to mitigate waterlogging and prevent disruptions to agriculture practices.
8.	Environmental Conservation Act, 1995 (amendment 2010)	Defines applicability of environmental clearance; regulation of development activities from the environmental perspective; framing applicable limits for emissions and effluents; framing of standards for air, water, and noise quality; formulation of guidelines relating to control and mitigation of environmental pollution, conservation, and improvement of environment and declaration of Ecologically critical areas.	The Environmental Conservation Act of 1995 serves as a pivotal framework for addressing various environmental issues to protect natural resources, preserve biodiversity, and ensure a healthier environment for future generations. So, this act is applicable for sub-project, implementation in the sub-project areas. .
9.	Environmental Conservation Rules, 2023	Environment Conservation Rules, 2023 and Environmental Clearance (EC) Procedures The Environment Conservation Rules (ECR), 2023 provides a basic framework for the environmental evaluation of proposed projects in all sectors and establishes procedures. Accordingly, the project proponent should first obtain a location clearance and conduct the appropriate study to obtain environmental clearance for the project. Any project constructed in Bangladesh must obtain an Environmental Clearance Certificate (ECC) before its operation. Like the Environmental Screening process of the projects, Rule 5 of ECR, 2023 has classified the projects into the following four categories based on the site conditions and the impacts on the environment. The projects are categorized into four categories they are: Green, Yellow, Orange, and Red. Various industries/projects falling under each category have been listed in Schedule 1 of the ECR, 2023. According to the rules of ECR, 2023, Red category projects require a location	Environmental issues are taken care of under this act. As per the ECR 2023 Schedule the project falls under the Red Category: Development of land (over 25 acres); and landfilling, dredging and management of dredging materials (over 5 km). Therefore, location clearance and an Environmental Clearance Certificate (ECC) would be required.

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
		clearance certificate followed by the issuing of ECC upon the satisfactory submission of the required documents.	
10.	Environment Court Act, 2000 (amendment 2002)	Provides the jurisdictions of the environment court, the penalty for violating the court's order, trial procedure in special magistrate's court, the power of entry and search, the procedure for investigation, procedure, and power of the environment court, the authority of environment court to inspect, appeal procedure and formation of the environment appeal court.	The applicability of the act, particularly in the context of violations that may occur during the implementation of sub-project activities. It aims to provide clarity on the legal framework established by the Act and its implications for environmental governance.
11.	Noise Pollution (Control)Rules, 2006	Prevention of Noise pollution and standards for noise levels. The rules provide for standard limits of noise level of vehicles and designated areas. According to the rule, motor honking within a 100-meter radius of a hospital, school or office is prohibited. The rules also do not allow use of brick crushers and cement mixers within a 500-meter radius of a residential area. Besides, prior permission is mandatory for using loudspeakers or megaphones. The rules stipulate safety and precautionary measures in workplaces, and designated authorities for allowing noise-generating appliances.	By implementing the noise pollution rules, suggested mitigation measures can be applied to reduce the noise generation impact on the workers and local community.
12.	Air Pollution (Control) Rule, 2022	The main objectives of this rule are to prevent, control, and reduce air pollution. The government will appoint a director general who will be responsible for managing and maintaining the environmental issue. The Rule specified several types of pollution such as pollution caused by factories, vehicles, construction, garbage, etc. According to the new rule, there will be a committee that will impose damages and punishment for such pollution. As stated by the rule, the government will give rewards to those who will protest against pollution and do not cause any type of pollution.	The significance of the Air Pollution Control Rules 2022 in relation to the sub-project activities that may generate emissions such as smoke, dust, and flumes and mitigating potential environmental impacts arising from sub-project activities.
13.	Solid Waste Management Rules, 2021	The Regulations define the responsibilities of businesses involved in solid waste management and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The Regulations also include provisions for the treatment of solid waste such as composting and energy recovery.	By implementing the Solid Waste Management Rules 2021 can help to minimize waste generation, promote recycling, and ensure safe disposal of waste, and foster environmental sustainability and public health during sub-project implementation.
14.	National 3R Strategy for Waste Management, 2010	The strategy for solid waste management is essential in order to minimize the environmental, social and economic problems by applying the 3R (reduce, reuse & recycle) strategy.	By implementing this Strategy, the 3R strategy can be applied to the management of construction waste and minimizing environmental impact during the implementation of sub-project activities.
15.	National Land TransportPolicy (NLTP), 2004	This policy introduced the concept of long-term network planning and integration of transport policy, planning, and appraisal across land transport modes. Each sub-sector undertakes physical and institutional improvement in line with its long-term policy. As indicated in the NLTP, environmental adaptation needs to be taken into account in project assessment which will help to mitigate climate change.	Following this policy, traffic, and transport in the sub-project areas can help safely handle the movements of construction vehicles and public transport during the transportation of construction materials and workers and reduce accidents or incidental events.
16.	The Groundwater Management	Management of groundwater resources; Installation of tube- wells at any place after licensing from Upazila Parishad.	It is not relevant to this sub-project; no groundwater tube well is required to be installed during dredging

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
	Ordinance, 1985		activities. However, the safe use of groundwater will be enhanced during the implementation of the proposed sub-project.
17.	The National Water Act, 2013	The National Water Act, of 2013 is based on the National Water Policy, of 1999 and provides the legal framework for integrated development, management, abstraction, distribution, usage, protection, and conservation of water resources in Bangladesh. The Act authorized DoE to prevent water pollution. The Act denotes water pollution as 'direct and indirect harmful changes of physical, chemical and organic properties of water'.	The National Water Act, of 2013 mandates responsible management of water resources, particularly in relation to stormwater disposal. To adhere to these provisions, the sub-project will establish a stormwater disposal system to effectively manage and control runoff. These structures will play a crucial role in preventing pollutants from entering the aquatic environment and safeguarding water quality.
18.	National Water Bodies Protection Act, 2000	The characterization of water bodies as rivers, canals, tanks, or floodplains identified by municipalities in division and district towns shall not be changed without the approval of the concerned ministry.	The National Water Bodies Protection Act can ensure the preservation and protection of water bodies from pollution, encroachment, and other forms of degradation. Given the proximity of the sub-project to the Bay of Bengal, it is imperative to adhere to the provisions of this Act to maintain the ecological balance and protect the livelihoods of communities dependent on these water resources.
19.	The Forest Act, 1927 and subsequent amendmentsin 1982 and 1989; National Forest Policy, 1994. (Amendment 2010)	Categorization of forests as reserve, protected, and village forests; Permission is required for the use of forest land for any non-forest purposes and Conservation of private forests and afforestation on wastelands	There will be afforestation activities along the roads, green spaces within industry compounds, landscaping, etc. under 2A & 2B zones and its adjoining areas which are very much adjacent to the sub-project area.
20.	National Fisheries Policy,1998	Preservation, management, and exploitation of fisheries resources in inland open water; fish cultivation and management in inland closed water; prawn and fish cultivation in coastal areas and preservation, management, and exploitation of sea fisheries resources.	The implications of the National Fisheries Policy, 1998, particularly in relation to water pollution that may arise from sub-project interventions. It highlights the potential impacts on the surface water quality of khals (canals) and adjacent sea areas, emphasizing the need for careful consideration and management to protect aquatic ecosystems.
21.	Marine Fisheries Act, 2020	Bangladesh has a legal framework for the regulation of marine living resources. The regime includes laws, policies, by-laws, and statutory orders issued from time to time by the Department of Fisheries (DoF), a division of the Ministry of Fisheries and Livestock (MoFL). The Marine Fisheries Act 2020 (2020 Act) is the principal legislation. It provides substantive rules	The Marine Fisheries Act 2020 provides guidelines and regulations that govern fishing activities, aiming to balance economic developments and environmental sustainability. Given that the sub-project is situated in

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
		concerning the fishing activities of the local and foreign fishing vessels within Bangladesh's maritime area. The 2020 Act deals mainly with the issue, renewal, revocation, and cancellation of licenses and permits, and the conditions thereof, for catching of fish in Bangladesh's marine waters and by Bangladesh vessels on the high seas. Other major provisions of the 2020 Act relate to the adoption and implementation of management measures, designation of offenses and penalties, appeals, and additional administrative procedures about the breach of any fishing rules. Before the enactment of the 2020 Act, the marine fisheries sector was regulated by the Marine Fisheries Ordinance 1983, which covered most of the matters noted above. Therefore, the new law does not offer anything that significantly enhances Bangladesh's marine fisheries management.	proximity to the Bay of Bengal to this important marine area, adherence to the provisions of the Act is essential.
22.	IUCN (1994) Guideline for Protected Area Management	According to IUCN (1994), protected areas can be defined as an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. As per the IUCN (1994) system protected areas considered are strict nature reserves, wilderness areas, national parks, natural monuments, habitat species, management areas, protected landscapes, seascape, and managed resource-protected areas.	The IUCN (1994) Guideline for Protected Area Management is not applicable due to the absence of protected areas in the sub-project areas, it is crucial to ensure that the biological diversity and natural resources within these sub-project areas are managed effectively.
23.	Coastal Zone Policy, 2005	The Coastal Zone Policy of 2005 is a framework established to manage and protect Bangladesh's coastal areas. It aims to balance economic development with environmental conservation, addressing issues, such as sustainable resource use, disaster risk reduction, and climate change adaptation. The policy emphasizes community participation, integrated coastal zone management, and the preservation of coastal ecosystems. It also promotes the sustainable development of coastal resources while safeguarding natural disasters like cyclones and sea-level rise. Overall, the Coastal Zone Policy of 2005 guides planning and decision-making to ensure the sustainable development and resilience of Bangladesh's coastal regions	The Policy is designed to safeguard coastal ecosystems while promoting sustainable development. The sub-project is situated in proximity to the coast, it becomes imperative to align with this policy to mitigate potential environmental impacts and ensure that coastal resources are utilized responsibly.
24.	Wildlife (conservation and security) Act, 2012	The Wildlife (Conservation and Security) Act, 2012 is the revamped version of the Bangladesh Wildlife (Preservation) Order, 1973, and the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. The act is an improved version taking into consideration current development issues and management tools. The act has adopted ten (10) new types of protected areas for the conservation and protection of wildlife resources, created avenues for community-conserved areas, and community-based management of protected areas. The act has included a revised schedule of protected wildlife and has included many species that were previously not listed as protected wildlife such as the Ganges River dolphin and smooth-coated otters in the rivers. This act proposed 1 (one) year imprisonment and a BDT 50,000 fine for violation of the law. The law also proposed at least two (02) years and the highest 7 (seven) years of imprisonment and minimum BDT 1 (one) Lakh and a maximum BDT 10 Lac fine for killing a tiger or elephant.	The commitment of the sub-project is to adhere to the Wildlife (Conservation and Security) Act, 2012, ensuring the safety and protection of wildlife in areas where wild animals, such as foxes and deer, are present. The importance of wildlife conservation is paramount, and this sub-project aims to implement measures that safeguard these species while promoting sustainable development.
25.	Biodiversity Act, 2017	It provides for the creation of the National Committee and the Biodiversity Management and Surveillance Committees at local levels (i.e., Districts, Upazilas, Municipalities, and Unions). In general, all these committees are mandated to assist the Government in implementing the	The commitment of the sub-project to adhere to the Biodiversity Act, of 2017, serves as a framework for protecting biological diversity and ensuring

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
		National Biodiversity Strategy and Action Plan (NBSAP) and to visit the biodiversity-enriched areas in their respective territories; and monitor the progress of implementation of the NBSAP.	sustainable use of its components. By aligning with the provisions of this legislation, the sub-project aims to contribute positively to the preservation of ecosystems and the diverse species that inhabit them.
26.	National Biodiversity Strategy and Action Plan,2021	Conserve and restore the biodiversity of the country for the well-being of the present and future generations; maintain and improve environmental stability for ecosystems; ensure the preservation of the unique biological heritage of the nation for the benefit of the present and future generations; guarantee the safe passage and conservation of globally endangered migratory species especially birds and mammals in the country; stop the introduction of invasive alien species, genetically modified organisms and living modified organisms	The sub-project is committed to upholding the principles outlined in the National Biodiversity Strategy and Action Plan, 2021. By implementing targeted actions aimed at conserving biodiversity, the project will contribute to the overall health of ecosystems and the well-being of communities.
27.	Labor Act 2006 and amendment 2013	The Labor Act is the most comprehensive labor and workplace-related legislation in the country, consolidating the provisions of 25 separate acts into a single labor code in 2006. Among others, it sets occupational safety and health standards, compensation for injury and accidents in the workplace, maternity benefits, factory inspectorate, and restrictions in child labor. The responsibility of enforcing workplace safety such as fire safety, and welfare of workers has been given to the Department of Inspection for Factory and Establishments (DIFE), which is under the Ministry of Labor and Employment. The law applies to all "establishments" which are defined widely to include, shops, hotels, restaurants, factories (though these must employ more than five laborers), plantations, docks, transport services, construction sites, and "any premises in which laborers are employed to carry on any industry." It does not apply to the agricultural sector – though it does apply to, tea plantations, and certain obligations apply to tea gardens. The agencies mandated to implement the law include the Department of Labor/Labor Directorate (DOL) and the Department of Inspection for Factories and Establishments. 92.68.Bangladesh modified its maternity benefit provisions by enacting the Bangladesh Labor Act, 2006, repealing three different Acts, i.e., the Maternity Benefit Act, 1939; the Mines Maternity Benefit Act, 1941; and the Maternity Benefit (Tea Estate) Act, 1950. 93.69.The labor market of Bangladesh is one of the major attractions for foreign investors due to the cheap wage rate and availability of skilled labor. To safeguard the interest of the laborers, the Government has implemented several laws and regulations recently. The labor laws are governed by the decision-making Act 2006 as amended in 2010 and 2013 and Labor Rules 2015.	It outlines the responsibilities and requirements for ensuring the welfare of laborers during the construction phase of the sub-project. It emphasizes the importance of providing basic amenities, adhering to labor laws, and ensuring the safety and health of workers. The guidelines set forth aim to protect the rights of laborers and ensure compliance with government regulations.
28.	National Profile on Occupational Safety and Health in Bangladesh, 2019	The National Occupational Health and Safety Policy, 2013 addresses national commitment as per the Constitution for continual improvement of occupational health and safety management system 21 of the establishment to prevent or reduce workplace fatalities and work-related diseases. The policy specified the obligations of all relevant stakeholders and organizations. With the objectives, the various roles and responsibilities of relevant stakeholders including government, factory/business owners, trade union, employers, and workers are clearly	It provides an overview of the National Profile on Occupational Safety and Health (OSH) in Bangladesh 2019, and its relevance to sub-project activities that involve various categories of workers. Ensuring the safety and health of workers is paramount, and this profile serves as a foundational reference for

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
		identified and established. The Ministry of Labor and Employment (MoLE) is mainly responsible for the implementation and development of a national action plan under the policy coordinating with all stakeholders. The key provisions include occupational accidents, hazards, and diseases related to accident prevention regulations, prevention from workplace hazards, disease prevention and safeguards, record keeping and planning, rehabilitation, and awareness building. The National OSH Policy also ensures safety in transportation, maintenance, and use of chemicals used in the production process. Some of the laws pertaining to occupational health and safety apply to this project.	implementing effective OSH measures in diverse work environments.
29.	BEZA Act, 2010	Under this act, BEZA, economic zone developers, and industrial units established in the economic zones shall be bound to comply with international commitments recognized by the Government of Bangladesh including compliance with all the existing laws on environment and environmental protection.	The BEZA Act, 2010, focuses on the regulation of social and environmental issues associated with the development of projects for promoting sustainable development and ensuring the engagement of local communities during the implementation of projects and industries in the BEZA zones.
30.	Bangladesh National Building Code (BNBC),2020	The Bangladesh National Building Code (BNBC) clearly sets out the constructional responsibilities according to which the relevant authorityof a particular construction site shall adopt some precautionary measures to ensure safety. The BNBC also stipulates the general duties of the employer to the public as well as workers. According to this section, "All equipment andsafeguards required for the construction work such as the temporary stair,ladder, ramp, scaffold, hoist, runway, barricade, chute, lift shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them". The Code also clarifies the issueof the safety of workmen during construction and in relation to this, sets out the details about the different safety tools of specified standards. In relation to the health hazards of the workers during construction, this chapter describes the nature of the different health hazards.	The significance of the Bangladesh National Building Code (BNBC) in the context of constructing various types of buildings within a sub-project area. The BNBC serves as a comprehensive guideline that ensures safety, sustainability, and efficiency in building practices.
31.	Balumahal and Soil Management Act, 2023	Balumahal and Soil Management Act, 2023 provides to overcome the hazards faced and extraction of sand/soil in a planned manner during leasing out of Balumahal. The act imposes the restriction of extraction of sand from specified areas on certain conditions. This act includes the illegal extraction of sand as an offense and is subject to trial for a penalty for such activities.	This act plays a significant role in the regulation of land development activities, including dredging. Although it may not be directly applicable in this sub-project, however, understanding its provisions is essential for ensuring compliance and promoting sustainable land use practices, particularly within the framework of BEZA's land management initiatives.
32.	Standing Order on Disaster, 2010 and Disaster Management Act,2012	The Order (2010) and Act (2012) address activities related to disaster management in a coordinated, object-oriented manner and strengthened way and formulate rules to build up infrastructure aspart of effective disaster management to fight against all types of disasters.	It is relevance to the sub-project activities, as the sub-project sites located in cyclone-prone areas. It emphasizes the importance of adhering to these regulations to ensure safety and preparedness in the face of natural disasters, specifically cyclones.

SN	Acts /Rules/ Polices/Plans	Key provisions and purpose	Relevance with the sub-project
33.	Bangladesh EPZ/EZ LaborLaw Ordinance No 01, 2019	This law has been designed to ensure occupational health & safety, cleanliness, safety and welfare management, no discrimination in termsof wage, and a well as human rights at the working site.	The ordinance outlines the procedures for handling complaints and ensures that labor rights are protected in these specialized economic areas.
34.	EIA Guidelines for Industry, 2021	The EIA Guidelines for Industry, 2021, introduced by the Department of Environment (DoE), Bangladesh, is the only guidelines for conducting an Environmental Impact Assessment which is a formal study process used for impact identification, casting and evaluation, environmental consequences, and plans for mitigation measures, and monitoring programs of proposed development industries, projects and activities. This involves the study of the probable changes in the physical and biological as well as socio-economic environment that may result from the proposed development activities or projects, and a suitable environmental management plan to minimize adverse effects on the one hand to enhance positive effects on the other. In Bangladesh, Initial Environmental Examination (IEE) and EIA study have been made regulatory needs under certain categories of projects as specified in the Environment Conservation Rule, 1997 for obtaining an Environmental Clearance Certificate which is mandatory for any industrial and other development projects. Since IEE and EIA are mainly used as decision-making tools, they must be linked to the project planning process, and their findings and measures are integrated throughout the entire project cycle –inception, feasibility, technical design, cost estimation, preparation of a portfolio, and various phases of project implementation. In Bangladesh, it has, in fact, not been the case.	Adhering to the EIA Guidelines during the development of the ESIA report and the process of obtaining Environmental Clearance from the DoE is essential for promoting sustainable development and protecting the environment. By following these guidelines, project developers can ensure their projects are environmentally sound and socially responsible.
35.	Fire Prevention and Fire Fighting Act, 2003	According to the act, every owner of the building is to take precautions and other measures necessary for public safety. It depicts, notwithstanding anything contained in any other law, without the approval of the Directorate General of Fire Service and Civil Defense regarding fire prevention or extinction, no structural design or layout of the multi-storied commercial building shall be approved or amended. For fire extinguishing, water shall be collected from nearby any water bodies where the owner of these water bodies or any other person shall not give any objection to use.	By implementing the Act's provisions, BEZA can foster a culture of safety, reduce the risk of fire incidents, and ensure compliance with legal requirements. This proactive approach not only protects lives but also enhances the overall integrity and success of the development project.
36.	Child Labor Elimination Policy, 2010, Bangladesh EPZ/EZ Labor Law Ordinance No 01, 2019	Children should withdraw working from in different forms of occupations, e.g., hazardous work and the worst forms of child labor; Providing special emphasis on indigenous and physically challenged children to bring them back to the congenial environment; Planning and implementing different short-, medium-, and long-term strategies and programs to eliminate various forms of child labor.	It emphasizes the importance of preventing child labor during the construction period, particularly considering the anticipated labor influx that may occur. The policy aims to ensure that all labor practices adhere to legal standards and promote the welfare of children in the workforce.

Table 2-2: World Bank ESSs, Pertinent GoB's Environmental and Social Policies Relevant to the Sub-project, and Gap Analysis

Sl No	World Bank ESF-ESS Standards	World Bank's ESF 2018		Equivalent National Environmental Policy and Regulations	Relevance & Non-Relevance to the Sub-project	Gaps and remedy redressal
		Objectives	Requirements			
1.	World Bank Environment and Social Policy for Investment Project Financing	It sets out the mandatory requirements of the Bank about the sub-project it supports through Investment Project Financing.	The types of E&S risk and impacts that should be considered in environmental and social assessment. The use and strengthening of the environmental and social assessment, development, and implementation of World Bank-financed projects where appropriate.		Applicable to this Zones development project as the sub-project is funded by the World Bank. By adhering to this principle, the sub-project can safeguard the well-being of communities and the environment by implementing the Environmental and Social Impact Assessments (ESIA), Engaging local communities, mitigating the impacts establishing the monitoring mechanism, etc.	
2.	ESS-1 Assessment and Management of Environmental and Social Risks and Impacts	Identify, assess, evaluate, and manage environmental and social risks and impacts in a manner consistent with the ESF. Adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable, and they are not disadvantaged in sharing development benefits and opportunities.	The types of E&S risk and impacts that should be considered in the environmental and social assessment. The use and strengthening of the Borrower's environmental and social framework for the assessment, development, and implementation of World Bank-financed projects where appropriate.	National Environmental Policy, 1992; NEMAP 1995; ECR 2023; ECA 1995 and subsequent amendments until 2010; Noise Pollution (Control) Rules 2006; Air Pollution (Control) Rule 2022; Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009; BEZA Act, 2010	The ESS-1 is relevant to the sub-project, highlighting the E&S risks and impacts that have been identified based on baseline environmental and social surveys and consultations with primary stakeholders including communities, surrounding communities, and the project implementing unit.	By and large, the national policies and regulations are consistent with the requirements of ESS-1
3.	ESS-2 Labor and Working Conditions	Promote safety and health at work. Promote the fair treatment, non-discrimination, and equal opportunity of project workers. Protect project workers, with particular emphasis on vulnerable workers. Prevent the use of all forms of forced labor and child labor. Support the principles of freedom of	Requirements for the Borrower to prepare and adopt labor-management procedures. Provisions on the treatment of direct, contracted, community, and primary supply workers and government civil servants. Requirements on terms and conditions of work, non-discrimination and equal	Bangladesh Labor Law, 2006, Bangladesh Labor Act, 2013 and Bangladesh Labor Rules, 2015 Bangladesh EPZ/EZ Labor Law Ordinance No 01, 2019 Industrial Policy, 1999 Noise Pollution (Control) Rules 2006	ESS-2 is directly relevant to this sub-project since the sub-project project will engage direct, contracted, migrant workers and primary suppliers. ESS-2 will ensure labor and housekeeping. i) Direct workers will include the project managers and supervisors, who are employees of PIU, BEZA, deployed for PRIDE; ii) Contracted workers will be the workforce deployed by the	The national legal provisions almost cover all requirements of ESS2. Under the PRIDE project of the BEZA object's Labor management procedure has been prepared to regulate working conditions and management of

Sl No	World Bank ESF-ESS Standards	World Bank's ESF 2018		Equivalent National Environmental Policy and Regulations	Relevance & Non-Relevance to the Sub-project	Gaps and remedy redressal
		Objectives	Requirements			
		association and collective bargaining of projectworkers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns.	opportunity, and worker's organizations. Provisions on child labor and forced labor management. Requirements on occupational health and safety, in keeping resemblance with the World Bank Group's Environmental, Health, and SafetyGuidelines (EHSG).	Air Pollution (Control) Rule 2022	Contractors and the sub-project Management Unit under the PRIDE project. The Contractor(s) might further engage multiple subcontractors. iii) The influx of migrant workers from another area for construction works hasbeen a norm in the project area and is likely to continue in this sub-project; iv) Primary supplier workers will be the workers who will be providing goods and materials e.g., dredging materials land development, etc..	worker relations including workers specific GRM, terms, and conditions of employment, non-discrimination and equal opportunity, protection of workforce, prohibition of child/forced labor and provision of OHS.
4.	ESS-3 Resource Efficiency and Pollution Prevention and Management	Promote the sustainable use of resources including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Minimize and manage the risks and impacts associated with pesticide use. Requires technically and financially feasible measures to improve efficient consumption of energy, water, and raw	Requires an estimate of gross greenhouse gas emissions resulting from the project (unless minor) where technically and financially feasible. Requirements on management of wastes, chemicals, and hazardous materials and contain provisions to address historical pollution. ESS-3 refers to national law and Good International Industry Practice, in the first instance the World Bank Groups' EHSGs.	National Fisheries Policy, 1998 Water Supply and Sanitation Act, 1996 Ground Water Management Ordinance, 1985 National Water Bodies Protection Act, 2000 National Agriculture Policy, 2013 National Water Act, 2013 Noise Pollution (Control) Rules, 2006 The Sustainable and Renewable Energy Development Authority Act, 2012 (Act No. 48 of 2012) National Strategy for Waste Management Environment Court Act, 2000 and amendment in	This sub-project is relevant to the ESS-3. It emphasizes the importance of identifying feasible measures during the sub-project preparation and Environmental and Social Assessment (ESA) process. The focus is on optimizing energy and water usage, utilizing local and recycled materials, and implementing effective pollution management strategies to mitigate potential environmental impacts. Raw materials are used by exploring local materials, recycled aggregates, use of innovative technology to minimize the project's footprints on finite natural resources. The sourcing of construction materials would also need to be consistent with the provision of WBG EHSG. With respect to Pollution Management,	GOB has rules and regulations those address the pollution prevention such as ECA 95, ECR 97/2023, Rules for hazardous waste management and strategies for adaptation and mitigation to climate change. While many ESS3 requirements are addressed by existing regulations, there are gaps in many cases such as lack of rules directly addressing the issues related to sourcing of construction

Sl No	World Bank ESF-ESS Standards	World Bank's ESF 2018		Equivalent National Environmental Policy and Regulations	Relevance & Non-Relevance to the Sub-project	Gaps and remedy redressal
		Objectives	Requirements			
		materials and introduces specific requirements for water efficiency where a project has high water demand.		2002 National 3R Strategy for Waste Management, 2010 Solid Waste Management Rule 2021	based on similar project experiences, the project will develop, as part of the ESA process, prevention and management measures to offset risks and impacts of pollution from potential sources such as dust and emission from the operation of the generator, blower, compressor, dredger, vehicles, material and spoil stockpile; effluents and wastewater from labor camps, construction camp; spillage or leakage during handling of chemical and, hazardous materials like high strength diesel, used oil, battery wastes etc.; and disposal of non-hazardous wastes generated during project implementation period.	material, resource efficiency etc.
5.	ESS-4 Community Health and Safety	Anticipate or avoid adverse impacts on the health and safety of project-affected communities during the project life-cycle from routine and non-routine circumstances. Promote quality, safety, and climate change considerations in infrastructure design and construction including dams. Avoid or minimize community exposure to project-related traffic and road safety risks, diseases, and hazardous materials. Have in place effective measures to address emergency events. Ensure that the safeguarding of	Requirements on infrastructure taking into account safety and climate change, and applying the concept of universal access where technically and financially feasible. Requirements on traffic and road safety including road safety assessments and monitoring. Addresses risks arising from impacts on provisioning and regulating ecosystem service. Measures to avoid or minimize the risk of water-related, communicable, and non-communicable diseases. Requirements to assess risks associated with security	National Water Bodies Protection Act, 2000 Noise Pollution (Control) Rules 2006 National 3R Strategy for Waste Management, 2010 Solid Waste Management Rule 2021 Bangladesh National Building Code (BNBC), 2020 Bangladesh EPZ/EZ Labor Law Ordinance No 01, 2019	The ESS-4 Community Health and Safety considerations are critical in the planning and execution of the sub-project activities. Addressing the potential impacts of construction activities, increased traffic, environmental disturbances, and social dynamics will be essential for safeguarding the health and safety of the local community. Implementing effective mitigation measures will help to minimize risks and foster a positive relationship between the project and the community.	In the existing GoB regulatory systems (laws, rules, policies and acts), there is no direct community health and safety. Hence, these policies fulfill community health and safety partially. The gaps are addressed through suitable provisions in ESMP. In addition, the contractor will be responsible for implementing the ESMP regarding community health

Sl No	World Bank ESF-ESS Standards	World Bank's ESF 2018		Equivalent National Environmental Policy and Regulations	Relevance & Non-Relevance to the Sub-project	Gaps and remedy redressal
		Objectives	Requirements			
		personnel and property is carried out in a manner that avoids or minimizes risks to the project-affected communities.	personnel, and review and report unlawful and abusive acts to relevant authorities.			and safety, which includes the OHS plan, labor Influx Management Plan, workers camp management plan, traffic and road safety management plan etc.
6.	ESS-6 Biodiversity Conservation	Protect and conserve biodiversity and habitats. Apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources.	Requirements for projects affecting areas that are legally protected designated for protection or regionally/internationally recognized to be of high biodiversity value. Requirements on sustainable management of living natural resources, including primary production and harvesting, distinguishing between small-scale and commercial activities. Requirements relating to primary suppliers, where a project is purchasing natural resource commodities, including food, timber, and fiber.	National Biodiversity Strategy and Action Plan (2004) The Forest Act, 1927 and subsequent amendments in 1982 and 1989 National Forest Policy, 1994 Wildlife Conservation (Protection and Safety) Act, 2012 Bangladesh Biodiversity Act, 2017	The relevance of ESS-6 to the sub-project highlights the importance of considering ecological impacts in land development initiatives. By implementing the proposed mitigation and control measures, it is possible to minimize adverse effects on local habitats and maintain ecological functions. The commitment to environmental sustainability will not only protect biodiversity but also enhance the overall resilience of the ecosystem in the face of development pressures.	Provisions from the acts meet the ESS requirements. ESMP will be prepared to address the marine biodiversity in dredging locations of the Sandwip channel
7.	ESS-8 Cultural Heritage	Protect cultural heritage from the adverse impacts of projectactivities and support its preservation. Address cultural heritage as an integral aspect of sustainable development. Promote meaningful consultation with	Requires a chance to finds a procedure to be established. Recognition of the need to ensure peoples' continued access to culturally important sites, as well as the need for confidentiality when revealing information about cultural heritage assets that	Cultural Heritage Prevention Policy of Bangladesh, Ministry of Cultural Affairs	The sub-project activities are not expected to impact cultural heritage. However, the inclusion of a 'chance find' procedure in the EMPs serves as a precautionary measure to address any unexpected discoveries, ensuring that cultural heritage is respected and preserved throughout the project lifecycle.	Currently, no official cultural heritage policy is available in Bangladesh hence provisions from the act do not fully meet the ESS requirements.

Sl No	World Bank ESF-ESS Standards	World Bank's ESF 2018		Equivalent National Environmental Policy and Regulations	Relevance & Non-Relevance to the Sub-project	Gaps and remedy redressal
		Objectives	Requirements			
		stakeholders regarding cultural heritage. Promote the equitable sharingof benefits from the use of cultural heritage.	would compromise or jeopardize their safety or integrity. Requirement for fair and equitable sharing of benefits from commercial use of cultural resources. Provisions of archaeological sites and materials, built heritage, natural features with cultural significance, and moveable cultural heritage.			Chance find procedures is included in ESMP. Impacts on religious structures (not protected, but social and cultural value) will be mitigated or managed through provisions for restoration.
8.	ESS-10 Stakeholder Engagement and Information Disclosure	Establish a systematic approach to stakeholder engagement that helps Borrowers identify stakeholders and maintain a constructive relationship with them. Assess stakeholder interest and support for the project and enable stakeholders' views to be taken into account in project design. Promote and provide means for effective and inclusive engagement with project-affected parties throughout the project life cycle. Ensure that appropriate project information is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner.	Requires stakeholder engagement throughout the project life cycle, and preparation and implementation of a Stakeholder Engagement Plan (SEP). Requires early identification of stakeholders, both project-affected parties and other interested parties, and clarificationon how effective engagement takes place. Stakeholder engagement to be conducted in a manner proportionate to the nature, scale, risks and impacts of the project, and appropriate to stakeholders' interests. Specifieswhat is required for informationdisclosure and to achieve meaningful consultation.	Environmental conservation Rules, 2023 Right to Information Act, 2009	ESS-10 Stakeholder Engagement and Information Disclosure is integral to the sub-project's success. By adhering to the World Bank's principles of transparency and knowledge sharing, the project can ensure that all stakeholders are informed and engaged, ultimately leading to better project outcomes and community support. It highlights the importance of public access to information regarding the Environmental and Social Management Plan (ESMP) during both the preparation and implementation of the sub-project.	Environmental Impact Assessment Notification-1997 is not applicable to the EZ-project though it has provisions for public hearing as part of impact assessment process. The PRIDE Project has prepared a Stakeholder Engagement Plan (SEP) to engage with all stakeholders relevant to the different components and sub-components of the project.
World Bank Groups' EHSGs, IFC, 2007						
9.	General EHS Guidelines, April,	The General EHS Guidelines contain	Requirements on environmental, health, and		The General EHS Guidelines of IFC are a vital resource for the successful	

Sl No	World Bank ESF-ESS Standards	World Bank's ESF 2018		Equivalent National Environmental Policy and Regulations	Relevance & Non-Relevance to the Sub-project	Gaps and remedy redressal
		Objectives	Requirements			
	2007, IFC	information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors	safety issues during construction of different interventions of EZ		implementation of sub-projects. By adhering to these guidelines, project authority can mitigate risks, enhance sustainability, and promote the health and safety of both workers and local communities. Implementing these best practices not only fulfills regulatory requirements but also contributes to the overall success and acceptance of projects in the long term.	
10.	EHS Guidelines for Construction Materials Extraction, April 2007, IFC	The EHS Guidelines contain the performance levels and measures that are considered for construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite	Requirements on the resource management of construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite		These guidelines are relevant, and the sub-project will comply where applicable	

Notes: ESS-5 -Land Acquisition Restrictionson Land Use and Involuntary is not applicable for this sub-project. The land is owned by the NSEZ-BEZA. There is no private land in the proposed land development area. Similarly, ESS-7 (Indigenous Peoples) is not relevant, since no indigenous peoples will be affected by the sub-project. ESS-9 (Financial Intermediaries) is also not applicable to the country system, project proponents, regardless of funders, are subject to the same country's laws.

2.3. INTERNATIONAL TREATIES OR CONVENTIONS SINGED BY BANGLADESH

31. Most of the development projects have been implemented in Bangladesh by the financial help and technical guidance of some international donor agencies. These international agencies have their own environmental and social safeguard policies. The GoB has also agreed and signed some international treaties, conventions, protocols, and agreements for environmental assessment, protection, and pollution Control. International Design Codes, Standards, and Guidelines have also been implemented to conduct any development project here in Bangladesh. Bangladesh is a party to many international conventions, treaties, and protocols (ICTPs) related to the project and is committed to ensuring that these protocols are complied with during all development works. The main ICTPs are the Rio Declaration (environment and development), 1992, Convention on Biological Diversity (Rio de Janeiro), 1992, World Heritage Convention, 2011, International Plant Protection Convention (IPPC), 1951, Plant Protection Agreement for the Southeast Asia and Pacific Region 1956, Convention on Biological Diversity (CBD) 1992, UN Framework Convention on Climate Change (UNFCCC) 1992, Ramsar Convention 1971, etc. Note that all these international treaties are not directly applicable to the proposed sub-project. Multilateral Environmental Agreements (MEAs) Bangladesh has so far signed, ratified, and or accessed 35 International Conventions, and the related to this sub-project and signed by the Government of Bangladesh are shown in **Table 2-3**.

Table 2-3: International Conventions signed by Bangladesh applicable to this Sub-project

Treaty or Convention	Year	Brief Description	Responsible Agency
Working Environment Convention (Geneva)	1977	Protect workers against occupational hazards in the working environment	Ministry of Health and Family Welfare
Occupational Safety and Health Convention (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment.	Ministry of Health and Family Welfare
Kyoto Protocol (Japan)	1997	Under UNFCCC, the International treaty on Climate change and emission of greenhouse gases	DoE/ MoEFCC
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of bio-diversity sustainable use of its components and access to genetic resources	DoE/ MoEFCC
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention/Protocol)	1972	It is for protecting the marine environment from human activities	DoE/ MoEFCC

2.4. CATEGORIZATION OF THE SUB-PROJECT

2.4.1.GOB SUB-PROJECT CATEGORIZATION

32. The proposed sub-project 'land development of part of Precinct F (IMD Zone and Housing Facilities) of NSEZ is categorized as 'Red category' following the ECR 2023, Schedule-1, Item no. 33 (Land development, more than 25 acres). Therefore, the proposed sub-project requires a Site Clearance Certificate (SCC) and an Environmental Clearance Certificate (ECC) from the Department of Environment (DOE) under the MoEFCC. Besides, based on this ESIA / EIA needs to be conducted to meet the requirement of GoB as an obligatory requirement of the DoE for obtaining the ECC) before commencement of the civil works.

2.4.2.WORLD BANK SUB-PROJECT CATEGORIZATION

33. The World Bank screens all projects to determine the nature and extent of the environmental and social assessment needed, based on the type, location, sensitivity, and scale of the activity, as well as the nature and magnitude of its potential impacts, the capacity and commitment of the Borrower to manage the environmental and social impacts and risks in line with the ESSs. This screening also identifies any additional information required to complete the Bank's environmental and social review and determine whether to support the activity.

2.4.3.RISK CLASSIFICATION (ESS1): ASSESSMENT AND MANAGEMENT OF ES RISKS AND IMPACTS

34. The projects are normally classified by the World Bank (including projects involving Financial Intermediaries (FIs)) into four categories: High Risk, Substantial Risk, Moderate Risk or Low Risk based on the type, location, sensitivity, and scale of the project; the nature and magnitude of the potential environmental and social risks and impacts; and the capacity and commitment of the Borrower (including any other entity responsible for the implementation of the project) to manage the environmental and social risks and impacts in a manner consistent with the ESSs.

35. **High Risk:** The Project is likely to generate a wide range of significant adverse risks and impacts on human populations or the environment. This could be because of the complex nature of the Project, the scale (large to very large) or the sensitivity of the location(s) of the Project. This would take into account whether the potential risks and impacts associated with the Project have long-term, permanent, and/or irreversible (e.g., loss of major natural habitat or conversion ofwetland), and are impossible to avoid entirely due to the nature of the Project; high in magnitude and/or in spatial extent (the geographical area or size of the populationlikely to be affected is large to very large); significant adverse cumulative impacts; significant adverse transboundary impacts; and a high probability of serious adverse effects to human health and/or the environment (e.g.,due to accidents, toxic waste disposal, etc.).

36. **Substantial Risk:** The Project may not be as complex as High-Risk Projects, its ES scale and impact may be smaller (large to medium) and the location may not be in such a highly sensitive area, and some risks and impacts may be significant, they are they are mostly temporary, predictable and/or reversible, and the nature of the Project does not preclude the possibility of avoiding or reversing them (although substantial investment and time may be required); there are concerns that the adverse social impacts of the Project, and the associated mitigation measures, may give rise to a limited degree of social conflict, harm or risks tohuman security; they are medium in magnitude and/or in spatial extent (the geographical area and size ofthe population likely to be affected are medium to large); the potential for cumulative and/or transboundary impacts may exist, but they are lesssevere and more readily avoided or mitigated than for *High-Risk* Projects; and there is medium to low probability of serious adverse effects to human health and/or theenvironment (e.g., due to accidents, toxic waste disposal, etc.), and there are known and reliable mechanisms available to prevent or minimize such incidents;

37. **Moderate Risk: T**he potential adverse risks and impacts on human populations and/or the environment are not likelyto be significant. This is because the Project is not complex and/or large, does not involve activities that have a high potential for harming people or the environment and is located away from environmentally or socially sensitive areas. As such, the potential risks, impacts, and issues are likely characterized as: predictable and expected to be temporary and/or reversible; low in magnitude; site-specific, without the likelihood of impacts beyond the actual footprint of the Project; and low probability of serious adverse effects to human health and/or the environment (e.g., donot involve use or disposal of toxic materials, routine safety precautions are expected to be sufficient to prevent accidents

38. **Low Risk:** A project is classified as **Low Risk** if its potential adverse risks and impacts on human populations and/or the environment are likely to be minimal or negligible. These Projects, with few or no adverse risks impacts, and issues, do not require further ES assessment following the initial screening.

3. SUB-PROJECT DESCRIPTION

3.1. INTRODUCTION

39. The National Special Economic Zone(NSEZ) is one of the largest EZs in Bangladesh to be set up on over 33,000 acres of land located in Mirsharai, and Sitakunda Upazila of Chattogram district, and Sonagazi Upazila in Feni District. A Master Plan[6] of the NSEZ has been prepared under the Private Sector Development Support Project (PSDSP), financed by the World Bank in 2020. The World Bank's Private Investment & Digital Entrepreneurship (PRIDE) project would support the phased development of the NSEZ and divide the economic zone into several zones in the Master Plan, under the NSEZ. One initiative is land development sub-projects, particularly the IMD zone and zones 5 and 18 for the housing facilities. The sub-project will spearhead the adoption and mainstreaming of green industrial park concepts in the implementation and development of economic zones in Bangladesh.

40. The proposed sub-project involves the development of the low-lying lands, comprised partly of Precinct F comprised of the `IMD Zone (Zones 12 and 13), Zone 5, and Zone 18, for the proposed housing facilities areas. The land development will be done by dredging materials from the Sandwip Channel. The total area of land development will be about 1560 acres under four zones as shown **Table 3-1** and **Figure 3-1. .**

Table 3-1: Areas of Land Development under the Sub-project

Land Use of Precincts	Zone	Area (Acres)
F- Light/ Medium Industrial Area (IMD Zone)	Zone 12	550
F- Light/ Medium Industrial Area (IMD Zone)	Zone 13	
F- Housing Facilities	Zone 18	660
F- Housing Facilities	Zone 5	350
Total		**1560**

Source : PIU, NSEZ, 2025, NSEZ Master Plan 2020

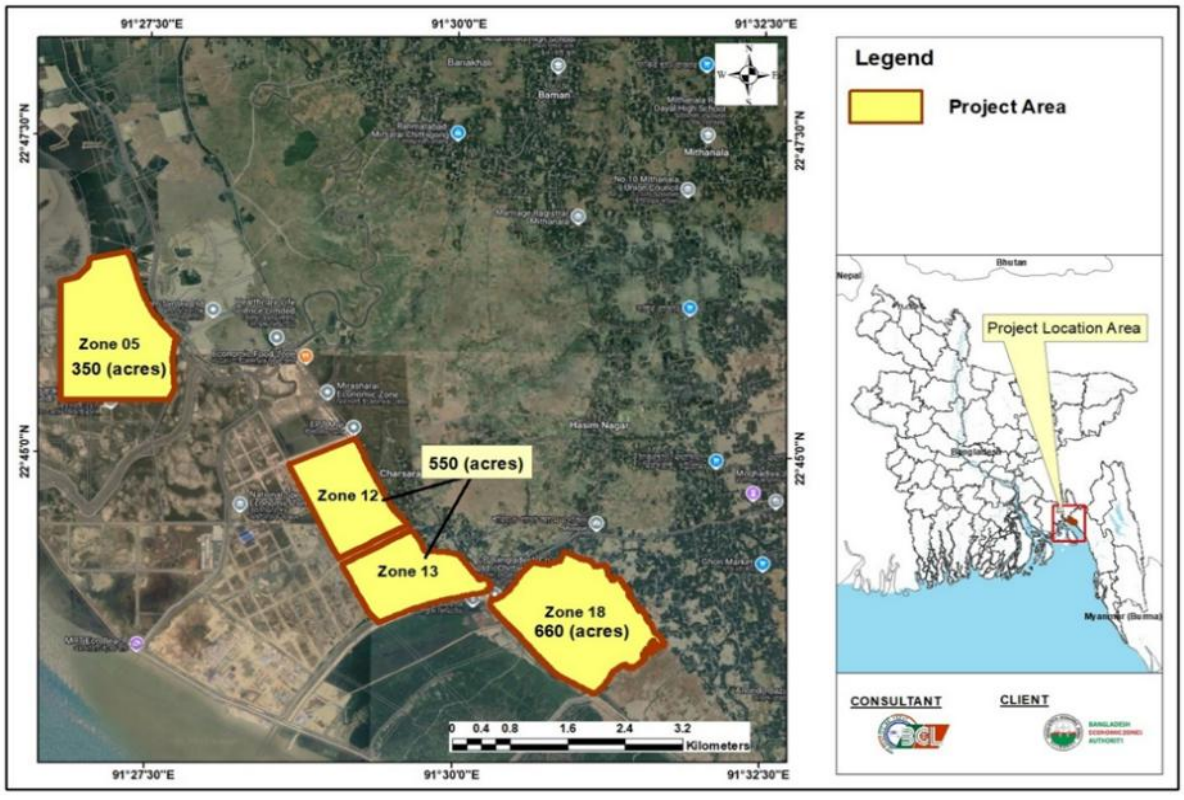


Figure 3-1 : Land Development area in Zones 5, 12, 13, and 18 of the Sub-project

41. The sub-project site is situated in Mirsharai Upazilla of Chattogram district and positioned 12 km west of the national Highway (Dhaka-Chattogram Highway). Chattogram City is located 60 km to the south, while Mirsharai Railway station is approximately 10.0 km east of the site. In the southern direction, the Shah Amanat International Airport at Chattogram is about 79 km away, and the seaport in Chattogram district is situated 67 km to the south of the site. The sub-project site is along the coastline and stretches 25 kilometers within the Sandwip Channel on the

[6] BEZA (September 2020) Bangabandhu Sheikh Mujib Shilpanagar (BSMSN) Master Plan Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh

eastern edge of the Bay of Bengal. An ancient embankment borders the area's eastern side, while a new super dyke has been built along the sea's western edge. The majority of the BSMNS's land is reclaimed land. The land elevation on the site varies from -3.33-meter MSL to the highest point at +8.7 m MSL. There are other sub-zones inside the NSEZ region. Because of its advantageous position, the NSEZ area has a lot of potential. Merely 10 kilometers to the west lies the Dhaka-Chattogram highway, while the next railway station is located 11.5 kilometers to the west

42. The surroundings of the Precinct F (IMD Zone and Housing Facilities) are described as follows:

- North: Feni River, switch gate of Feni River, fellow lands, etc.
- East: Dhaka-Chattogram Highway (10 km from the study area), EZ connecting road, Ichakhali khal switch gate, Mangrove Forest, CDSP Bund, etc.
- South: Bay of Bengal, super dyke, etc.
- West: the Bay of Bengal, Super dyke of Economic zone, Industry, etc.

43. Various on-site and off-site activities are currently underway, including the construction of embankments, internal roads, access roads, telecommunication infrastructure, power and water supply facilities, and drainage management infrastructure. The location is positioned at the eastern end of the Bay of Bengal, and a super dyke has been built along the western boundary of the Zone 2A & 2B to safeguard the site from water ingress during high tide and surges.

3.2. SUB-PROJECT DATA SHEET

44. The basic information on the landfilling in the part of Precinct F (IMD Zone and Housing Facilities) of NSEZ is shown in the table below.

Table 3-2: Sub-project Data Sheet

SN	Item	Description	Agencies
Sub-project activities			
1.	Selection of dredging sourcing location	The contractor will select the dredging location after pre-approval from the competent authority	Sub-project: Land Development of Part of Precinct F (IMD Zone and Housing Facilities of NSEZ-Development Project, funded by the World Ban
2.	Dredging from the Sandwip Channel	Cutter Suction Dredger	
3.	Setting Up Pipelines for Dredging Material	Prepare pipeline setting layout plan and finalize by community consultations	
4.	Landfilling, compaction of lands	As per standard methods	
5.	Draining out the dredging water	As per the Dredging Management Plan	
6.	Construction labor camps, yards, etc.	As per Contract specifications	
Associated Facilities			
7.	Bridge Construction	Bridge (over Feni River on Sonagazi & Mirsharai Economic Zones Connecting Road Project)	LGED-Project Government of Bangladesh (GOB) funded project
8.	Construction of Super Dyke (additional)	Construction of Super Dyke (additional)	BWDB - Project Funding agency yet to be confirmed
On-site infrastructure (to be developed under PRIDE project but not included within the proposed sub-project)			
	Road network	Saroni Road (30 km)	This was formerly completed under PSDSP
	Common Effluent Treatment Plant	CETP 48MLD	Currently ongoing under the NSEZ Development Project.
	Internal Road 2A and 2B	22 km	
	Storm Water Network	30 km	
	Power supply network	with substations	
	Access Road	7 km	

Source: Master Plan, 2020 NSEZ and other Study reports

45. However, the sub-projects ongoing under the PRIDE, funded by the World Bank, are not considered as the Associated Facilities.

3.3. DREDGING

3.3.1.SETTING UP PIPELINES FOR DREDGING MATERIAL

46. The project will involve the installation of delivery pipelines designed to transport dredging material efficiently. This will ensure that the material is moved from the dredging site to designated disposal or processing areas without disrupting the surrounding environment.

3.3.2.ACCESS ROADS PREPARATION

47. The construction of access roads is crucial for facilitating transportation to and from the project site. These roads will provide necessary connectivity for vehicles and equipment, ensuring smooth operations throughout the project duration

3.3.3.TEMPORARY DRAINAGE SYSTEM DEVELOPMENT

48. A temporary drainage system will be established to manage water runoff during the dredging activities. This system will help prevent flooding and water accumulation on-site, ensuring a safe working environment for all personnel involved.

3.3.4.STORMWATER MANAGEMENT

49. To address long-term water management, a stormwater management network will be developed. This network will be designed to control and direct stormwater runoff, reducing the risk of erosion and water pollution in the surrounding areas.

3.3.5.LABOR CAMP ESTABLISHMENT

50. To accommodate the migrant laborers, there will be one more labor camp near landfilling sites, ensuring accessibility to sanitary toilets, drinking water facilities, waste management facilities, and kitchen facilities. However, the laborers who were hired locally don't need on-site accommodation facilities.

3.3.6.EQUIPMENT MOVEMENT TO THE SITE

51. Necessary heavy equipment like bulldozers, excavators, cutting dredgers, and others will be transported to the site following safety measures, protocols, and logistical considerations. The process can be carried out efficiently and safely, contributing to zero harm to the environment and workers while transporting heavy equipment to the site.

3.3.7.LAND PREPARATION

52. The landfilling will be executed by dredging from suitable locations within the Sandwip Channel. The dredging pipeline will traverse various areas, including the internal road network of the Bangladesh Economic Zones Authority (BEZA) premises, as well as crossing over Khal and grazing lands. To ensure minimal disruption and maintain good relations with the local community, all crossing work will be conducted in consultation with community members. This approach aims to foster understanding and cooperation among stakeholders. Appropriate notices will be issued to inform the community about the dredging activities, ensuring they are well-informed and can voice any concerns or suggestions they may have. The land preparation involves delivery pipe installation, dredging, and landfilling.

3.3.8.DREDGING ACTIVITIES

53. The proposed construction of dredging materials pipelines designed to efficiently transport dredged materials from the channel and river to designated areas within Precinct F (IMD Zone and Housing Facilities) of the NSEZ. To anticipate the volume of filling material to be required for the development of 1560 acres, the consultant has estimated volumes of dredged material to be dug from the Sandwip Channel, as shown in Table 3-3Table 3-3: Approximate Requirement of the Dredged Materials for Landfilling the Sub-Project Area. In this estimation, considered data on Average Pre-level, Formation Level from the Development Project Proposal (DPP) [7]of BEZA, According to the calculation, the filling volume for the proposed area under zone numbers 5, 12, 13 & 18 will require approx.15.85 MCum.

[7] Development of Project Proposal, BEZA, November, 2020

Table 3-3: Approximate Requirement of the Dredged Materials for Landfilling the Sub-Project Area

Zone No.	Actual Area	Average Pre-Level	Actual Area	Proposed Land Development Area				
				Acres	Sqm	Formation Level (m)	Filling Height (m)	Filling Volume (Cum)
Zone 5	4.063	4,063	675	350	1416401.00	6.5	2.438	3,452,477.44
Zone 12 & 13	3.977	3.977	734	550	2225773.00	6.5	2.524	5,616,738.17
Zone 18	3.963	3,963	686	660	2670927	6.5	2.537	6,776143.32
	Total		2095	1560				15,845358.92

Source: Project Development Proposal (DPP), Prime Minister's Office, November 2020, Google Earth,

3.4. MANPOWER

54. The bid document may contain clauses allowing foreign-trained personnel to be involved by the contractor or monitoring supervision firm. The following number of manpower will be involved in the land development (Table 3-4) under the Contractor side.

Table 3-4: Tentative Manpower Required

Concern Authority	Designation	No. of Personnel
Contractor	Site Engineer	5
	Material/Mechanical Engineer	5
	Surveyor	3
	Account and Finance	2
	Operator (Dredging m/c)	5
	Driver (Truck, tractor, dump track, excavator, compactor)	25
	Labor	150
	Environment Health and Safety Officer	1
	Work Assistant	10
	Cook	5
	Cleaner	5
	Security Guard	14
	Sub-total (Third party monitoring)	**230**

Source: NSEZ-BEZA

55. Around 230 numbers of individuals will be needed for the contractor to carry out sub-project activities.

3.5. ENERGY REQUIREMENT

56. The land development activity will require setting up dredging machines, administrative units site offices, and labor camps. The dredger will be equipped with diversified heavy-duty machinery such as cutter pump, ladder pumps, board pumps, and jet pumps. While the administrative and site offices will require different kinds of machinery, generators, air conditioning machines, computers, and laptops. And the labor camps should have all kinds of home appliances. The contractor along with the help of BEZA and local suppliers needs to ensure electricity and energy to operate these facilities. The following table estimates the approximate amount of energy requirement (**Table 3-5).**

Table 3-5: Estimated Energy Requirement

Sl. No.	Activities	Energy consumption (in kwh)	Daily energy consumption (in Kw)	Total Number	Total Energy day (in KW)	Monthly Energy Consumption (in Kw)	Remarks
A.	**Labour camps and administrative setup**						
1	1 ton A/C	1.5	12	10	23.5	705	
2	1.5-ton A/C	1.7	15	5	75	2250	
3	2-ton A/C	2	20	5	100	3000	
4	Ceiling Fan	0.018	0.216	60	12.96	388.8	
5	Refrigerator freezer	0.4	2	6	345	17280	The freezer will operate 24 hours each day

Sl. No.	Activities	Energy consumption (in kwh)	Daily energy consumption (in Kw)	Total Number	Total Energy day (in KW)	Monthly Energy Consumption (in Kw)	Remarks
6	36-watt T5 tube light	0.36	4.32	100	432	12960	
7	15-watt LED light	0.15	1.8	250	450	13500	
8	100-watt Street LED light	0.4	4.8	100	480	14400	10 lights/km, consider 10 km will be covered by street lights
9	Air compressor	10	80	5	400	12000	
10	Other equipment(s)	5	60	1	60	1800	
	Sub-total: A				**2380**	**71350**	
B.	**Dredger (32" cutter suction dredger) Energy consumption**						
1	Cutter pump	1100	0	1	1100	33000	
2	Ladder pump	1060	0	1	1060	31800	
3	Inboard pump(s) x 2	2500	0	2	5000	150000	
4	Jet pump	600	0	1	600	18000	
	Sub-total: B				**7760**	**232800**	
	Total (A + B)				**10369**	**304153**	

Source: NSEZ-BEZA

57. During the construction (dredging) approximately 10369 kW/day or 3,04,153 kW/month electricity would be required.

3.6. UTILITY AND MACHINERY REQUIREMENT

58. Fuel and electricity are necessary for the Dredging activities. The approximate utility demand for the pipeline construction is presented in **Table 3-6.**

Table 3-6: Consumption of Utility During Construction

Sl. No.	Name of utilities	Details	Utility sources
1	Water	Approximately 2-4 MLD of water will be needed for hydro test and domestic purposes	Deep tube well
2	Electricity	10,369 kw/day (approximately)	National Grid/ BSMSN/DG
3.	Fuel: Gas	For cooking and welding, cylinder gas will be used	Supplier
4.	Fuel: Diesel	for 20 no. heavy vehicles, 5 no. diesel generator	Supplier
5.	Fuel: Octane	for 10 no. light vehicles	Supplier

Source: NSEZ-BEZA,

3.7. SUB-PROJECT IMPLEMENTATION SCHEDULE AND COST ESTIMATE

59. The implementation schedule of the sub-project is 36 months. The tentatively estimated dredging work cost of the sub-project implementation will be as follows

Table 3-7 : Tentative Estimated Cost for Sub-project Implementation

Sl. No.	Activities	Total Volume cum	Landfilling cost/cum (in BDT)	Total Cost (in Million BDT)
1.	Physical	15.845,	@340BDT/cum	5389
2.	Technical			
3.	Institutional			

Source: PIU-BEZA, 2043

60. It is also noted that while the current project closing date is December 2025, a formal revision is in process,

and the closing date is expected to be extended to December 2027. The financing agreement between BEZA and the World Bank is being revised to reflect this extension.

3.8. VALUED ENVIRONMENTAL AND SOCIAL COMPONENT (VC)

3.8.1.IDENTIFICATION OF VALUED COMPONENTS (VCS)

61. Valued environmental and social components (VCs) are defined as fundamental elements of the physical, biological or socio-economic environment, including air, water, soil, terrain, sedimentation, erosion, wildlife, terrestrial and marine biodiversity, fish, birds, land use, natural resource-dependent livelihoods such as (agricultural, grazing land, etc.) that may be affected by the proposed project. Identification of valued environmental components (VCs) for this sub-project commenced with a long list of environmental and social attributes. The VCs were identified and finalized based on stakeholder feedback combined with site visits, scientific research, and professional judgment to determine the appropriate VCs and to analyze the limits of acceptable change, as shown in **Table 3-8.**

Table 3-8: Valued Environmental and Social Components (VCs)

Environmental Element	Environmental Aspect	Identified Important VCs
Land use	landfilling activities will change the existing landscaping	Land use pattern
Air pollution, and noise Social (community health and safety)	Land traffic and dredging operation Dredging Operation	Air quality Noise, Land traffic Community health and safety Occupational health and safety GHG emission
Water, soil, (terrestrial and freshwater)	General waste production Sewage water production Water quality in effluents or accidental discharges Storage and use of hazardous materials	Groundwater quality, surface water, and sediment quality Occupational health and safety Soil quality, Waste Generation Spillage of oil/effluent/dredging spoils
Drainage system	Landfilling activities Dredging operation Water logging (flood)	Land use and land cover Land traffic, Community health and safety Water Quality, Soil erosion
Terrestrial Flora and fauna	Landfilling damage, the existing trees and vegetation	Tree and fauna, birds, marine birds
Biotic (benthic fauna)	Seabed impact during dredging	Water quality Biodiversity
Biotic (marine mammals)	Underwater noise during dredging	Biodiversity
Social	Interaction with social actors	Stakeholder engagement
Occupational health and safety)	Workforce Temporary workforce Influx of labor	Employment generation Occupational health and safety Social conflict, GBV/ SEA/SH
Social (community health)	Landfilling activities Dredging operation Water logging (flood)	Community health and safety, Employment generation Social conflict Drainage, Traffic and Transport Drainage, GHG emission Social conflict, GBV/ SEA/SH

Table 3-9: Rationale of Impacted VCs by the sub-project activities

Sl. No.	ES parameters	Rationale
1.0	**Durring Land Development Activities (Pipeline installation, dredging and landfilling)**	
1.1	Change of Land Use and Land Cover	This has been selected as a VC because the land use and existing land cover will be changed due to dredging activities.
1.2	Climate Change Vulnerability	This has been selected as a VC because of the vulnerability to climate change impacts, such as extreme weather events: rainfall/precipitation, temperature changes, flash flood/flooding, GHG Emission (from the dredging activity, utility

Sl. No.	ES parameters	Rationale
		and use of machinery etc.) and Carbon footprint related to the land reclamation and dredging operations.
1.3	Air Pollution	This has been selected as a VC due to the emission of air pollutants from various sources during construction activities, including pipeline setting up, the use of equipment, and the movement of vehicles. These activities will create air pollution. The baseline study should monitor the air quality along with air temperature, relative humidity, air pressure, wind speed, and direction.
1.4	Noise Level and Vibration	This has been considered as a VC since the ambient noise levels will increase due to construction activities, equipment, vehicles, pipeline set, etc.
1.5	Surface Water Quality	Dredging can allow saltwater and heavy metals from the Sandwip Channel to move further into inner water bodies. In compliance, WB's ESF-ESS3 needs to study Discharging of dredging water could deteriorate the water quality of Bamonsundher Khal, Daborkhali, Ichakhali Khal, and Ichakhali Chanel. In addition, dredging from the Sandwip Channel could influence the water flow and navigation.
1.6	Ground Water Quality	This has been selected as VC because groundwater quality may deteriorate due to the leaching the heavy metals from the dredging material into the ground.
1.7	Soil Erosion and Impact on Soil Quality	Erosion and sedimentation risks, especially in newly reclaimed areas, may occur and may be prone to flooding. After dredging, the channel's shore may become eroded or accession. Soil composition, fertility, and quality may degrade due to dredging and reclamation. Therefore, features like geology, physiography, topography, land use and land cover have been considered.
1.8	Water Logging and Drainage	This has been selected as a VC because waterlogging and drainage congestion may occur during dredging activities and construction works.
1.9	Waste Generation and Spillage of oil/effluent/dredging spoils	The waste has been selected as a VC because soil, water can be deteriorated by accidental release, inappropriate disposal of oil from the dredging equipment/ vehicles, and disposal of dredging liquid waste.
1.10	Movement of water vessels, road traffic, and transport	Disruption/obstacle of water vessels movement route during dredging activities. Road traffic disruption at the offshore dredge disposal area
2.0	**Ecological Aspect**	
2.1	Terrestrial Ecology	This has been selected as a VC because terrestrial ecology which comprises plants, animals (amphibian, reptile, avifauna, mammal, livestock and poultry) etc. may be affected or disturbed due to the dredging and landfilling activity. Channel bank erosion may occur during dredging. Breeding activities of species may be impacted. Migratory birds might be affected due to the sub-project interventions.
2.2	Aquatic Ecology	This has been selected as a VC because aquatic flora and fauna may be affected by the dredging activities. Marine fish species may be affected. Disturbance of seafloor, the suspension of fine sediments and the re-deposition of coarse factions affect marine ecosystem community such as Phytoplankton, Zooplankton and Benthic Community. But there is a scope of natural recovering the benthic community after dredging.
3.0	**Social Aspect (during the construction)**	
3.1	Labor Influx and Working Conditions	This has been selected as a VC because labor influx might create negative impacts due to employment of workers/workforce from different places. Conflict between local workers and far-off workers and local community may be initiated. Unhygienic conditions resulting from day-to-day activities of workers during construction stage may spread various diseases and other adverse impacts. In compliance of the WB's ESF-ESS2 needs to implement Labor Management Plan for this project.
3.2	Occupational Health Safety	Accident of the Workers and project personnel may occur as well as to local community. Health and safety of the workers is a concern during dredging activities. OHS management plan and SEP need for compliance of the WB's ESF- ESS 2 and ESS4 requirements
3.3	Employment Generation	Employment opportunities will be ensured by direct employment for unskilled labor, indirect employment to the local community, and employment of women

Sl. No.	ES parameters	Rationale
		workers. Direct employment includes site clearance, excavation, loading and offloading of materials and deliveries, mason and construction works. Further, the construction labor force will require food and other items, which are expected to be supplied by the local eateries, retail shops, and the local community.
3.4	Gender-Based Violence, Social Conflict and Child Labor	Employment opportunities will be created in the sub-project however, gender discrimination under wages, women-friendly working conditions, and violence against women may create impacts. In addition, child labor may be engaged, which impacts educational opportunities.
3.5	Community Health and Safety	This has been selected as a VC because community health and safety might be at risk due to landfilling activity, setting up pipelines, construction vehicles movement, and engaging labor force for landfilling activity.
3.6	Economic displacement, Disturbance of agricultural land and produce	Dredging Pipeline Infrastructure sometimes passes over agricultural lands, and the sub-project activity will impact on livelihood based on fishing, grazing, etc. requires studying in compliance with the WB's ESF- ESS1 and ESS5
3.7	Traffic movement Disruption	This has been selected as a VC because the dredging pipeline will cross local roads, sometimes creating a problem for the smooth movement of vehicles and pedestrians.

62. A rapid site-specific environmental screening was carried out based on project activities to determine the potential environmental and social impacts. The quantification of the impacts on the Valued Components (VCs) for the dredging locations and the landfilling site has been mentioned in Table 3-10 following *Approach and methodology Step-5*:*Qualitative and Quantification, and Evaluation of Impacts* in Section 1.5, Chapter 1 of this study based on the Environmental and Social Screening findings (**Annexure- 1**)

Table 3-10: Importance of VCs impacted by the Sub-project Activities

VCs	Dredging locations	Land development sites	Total impacts on VCs
Change of Land Use and Land Cover	-	-6	-6
Climate Change Vulnerability	-	-6	-6
Air Quality	-3	-3	-6
Noise	-3	-3	-6
Surface Water Quality	-3	-2	-5
Ground Water Quality	-2	-3	-5
Soil Erosion and Impact on Soil Quality	-5	-3	-8
Water Logging and Drainage	-	-8	-8
Waste Generation	-2	-4	-6
Aquatic Ecology	-5	-	-5
Terrestrial Ecology	-	-5	-5
Marine ecology	5		-5
Labor Influx and Working Condition	-3	-5	-8
Occupational Health and safety	-3	-5	-8
Employment Generation	+1	+7	+8
GBV/ SEA/SH	-	-5	-5
Social conflict	-2	-3	-5
Community health and safety	-1	-3	-4
Movement of Water Vessels, Road Traffic and Transport	-2	-4	-6

Note: Expert judgment was used to select impacted VCs based on sub-project activities, nature, and longevity of impacts, etc.

4. ENVIRONMENTAL AND SOCIAL BASELINES

63. In evaluating the environmental and social assessment of the sub-project, a comprehensive environmental and social baseline survey has been conducted in the vicinity of the designated location, considering both the physical environment and natural and socioeconomic aspects identified based on the Valued Environmental and Social Components (VCs). The analysis involved a combination of secondary data sources, including literature reviews, maps, monitoring reports, and primary sources such as field surveys, laboratory analyses, and public consultations within the project area. Baseline information has been considered into three categories such as

- Physical Environment: Encompassing geology, physiography, land use, soils, meteorology, hydrology, including environmental quality such as air, water, noise quality, vibration level, soil, and sediment pollution, etc.;
- Biological Environment: Addressing factors related to life, including habitats, aquatic life, fisheries, terrestrial and aquatic habitats, flora, fauna, and marine ecology;
- Socio-economic Environment: Focusing on anthropological factors such as demography, income, infrastructure, etc.

4.1. AREA OF INFLUENCE

64. The Land Development of Part of Precinct F (IMD Zone and Housing Facilities) will be 1560 acres, which includes Zones 12, 13,18, and 5 of the NSEZ under the PRIDE project. The reclamation of low-lying land will create environmental, biological, and socio-economic impacts in the adjoining areas. A 10 km buffer zone area around the sub-project has been considered as an area of influence (AOI) considering the land type, soil characteristics, drainage, hydrology, water quality, air quality, noise, etc. as well as determination of the present status of the biodiversity impacts both on terrestrial and aquatic flora and fauna, whereas, the social considerations were determined based on-site visits, socioeconomic survey, and discussions with the local community. This will cover the impact on physical and social environments, as well as sensitive ecological features, as shown in **Figure 4-1**.

65. The AOI was considered for the information collection on the potential VCs viz, land type, soil characteristic, drainage, hydrology, water quality air quality, noise, etc., as well as determination of the present status of the biodiversity impacts both on terrestrial and aquatic flora and fauna, while social considerations were determined. The measurements of the surface water and groundwater quality, air quality, noise level, and vibration level are carried out within the AOI area, as shown in **Figure 4-2.**

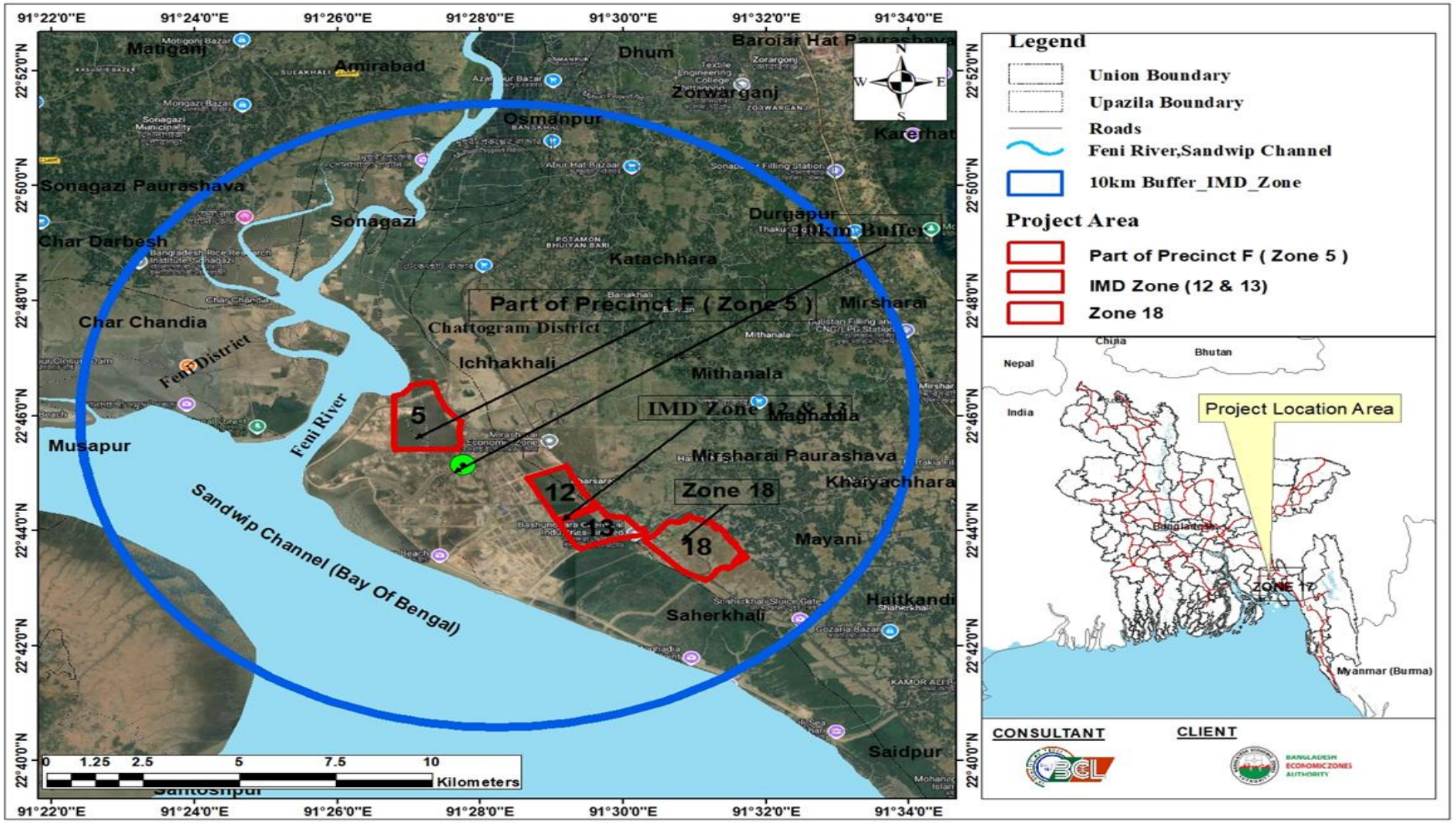


Figure 4-1: Sub-project Area of Influence
Google Earth Imagery

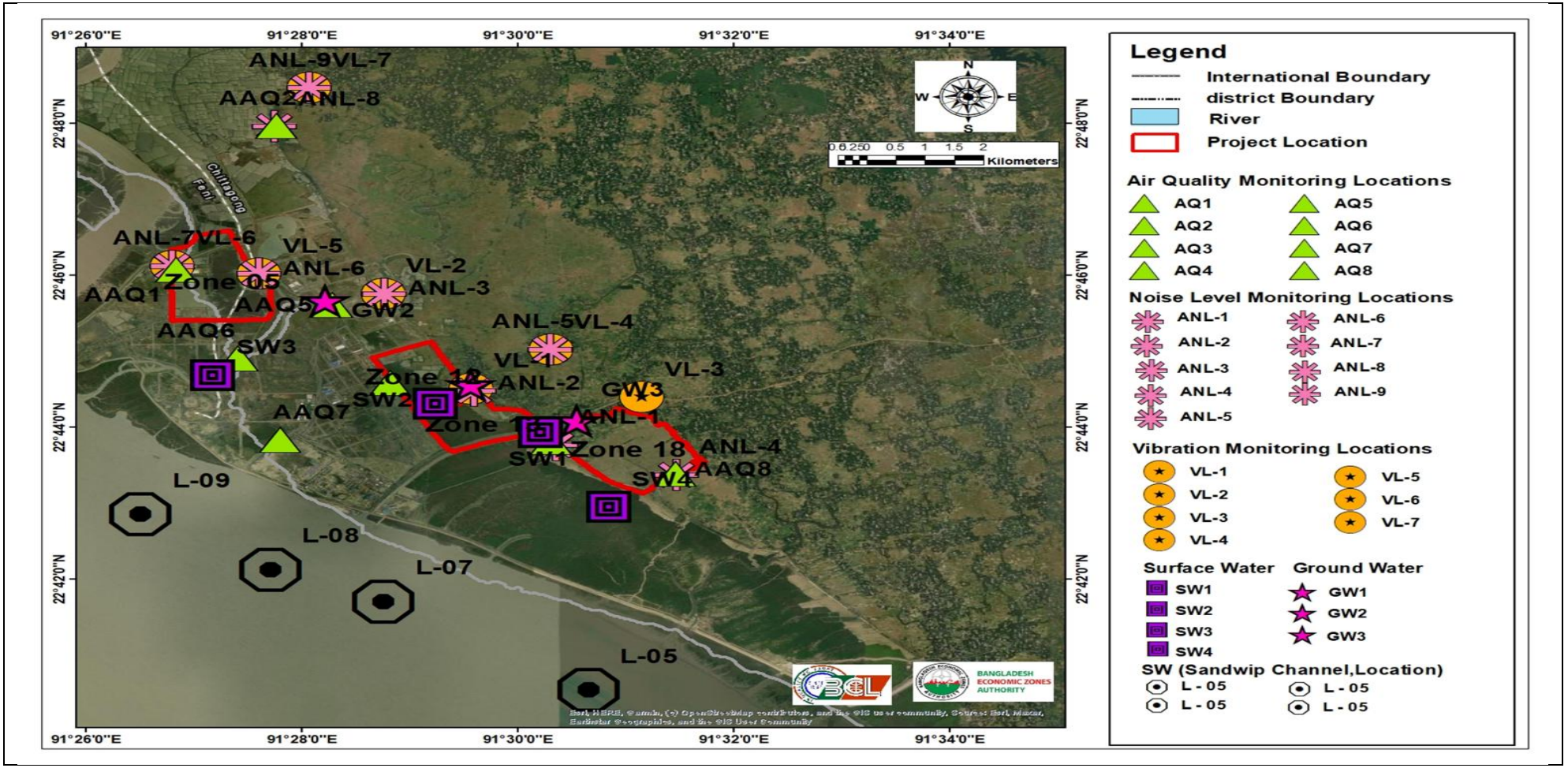


Figure 4-2: Monitoring Locations for Surface Water, Groundwater, Air Quality, and Noise Level in Study Area
Google Earth Imagery

4.2. PHYSICAL ENVIRONMENT

4.2.1.LAND USE

66. It is noted that the designated areas for land development of the sub-project are 1560 acres. While the land uses the entire Zone 12 (368 acres), Zone 13 (366 acres), Zone 5 (675 acres), and Zone 18 (686 acres) of a total of 2095 acres are considered. The analysis indicated that vegetation coverage is about 674 acres, agricultural land is 669 acres, and lowland is 523 acres. The area of canals 70.6 and water bodies cover about 13 acres of land. The land use map and quantification of different categories of land use are presented in

67. **Table 4-1** and **Figure 4-3**.

Table **4-1: Land Use of the Sub-project Zone Areas**

Land Types	Area(acres)
Agricultural Land	669.13
Structure	61.10
Vegetation	674.00
High Land	20.93
Low Land	523.18
Open Land	1.10
Road Site Land	1.29
Road	45.24
Super Dyke	15.29
Canal	70.08
Waterbodies	13.60
	2094.94

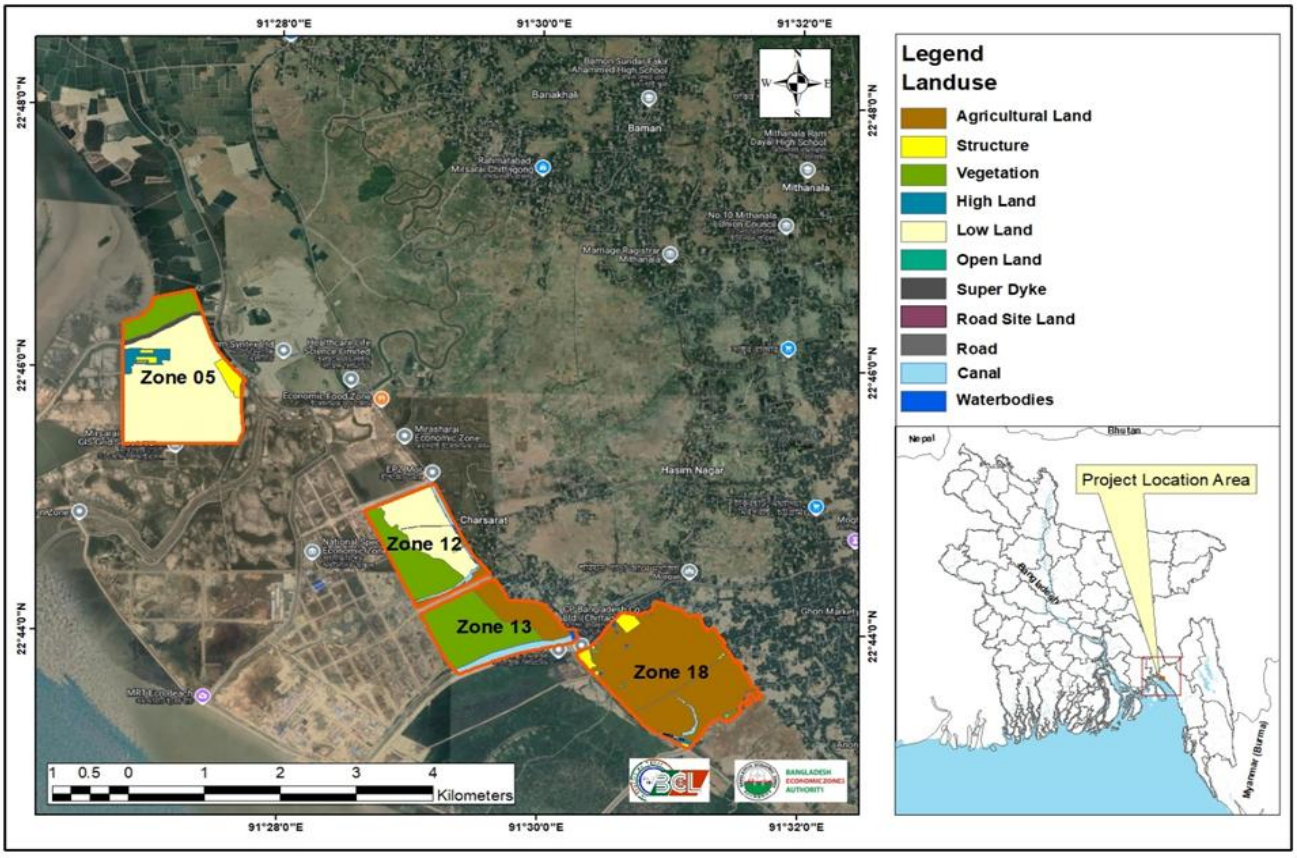


Figure 4-3 : Land Uses of the Entire Zone 12, 13, 5 and 18 Area
Source: Google Earth

4.2.2.CLIMATIC FACTORS: TEMPERATURE, WIND, HUMIDITY, AND RAINFALL

68. The sub-project of NSEZ is located in Mirsharai Upazila of the Chattogram district. Like other parts of Bangladesh, the study area experiences significant temporal variations of climatic conditions due to the influence of moisture-laden monsoon winds from the southwest in summer and drier, colder northwestern winds in winter.

Climatological factors like temperature, wind direction, meteorology, rainfall, humidity, temperature, and natural hazards like seismicity, etc. have been considered as VCs, because sub-project activities have direct interactions with these factors. The Sitakunda meteorological station is at a distance of 25.0 km from the study site and is considered for the analysis of the climatological data for 10 years recorded from 2013 to 2022, and details in **Appendix 1, Baseline study, Volume-II**. The summarized records are as follows.

69. **Temperature:** The average minimum and maximum temperatures in Sitakunda station were 12.28°C & 32.94 °C. In the Mirsharai area, temperatures vary from 6-9°C in winters and 37-41°C in summers. The average minimum temperature varies between 12.28 to 25.91 °C, whereas the maximum temperature ranges from 27.16 to 32.94 °C.

70. **Rainfall:** The monsoon season is very important in this coastal region. The average annual rainfall of the Mirsharai 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 maximum rainfall in 2019 was 1589.0 mm in July.

71. **Humidity:** Humidity 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. Monthly normal relative humidity in the project area varies between 72% in February and 87% in July (in Sitakunda). The monthly normal humidity does not vary much with seasonal changes and is relatively high.

72. 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's 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. Real-time recorded wind speed and wind direction of the study area have been demonstrated in the WR plot for clarity of the real-time wind speed and direction aspects (**Table 4-2).**

Table 4-2: 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

73. **Evaporation**: The sub-project area reaches its maximum evaporation during the April-May months when temperature, sunshine, and wind are at or near their maximum levels for the year. The evapotranspiration peaks in April.

74. **Wind Speed:** The Project area is characterized by southerly wind from the Bay of Bengal during monsoon and north-westerly wind from the Himalayas during winter, similar to the national pattern. The windiest months are April – July, and the highest wind speed was observed at Sitakunda station and since this station is located at the nearest seashore. The seasonal variation of Wind Rose over the ten years (2013-2022) is given in the baseline condition of **Appendix 1, Baseline study, Volume II**. The Project area experiences natural calamities such as cyclones, tornadoes, and surges caused by the coastal wind and high-risk zones of cyclones.

75. **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. A maximum of 12 hours of sunlight per day in April, May, and June.

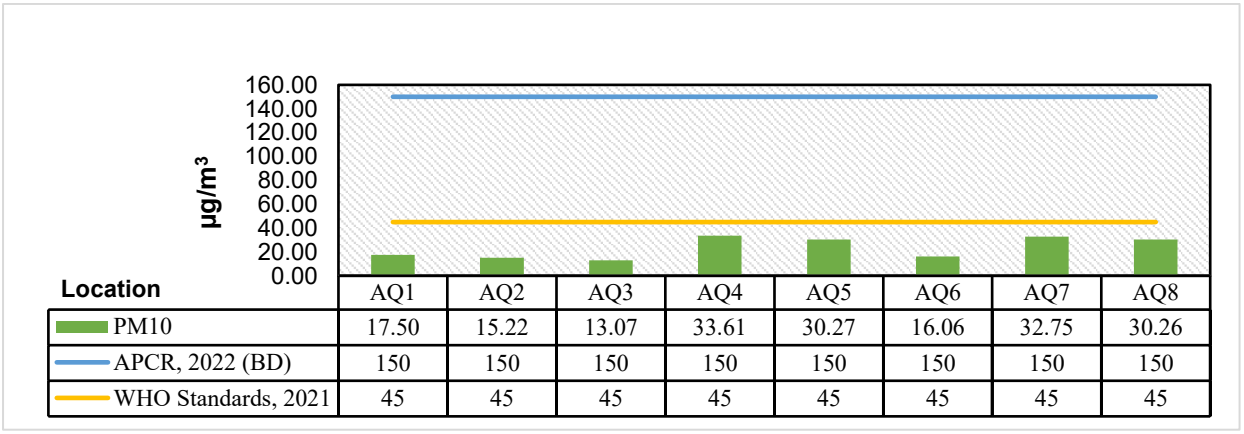
4.2.3.AMBIENT AIR QUALITY

76. Ambient air quality has been considered as a VC. Sampling locations were selected considering the area's background, accounting for potential point sources and other interferences. The height of sampling points was determined based on the presence of walls and other obstructions around the project location. Before installing the machine, environmental factors such as free-flowing air, wind direction, and well-mixed air were observed. Elevation angles of nearby buildings and obstructions were taken into account during site selection. All steps were executed by the Air Pollution (Control) Rules 2022 and IFC guidelines for the Ambient Air Quality Monitoring Program. Air

quality data was gathered at eight (08) locations within the project area over a 4-hour duration. Subsequently, the collected data was converted to represent 24 hours using an approved methodology, with the conversion details provided in the methodology section of this report. The air quality measurement locations were selected for different categories of land uses within the study area. Ambient air quality measurements were conducted from December 8, 2023, to December 14, 2023. The location of the monitoring area adjacent to CP Mor (AQ1) was selected due to its proximity to residential areas, allowing for the assessment of air quality impacts on local inhabitants. The east side of the project location, Daborkhali Point AQ2) was chosen to capture air quality data for providing insights into the dispersion of pollutants in that direction. Ichakhali Sluice Gate Bazar (AQ3) was included to evaluate the effects of local traffic and commercial activities on air quality., Adjacent to the main road, Bodiullah Para Bazar (AQ4), Charsarat Village (AQ5), Charsarat Village (AQ6), in front of Nippon and McDonald Steel Industries Limited (AQ7) and Dakshin Magadia (AQ8). The information regarding the ambient air quality monitoring GPS locations and ambient air quality monitoring methodology, test result reports and photographs are included in **Appendix 1 Baseline study, Volume-II**. Analysis of the tested results of PM_{10}, PM $_{2.5,}$ NO_2, S, O_2, O_3, and CO_2 are as follows.

Particulate Matter 10 Micron or Less (PM_{10})

77. PM_{10} concentration was monitored in the same locations as SPM. The same machine was used to monitor the PM_{10} concentration over a standard period. From the monitoring data, it is observed that PM_{10} concentrations were found within the standard value of the Air Pollution (Control) Rules, 2022.

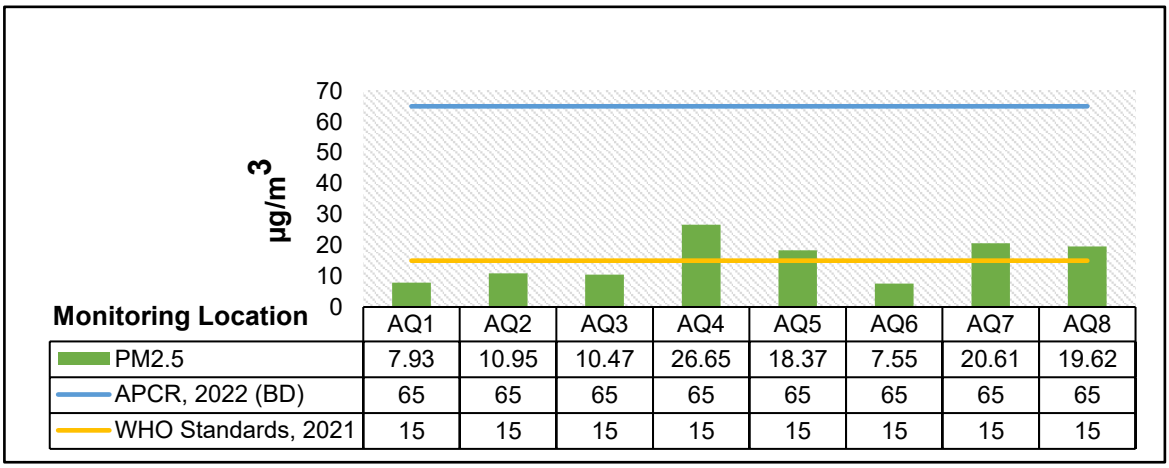


Location	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
PM10	17.50	15.22	13.07	33.61	30.27	16.06	32.75	30.26
APCR, 2022 (BD)	150	150	150	150	150	150	150	150
WHO Standards, 2021	45	45	45	45	45	45	45	45

Figure 4-4: Concentration of Particulate Matter 10 Micron or Less (PM10)
Source: Analysis carried out in the BCL Associated Ltd Laboratory

Particulate Matter 2.5 Micron or Less ($PM_{2.5}$)

78. $PM_{2.5}$ was monitored in the same areas by the same machine and the data has been represented for 24 hours. Monitoring data at all locations were found within the standard value of Air Pollution (Control) Rules, 2022. Whereas, the $PM_{2.5}$ data for the locations of AQ4, AQ5, AQ7, and AQ8 exceeded the IFC/WB standards.



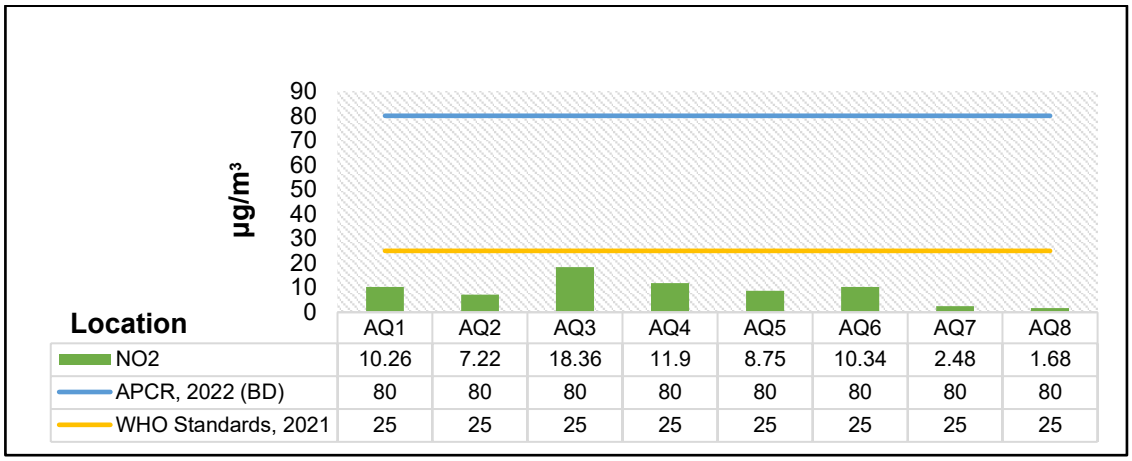
Monitoring Location	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
PM2.5	7.93	10.95	10.47	26.65	18.37	7.55	20.61	19.62
APCR, 2022 (BD)	65	65	65	65	65	65	65	65
WHO Standards, 2021	15	15	15	15	15	15	15	15

Figure 4-5: Concentration of Particulate Matter 2.5 Micron or Less ($PM2_{.5}$)
Source: Analysis carried out in the BCL Associated Ltd Laboratory

Nitrogen Dioxide (NO_2)

79. From the monitoring data, it is observed that NO_2 concentrations were found within the standard value of

Air Pollution (Control) Rules, 2022 and IFC/WB.

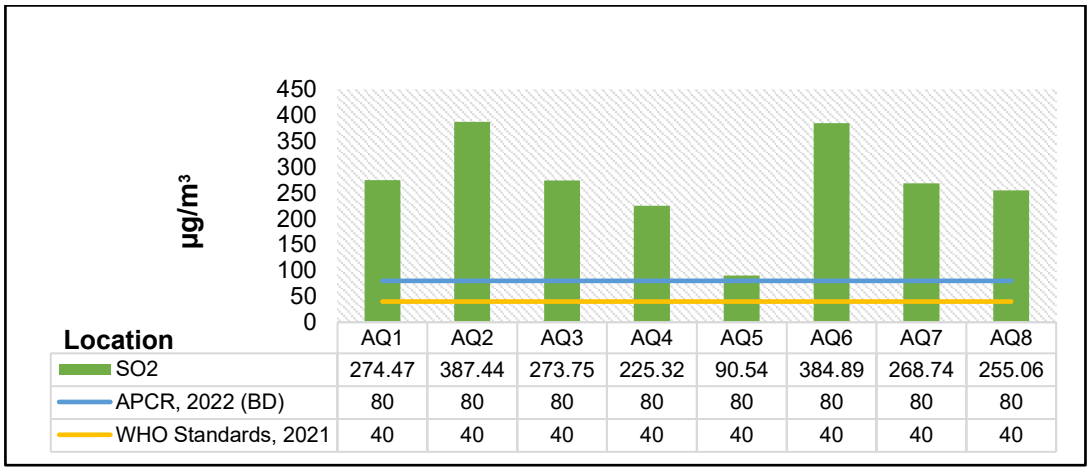


Location	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
NO2	10.26	7.22	18.36	11.9	8.75	10.34	2.48	1.68
APCR, 2022 (BD)	80	80	80	80	80	80	80	80
WHO Standards, 2021	25	25	25	25	25	25	25	25

Figure 4-6: Concentration of Nitrogen Dioxide (NO_2)
Source: Analysis carried out in the BCL Associated Ltd Laboratory

Sulfur Dioxide (SO_2)

80. The 24-hour SO_2 concentration at all the monitoring locations was reported above the standard value of IFC/WB and Air Pollution (Control) Rules, 2022.

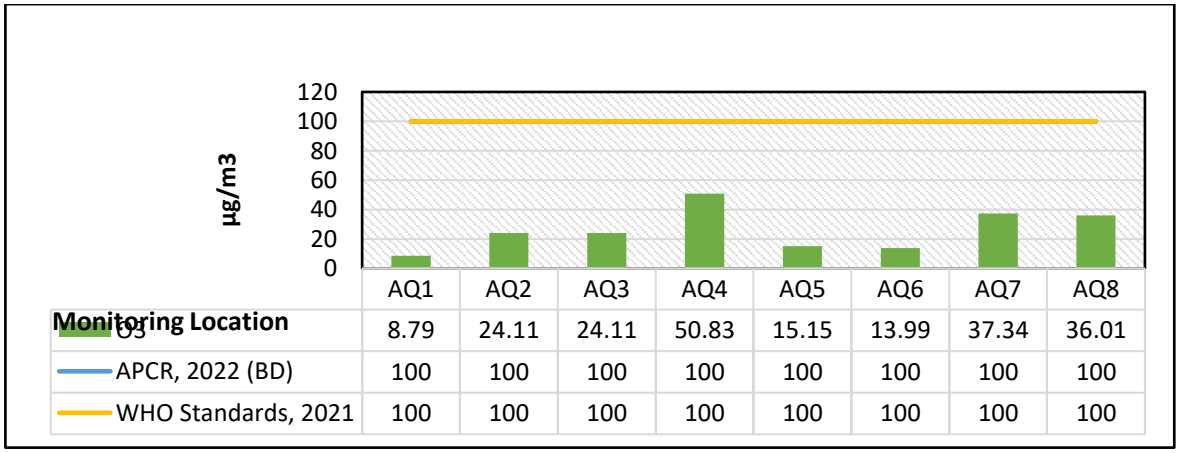


Location	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
SO2	274.47	387.44	273.75	225.32	90.54	384.89	268.74	255.06
APCR, 2022 (BD)	80	80	80	80	80	80	80	80
WHO Standards, 2021	40	40	40	40	40	40	40	40

Figure 4-7: Concentration of Sulfur Dioxide (SO_2)
Source: Analysis carried out in the BCL Associated Ltd Laboratory

Ozone (O_3)

81. Ozone was monitored by an ozone meter, and the data have been represented for 8 hours. The concentrations are significantly lower than the standard value of the Air Pollution (Control) Rules, 2022, and IFC/WB.

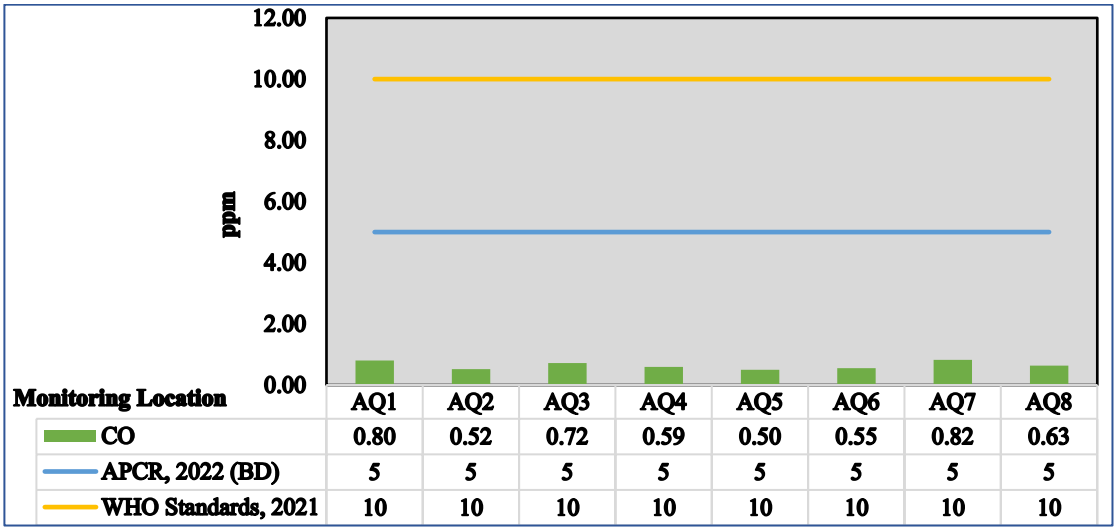


Monitoring Location	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
O3	8.79	24.11	24.11	50.83	15.15	13.99	37.34	36.01
APCR, 2022 (BD)	100	100	100	100	100	100	100	100
WHO Standards, 2021	100	100	100	100	100	100	100	100

Figure 4-8: Concentration of Ozone
Source: Analysis carried out in the BCL Associated Ltd Laboratory

Carbon Monoxide (CO)

82. Eight-hour CO concentrations are reportedly low at the monitoring locations compared with the standard value of Air Pollution (Control) Rules, 2022 on an 8-hour basis (5 mg/m^3).



Monitoring Location	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
CO	0.80	0.52	0.72	0.59	0.50	0.55	0.82	0.63
APCR, 2022 (BD)	5	5	5	5	5	5	5	5
WHO Standards, 2021	10	10	10	10	10	10	10	10

Figure 4-9: Concentration of Carbon Monoxide (CO)
Source: Analysis carried out in the BCL Associated Ltd Laboratory

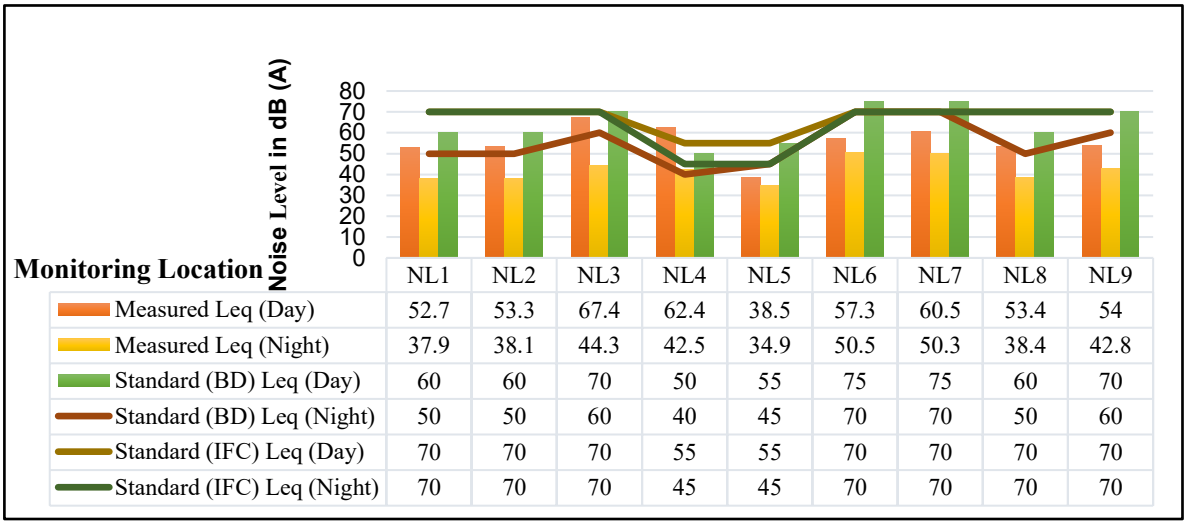
4.2.4.AMBIENT NOISE LEVEL

83. The primary goal of monitoring ambient noise levels was to establish a baseline in the sub-project area. The objective was to assess sound intensity at various monitoring locations across the sub-project site, carefully chosen to capture representative data. Selection criteria for these locations considered potential sources of construction activities and proximity to important receptors such as residential areas and educational institutions. The chosen sites fall into distinct categories like industrial, residential, commercial, mixed, and silent areas according to DOE/IFC classifications.

84. The noise monitoring locations are Adjacent to CP Mor, Ichakhali at east side of the project location (NL1 Mixed /Commercial area), Daborkhali Point, Ichakhali at Ichakhali Sluice gate Baz (NL2 Mixed /Commercial area) Ichakhali Sluice gate Bazar, Ichakhali (NL3 Commercial area) Adjacent to the main road, Dakshin Maghadia (NL4, Silent/Institutional), In front of Abdul Kader Mia House, Charsarat (NL5, Residential area), In front of BR Powered (NL6, Industrial area), In front of Nippon and McDonald Steel Industries limited (NL7, Industrial area), Baitur Rahman Panjegana Mosque (NL8, Mixed area) and Tekerhat Bazar (NL9, Commercial area), Detailed information about noise level measurement sampling and results are provided in Appendix 1 Appendices, Vol-2. Ambient daytime noise levels, denoted as Leq_{day}, exhibited a range of 38.5 to 67.4 dB(A) within the study area. In contrast, ambient nighttime noise levels (Leqnight) displayed variations ranging from 34.9 to 50.5 dB(A). Maximum daytime noise levels (Lmax) recorded at the monitoring locations spanned from 61.5 to 84.2 dB(A), while minimum daytime noise levels (Lmin) ranged from 30.4 to 41.4 dB(A).

85. For nighttime measurements, maximum noise levels (Lmax) were documented in the range of 47.1 to 57.1 dB(A), and minimum noise levels (Lmin) ranged from 30.1 to 41.7 dB(A). Notably, the highest daytime noise level was recorded at 67.4 dB(A) at NL3, while the lowest was 38.5 dB(A) at NL5.

86. During the monitoring period, NL6 had the highest nighttime noise level at 50.5 dB(A) followed by NL7 at 50.3 dB(A). NL5 had the lowest at 34.9 dB(A). In the case of NL4, both daytime and nighttime noise levels surpassed the stipulated standards outlined in the Noise Pollution Control Rules of 2006 in Bangladesh. This observation is attributed to the proximity of NL4's measurement location to a roadside, having a significant volume of vehicular traffic passing through. This proximity serves as a prominent factor contributing to the elevated noise levels. However, noise levels at other locations, both during the day and night, conform to the standards outlined in the Noise Pollution Control Rules of 2006 in Bangladesh and the International Finance Corporation (IFC) guidelines.



Monitoring Location	NL1	NL2	NL3	NL4	NL5	NL6	NL7	NL8	NL9
Measured Leq (Day)	52.7	53.3	67.4	62.4	38.5	57.3	60.5	53.4	54
Measured Leq (Night)	37.9	38.1	44.3	42.5	34.9	50.5	50.3	38.4	42.8
Standard (BD) Leq (Day)	60	60	70	50	55	75	75	60	70
Standard (BD) Leq (Night)	50	50	60	40	45	70	70	50	60
Standard (IFC) Leq (Day)	70	70	70	55	55	70	70	70	70
Standard (IFC) Leq (Night)	70	70	70	45	45	70	70	70	70

Figure 4-10: Concentration of Carbon monoxide (CO)
Source: Analysis carried out in BCL Associated Ltd Laboratory

4.2.5.GENERAL HYDROLOGY AND BATHYMETRIC CHARACTERISTICS

87. The general hydrology of the study area encompassed the Sandwip channel, Feni River, canals (*khal*) such as Ichakhali khal, Daborkhali khal, and Bamon Sundar khal, along with some ponds, and the flood plain area.

88. The Sandwip is an island located along the southeastern coast of Bangladesh in the Chattogram District. It is close to the mouth of the Meghna Reservoir in the Bay of Bengal and is separated from the Chattogram coast by the Sandwip Channel, which eastern part of the sub-project area.

89. The Sandwip channel passes along the western boundary of the sub-project area. Within the sub-project site, there are natural drainage systems, including Daborkhali and Ichakhali canals. The water flow in the Ichakhali canal is regulated by the sluice gate located at the entry point of the SW side of the sub-project site. The upstream area of the Ichakhali Canal is crisscrossed by natural drains that flow towards the Ichakhali Canal, which eventually flows into the Sandwip Channel.

4.2.5.1. BOTTOM TOPOGRAPHY AND BATHYMETRY OF SANDWIP CHANNEL

90. The Sandwip Channel is characterized by its unique underwater landscape and influences both the marine ecosystem and human activities in the region. Significant depth variations were found within the Sandwip Channel, the deepest areas were found to reach depths of over 30 meters, while shallower depths were less than 5 meters. Sediment analysis indicated a diverse distribution of sediment types across the channel. Fine sediments were predominantly found in shallower regions, while coarser sediments were in deeper areas. This distribution is influenced by tidal currents and sediment transport processes within the channel. The bathymetric survey identified several notable topographic features, including underwater depressions and sandbanks which lead to shaping the local marine habitat and influencing the movement of aquatic species[8]. Details are documented in Chapter 5, Alternative Analysis.

4.2.6.SURFACE WATER QUALITY

91. The surface water quality of the Daborkhali Canal, Bamonsundar Canal, Ichakhali Canal, Shaherkhali Canal, and the Sandwip Channel is considered VCs within the sub-project site. Surface water sampling sites were selected for testing in the analytical laboratory. The samples were analyzed, aiming to evaluate physicochemical, heavy metals, and bacteriological parameters, with subsequent comparison to national and international standards for establishing the baseline conditions of the study area.

92. The sub-project activities, particularly dredging, will be confined within suitable locations such as the Sandwip Channel, and liquid materials at the landfilling zone may be drained out into Bamonsundar Canal, Daborkhali Canal, Ichakhali Canal, and Shaherkhali Canal. Site components' locations, the convergence points of stream courses, high-water velocity areas, and permanent waterbodies/ponds were taken into consideration during sampling site selection. The tested parameters were Dissolved oxygen (DO), Total dissolved solid (TDS), Total suspended solid (TSS), Electric conductivity (EC), Turbidity, pH, Salinity, Chemical oxygen demand (COD),

[8] Source: Mirsharai Development Master plan (MUDP), 2020 under the Urban Development Directorate (UDD)

Biochemical oxygen demand (B0D), Mercery (Hg), Pead (Pb), Cadmium (Cd), Oil and Grease, Fecal coliform, (FC) and Total coliform (TC). The results were then compared to the Bangladesh Standards (ECR, 2023). The results of the inland surface water (from the canals) analysis are presented in **Table 4-3.** The results indicate that most of the samples comply with the national standard. TDS of SW1 and SW2 are slightly above the standards. Other than that, all physical and chemical properties of the samples are within the standards set by Environmental Conservation Rules (ECR), 2023. Locations of the sampling sites of the Bamonsundar Canal (SW1), Daborkhali Canal (SW2), Ichakhali Canal (SW3), and Shaherkhali Canal (SW4), along with result sheets and photographs are provided in **Appendix 1, Baseline study, Volume-II.**

Table 4-3: Results of the Surface Water Samples from the Canals within the Sub-project Study Area

Parameters	Unit	Bamonsundor Canal SW1	Daborkhali Canal SW2	Ichakhali Canal SW3	Shaherkhali Khal SW4	Bangladesh Standard[9]	Test Method (APHA)
DO	mg/L	5.39	7.56	7.51	6.47	≥5	4500-O-G
TDS	mg/L	2168	1332	166	304	1000	2540.C
TSS	mg/L	84	34.0	6.0	5.0	-	2540.C
EC	µS/cm	3910	2750	327	540	-	2510.B
Turbidity	NTU	42.8	81.2	65.6	46.9	-	Turbidimeter
pH	-	7.32	8.02	7.09	7.08	6-9	4500-H^+.B
Salinity	ppt	2.1	1.4	<0.1	0.2	-	-
COD	mg/L	5.64	1.88	2.82	3.76	50	5220.B
BOD	mg/L	2.32	<0.2	<0.2	0.58	≤6	5210.B
Mercury	mg/L	< 0.001	<0.001	<0.001	<0.001	-	3112.B
Lead	mg/L	< 0.001	< 0.001	<0.001	<0.001	0.1	3111.B
Cadmium	mg/L	< 0.001	< 0.001	<0.001	<0.001	-	3111.B
Oil and Grease	mg/L	<2.0	< 2.0	<2.0	<2.0	-	5520.B
Fecal Coliform	MPN/100ml	2.0	<1.8	2.0	<1.8[10]	2.0 indicates (absent) as per standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	2.0	2.0	2.0	<1.8	Same as FC	9221B-C

Source: Laboratory Analysis in BCSIR, January 2023

93. In addition, four surface water samples from the Sandwip Channel (L-05), Sandwip Channel(L-07), Sandwip Channel (L-08), and Sandwip Channel (L-09) were collected on 03 January 2024 after preliminary screening and identifying suitable locations for dredging sources. The tested results report water samples from the Sandwip Channel are presented in **Appendix -1, Vol-II**. The results were compared with the Bangladesh Standards (ECR, 2023). The findings indicate that several tested results were the same in all locations, and parameters adhere to the national standard limits as shown in **Table 4-4.**

Table 4-4 : Results of Surface Water Samples from the Sandwip Channel

Parameters	Unit	Sandwip Channel (Coastal Surface Water)				Bangladesh Standard[11]	(Test Method (APHA)
		L-05	L-07	L-08	L-09	Coastal	L-15
Parameters	**Unit**	**L-05**	**L-07**	**L-08**	**L-09**		
Temperature	°C	24.8	25.2	25.3	24.7	-	In-house
Turbidity	NTU	83.1	155	198	683	-	Turbidimeter
pH	-	7.90	7.95	7.98	8.00	6.5-8.5	4500-H^+.B
TSS	mg/L	463	505	539	903	50	2540.D
(EC	µS/cm	27500	27400	27300	27400	-	2510.B

[9] Bangladesh Environment Conservation Rules, 2023- Schedule 2 (Standards for Inland Surface Water, Water Usable for Fisheries).
[10] As per MPN (most probable number) chart (APHA-22nd edition), MPN <1.8 indicates absence of test organism in the supplied sample.
[11] 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

Parameters	Unit	Sandwip Channel (Coastal Surface Water)				Bangladesh Standard[11]	(Test Method (APHA)
		L-05	L-07	L-08	L-09	Coastal	L-15
Salinity	ppt	16.6	16.8	16.9	16.6		5220.B
(COD	mg/L	1.95	2.92	1.88	2.82	5	4500-H^+.B
(BOD	mg/L	< 0.2	<0.2	<0.2	<0.2	-	5210.B
TC	MPN/100ml	<1.8*	<1.8*	<1.8*	<1.8*	1000	9221B-C
Hg	mg/L	<0.001	<0.001	<0.001	<0.001	0.0001	3112.B
Pb	mg/L	<0.01	<0.01	<0.01	<0.01	0.05	3111.B
Cd	mg/L	<0.001	<0.001	<0.001	<0.001	0.005	3111.B
Zn	mg/L	<0.05	<0.05	<0.05	<0.05	-	3111.B
Cr	mg/L	<0.005	<0.005	<0.005	<0.005	0.05	3113.B

Source: Laboratory Analysis in BCSIR, January 2023

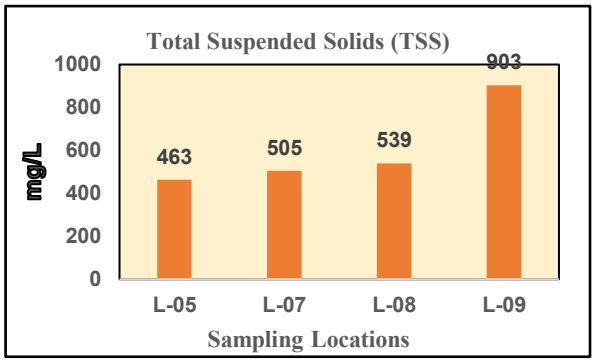
94. Detailed discussions on water quality parameters are provided below.

i) **Temperature:** Surface water temperature measurement is vital for understanding its impact on aquatic life, weather patterns, and human activities. It influences ocean currents and water quality, contributing to insights into environmental health and climate trends. The recorded temperature across all the locations ranged from 24.7 to 25.3 degrees. The highest temperature was recorded at sampling location L-08, and the lowest was at L-09. In addition to site-specific reasons, the sampling time was also a factor in changing the temperatures, since water samples were collected at different times in the day.

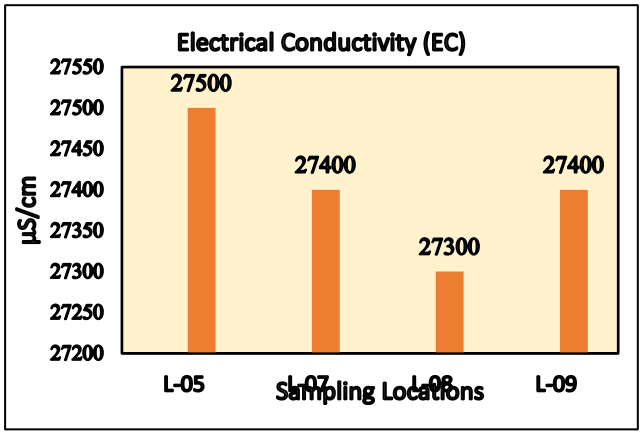
ii) **Turbidity:** Turbidity is a measure of the cloudiness of water, which represents the degree to which water loses its transparency due to the presence of suspended particulates. The maximum Turbidity, reaching 683 NTU, was observed in the L-09 sample. There is no set standard limit of turbidity in the Bangladesh ECR, 2023.

vii)pH: As per ECR 2023, the acceptable pH range is between 7.9 and 8.0 for the coastal water. This range ensures sufficient protection for freshwater fish and bottom-dwelling invertebrates. The pH values ranged from 7.8 to 8.0, complying with the standards outlined in the Bangladesh Environment Conservation Rules, 2023 - Schedule 2 (Standards for Inland Surface Water, Water Usable for Fisheries).

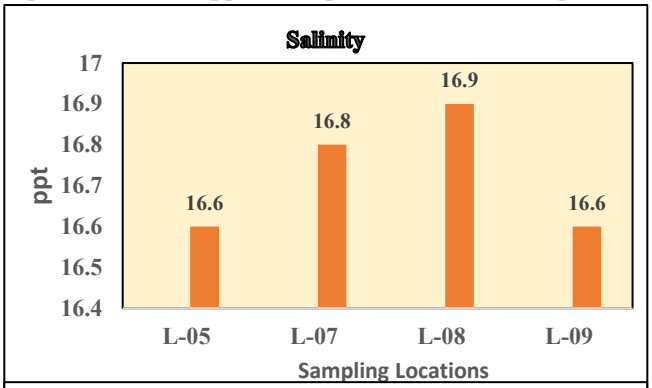
iii) **Total suspended solids (TSS):** The highest TSS concentration was identified as 903 mg/l at L-09 sample, and the lowest value was 463 mg/L at L-05 from the Sandwip Channel. High TSS in surface water causes more turbidity and cloudy conditions, and impacts aesthetics and aquatic habitats. It reduces sunlight penetration, affecting plant growth. Low TSS enhances water clarity and fosters a healthier aquatic environment with improved light penetration and stable habitats. The analyzed result indicates that the Sandwip Channel waters are more transparent, but far exceeded the standard limit of TSS for coastal water (50 mg/l) of the Bangladesh ECR, 2023.



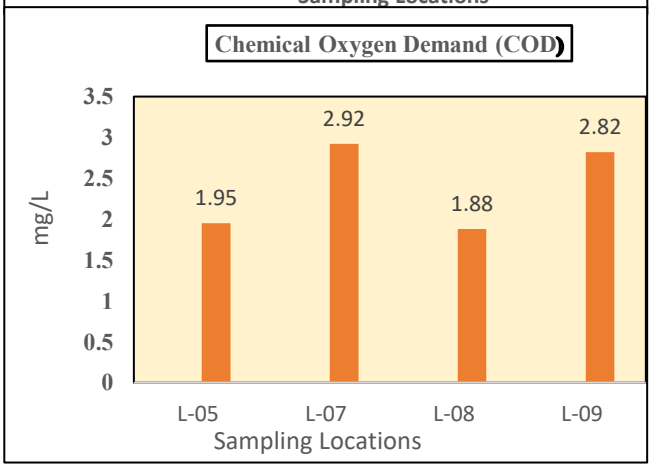
iv) **Electrical conductivity (EC):** Electrical Conductivity (EC) levels varied from 27300 to 27500 µS/cm, respectively. The electrical conductivity of water provides insights into its overall chemical composition, particularly the presence of dissolved salts. High EC values typically indicate higher salinity, while low values suggest lower mineral content. The EC of all four water samples from the Sandwip channel is almost similar. There is no set standard limit of the EC in the Bangladesh ECR, 2023.



viii) **Salinity:** Salinity levels ranged from 14.3 ppt in sample L-14 to 16.9 ppt in sample L-09. There is a specified standard for salinity in Inland and Coastal water as per ECR 2023 of Bangladesh.



ix) **Chemical Oxygen Demand (COD):** Chemical Oxygen Demand (COD) values were within the stipulated standards of the Bangladesh ECR, 2023. Elevated Chemical Oxygen Demand (COD) signifies more oxidizable organic material, decreasing dissolved oxygen (DO). This drop in DO can harm higher aquatic life forms by creating anaerobic conditions.



x) Biochemical Oxygen Demand (BOD): The concentration ranges less than 0.2 mg/l in all test samples, which is within the stipulated standards of the Bangladesh ECR, 2023. A higher Biological Oxygen Demand (BOD) suggests that more oxygen was needed, leaving less oxygen-demanding species and indicating poorer water quality. Conversely, low BOD indicates less oxygen consumption. Runoff from streets, sidewalks, and residential areas, carrying wastes and nutrients, contributes to increased oxygen demand.

x) **Bacteriological Parameter/Total Coliform:** The concentrations of total Coliform for all samples were found to be less than 1.8, indicating the value of total Coliform is below the standard for both Inland water and Coastal water.

xi) Heavy Metals: The analysis of heavy metal concentrations in water samples includes Cd, Zn, Mercury, Lead, and chromium based on the national standard (ECR 2023) and WHO standards. The concentration of Cadmium in all samples was found to be less than 0.001 mg/l. In ECR 2023 for Bangladesh, there is no specified standard for Cadmium in inland water, but coastal water is regulated with a standard of 0.005 mg/l per ECR 2023. The WHO standard for Cadmium in surface water is 0.003 mg/l. Zinc concentrations remained below 0.05 mg/l across all samples. This level is significantly lower than the WHO standard of 3 mg/l, suggesting that Zinc levels in the water are safe and well within acceptable limits. Mercury levels were recorded at less than 0.001 mg/l, which is compliant with the national standard (ECR 2023) and the WHO limit of 0.001 mg/l. This indicates that Mercury concentrations in the water samples are within safe limits. The concentration of Lead was less than 0.01 mg/l, which meets the national standard (ECR 2023). This level is indicative of safe water quality concerning Lead contamination (<0.01 mg/l) and Chromium concentrations (<0.005 mg/l) were reported to be below the national standard limits (0.05 mg/l), indicating that the levels of this heavy metal in the water samples are within acceptable ranges.

4.2.7.GROUNDWATER QUALITY

95. Groundwater is an integral part of the hydrologic cycle and originates from the percolation of rain or surface water into the ground. The groundwater has been selected as a VC because of its potential importance to the water supply of the sites. To make up for the lack of surface water in the project region, a lot of groundwater is used for irrigation. Though it varies in quality, shallow groundwater can be found 2 to 4 meters below the surface of the earth. While deep tube wells with manual pumps are used for drinking water, shallow tube wells are used for irrigation. In addition to seepage from rivers, canals, streams, and stored water, groundwater recharge occurs as a result of the gradual vertical percolation of rain and irrigation water. There is a net groundwater inflow from the north, serving as a primary source of recharge. However, the percolation rate is hindered by the thickness and impermeability of the upper clay layer. Recharge begins in May and peaks in August, but much potential recharge is lost due to quick

saturation of the upper water-bearing layers and rejection by heavy surface soil.[12] Approximately 88% of the population in Mirsharai relies on tube well water, ensuring that the majority do not encounter any issues with their drinking water supply. Merely 1% of the residents utilize Chara water in this region[13].

96. **Groundwater Sampling:** The primary monitoring of groundwater quality was carried out at three locations at Charsarat Village (GW1), BEZA Office (GW2), and Near CP Mor (GW3) during the monitoring period. The selection of groundwater sampling locations was primarily guided by factors such as the slope of the area, an understanding of the local groundwater flow regime, an understanding of groundwater use in the study area, and the availability of tube wells/bore wells for groundwater abstraction. In December 2023, three groundwater samples were collected; the GW1 sample was collected from 650-700 feet, the GW2 was from 680- 700 feet, and the GW3 was collected from 550-600 feet. The locations of groundwater sampling in and around the project site are detailed in **Appendix 1, Baseline study, Volume II.**

97. The results of the groundwater analysis are given in **Table 4-5,** and tested values have been compared to the best practices tools in Bangladesh, ECR, 2023, Schedule 2 (B), for understanding the baseline quality status of the groundwater. Following the national standards, it was found that the Total Dissolved Solids (TDS) and Turbidity in sample GW3 exceeded the national ECR 2023 standard. Furthermore, the Iron (Fe) concentration in all samples slightly exceeds the standard set by the Environmental Conservation Rules (ECR), 2023, Schedule 2 (B). Nevertheless, other parameters indicate that water quality is suitable for drinking purposes.

Table 4-5: Groundwater Samples Analysis Results

Parameters	Unit	Charsarat Village GW1	BEZA Office GW2	Near to CP Mor GW3	Bangladesh Standard[14]	Test Method (APHA)
TDS	mg/L	374	332	2544	1000	2540.C
EC	µS/cm	590	587	5580	-	2510.B
Turbidity	NTU	1.1	0.83	90.8	5.0	Turbidimeter
pH		7.52	7.30	7.31	6.5-8.5	4500-H+.B
Salinity	ppt	0.3	0.3	2.4	-	
Total Hardness as CaCO3	mg/L	82.0	118	944	-	2340.C
Iron	mg/L	1.14	1.82	7.18	0.3-1.0	3111.B
Arsenic	mg/L	< 0.005	<0.005	<0.005	0.05	3114.C
Manganese	mg/L	<0.05	<0.05	0.38	0.4	3111.B
Odor	-	Agreeable	Agreeable	Agreeable	-	In-house
Fecal Coliform	MPN/100ml	<1.8[15]	<1.8	<1.8	2.0 indicates (absent) as per BDS Standard 1240:2021	9221B-C
Total Coliform	MPN/100ml	<1.8	<1.8	<1.8	Sama as above	9221B-C
Source: Laboratory Analysis by BCSIR, December 2023 and January 2024						

4.2.8.SOIL CHARACTERISTIC

98. The soil of the sub-project area is mainly formed from recent alluvial sediments. The major types of soils reported from the study area include Grey Piedmont soils, which occur extensively on the northern and eastern Piedmont Plains and locally on the Chattogram coastal plain. They have been formed in the out-wash alluvium at the foot of hills, having a cambic B-horizon, which has a grey matrix and is medium or very strong acidic in reaction. They are mainly included in Dystric or Eutric Gleysols. Shear wave (S-wave) velocity, Vs, of soils, is a small-strain parameter that is widely used to evaluate the dynamic response of soils, including seismic site response, and liquefaction potential of soils **(Table 4-6).**

Table 4-6: Soil Type Identification from Shear Wave Velocity[16]

Ground Class	AVS 30 (m/s)	Soil Type
C	360-760	Very Dense/ Hard Soil and Soft rock
D1	300-360	Stiff / Dense to very tense/Hard Soil
D2	250-300	Stiff / Dense Soil

[12] Environmental and Social Assessment (ESA) Report, BEZA, 2020
[13] Physical Infrastructure Survey, Mirsharai Upazila Development Plan (MUDP), 2018
[14] Bangladesh Environment Conservation Rules, 2023, Schedule-2(B).
[15] As per MPN (most probable number) chart (APHA-22nd edition), MPN <1.8 indicates absence of test organism in the supplied sample.
[16] Geological study and seismic hazard assessment, Mirsharai Upazila Development Plan (MUDP)

Ground Class	AVS 30 (m/s)	Soil Type
D3	220-250	Medium Stiff to Stiff / Medium Dense to Dense Soil
D4	200-220	Medium Stiff / Medium Dense Soil
D5	180-200	Soft/Loose to Medium Stiff /Medium Dense Soil
E	<180	Soft / Loose Soil

99. The soil in the sub-project area consists of two major categories viz. Calcareous Alluvium and Grey Piedmont Soils. The sub-project areas in particular contain mostly Grey Piedmont Soils but have some Calcareous soils in Precinct F to the west. The map of soil characteristics is presented in Appendix -1, Vol-II. Piedmont soils were primarily created from the mountain and rock erosion resulting in predominantly clay soils. Such soils tend to be shallow and are not naturally rich in mineral deposits. This soil can be lacking in richness due to heat and rain that weatherizes the rocks and removes the bases. As a result of this weathering, most Piedmont soil is acidic. They have been formed in the out-wash alluvium at the foot of hills, having a cambic B-horizon which has a grey matrix and is medium or very strongly acid in reaction. This makes it the perfect soil for certain plants and trees, but it can be a challenge for lawn growth. Calcareous Alluvium Soils are stratified or raw alluvium throughout or below the cultivated layer. They are calcareous throughout or part of it and lack a diagnostic subsoil horizon. This alluvium on the active Ganges floodplain mainly comprises brownish-grey to pale brown sandy and silty deposits, which are moderately calcareous. These soils appear in the lower Meghna estuarine region. They are mainly Calcaric Fluvisols.

4.2.9.SOIL AND SEDIMENT QUALITY

100. Three soil samples were collected from the sub-project area (two from Zone 12 and one from Zone 13) for analysis. Standard sampling procedures were followed to ensure the quality of the samples collected. After collecting, the samples were analyzed in the Department of Soil, Water, and Environment, University of Dhaka. The soil in Zone 13 is of the texture silty clay, and the soil from Zone 12 ranges from silty clay loam to silty clay as it moves toward the south, owing to the gradual reduction in silt and accumulation of finer clay particles. Test results sheet and sampling photographs are included in **Appendix 1, Baseline study, Volume-II.** The percentage of soil classes is given in **Table 4-7.**

Table 4-7: Soil Textural Class of the Samples Collected from Sub-project Sites

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 2023

101. Besides, four (4) sediment samples were collected on 03 January 2024 and 20 February 2024, respectively, by using a vessel/ trawler from the Sandwip Channel. Sediment samples were collected within a depth of the top 10 cm of the sediment surface by using an Ekman dredger that causes minimum disturbance[17]. Sediment samples were collected to evaluate metal toxicity that can harm soil quality/land if this sediment is used for dredging, and also aquatic organisms. The sealed samples were sent to the BCSIR laboratory in Dhaka for the analysis of physicochemical parameters (concentration of heavy metals present) and Soil Water and Environment of Dhaka University for laboratory analysis to get a better understanding of the textural composition concentration and the concentration of the heavy metals of Zn, Cu, Hg, Pb, Cd as shown in **Table 4-8.** The details of sediment sampling locations, laboratory test reports, and photos of sampling are presented in **Appendix 1, Baseline study, Volume II.**

Table 4-8 : Test Results of Sediment Samples

Texture Class	Unit %	Sampling Locations				Australian standard[18]		Dutch Intervention Values on Soil quality standard[19]	Test Method (APHA)
		L-05	L-07	L-08	L-09	DGV[20]	GV-high		
Texture Classes-									
Sand	%	2.46	10.41	25.91	13.28	-	-	-	

[17] Reference: https://www.ppsthane.com/blog/soil-sediment-sampling
[18] Recommended toxicant default guideline values for sediment quality, Australian Government Initiative. https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants
[19] Guidance Document for Sediment Assessment, Date 4 November 2010, e Dutch Water Act. Ministry of Infrastructure and the Environment - DG Water. December 2009
[20] DGV means Default guideline values.

Texture Class	Unit %	Sampling Locations				Australian standard[18]		Dutch Intervention Values on Soil quality standard[19]	Test Method (APHA)
		L-05	L-07	L-08	L-09	DG V[20]	GV-high		
Silt	%	53.91	51.91	38.32	54.84	-	-	-	Hydrometer method
Clay	%	43.64	38.40	38.77	31.88	-	-	-	
Heavy metal analysis									
Zn	mg/kg	32.5	35.3	31.6	28.4	200	410	2000	3111.B
Cu	mg/kg	19.9	23.3	19.7	20.3	65	270	190	3113.B
Hg	mg/kg	< 0.001	<0.001	<0.001	<0.001	0.15	1.0	10	3112.B
Pb	mg/kg	8.58	9.91	8.60	9.3	50	220	580	3111.B
Cd	mg/kg	<0.001	<0.001	< 0.001	< 0.001	1.5	10	14	3111.B

Source: Laboratory Analysis in BCSIR, January 2023

102. **Sediment texture composition:** Laboratory Analysis indicates that sediment has three textural classes sand, silt, and clay. The clay texture percentage varies from 31.88 to 43.64%, and the silt texture varies from 38.32% to 54.84 %, while the sand texture varies from 2.46% to 25.91% according to the test results (Figure 4-11).

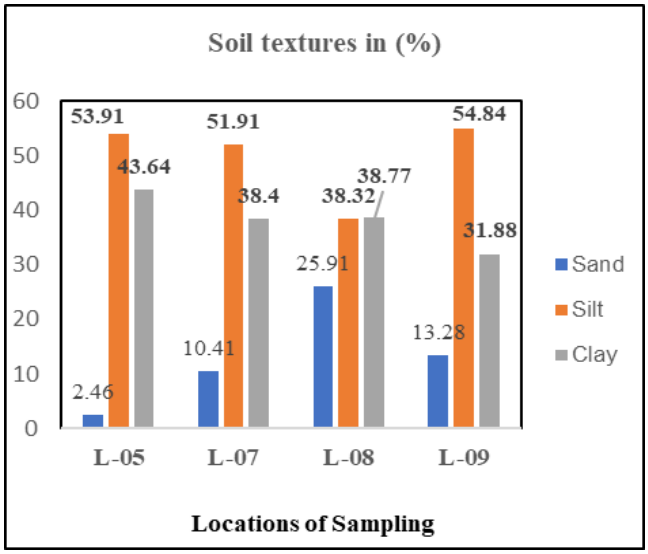


Figure 4-11: Sediment Texture Composition at Four Locations
Source: Surveyed 2022, BCL

103. **Heavy Metals** The concentrations of Zn in the sediment samples ranged from 28.4 mg/kg to 35.3 mg/kg, with the highest and lowest levels observed at L-05 and L-09, respectively. Copper values ranged from 19.7 mg/kg to 23.3 mg/kg, with the highest concentration at L-07 and the lowest at L-08. Mercury levels were consistently below 0.001 mg/kg for all locations. The highest concentration of Pb (9.91 mg/kg) was observed in L-07, and the lowest was at 8.58 mg/kg in L-05. Cadmium values were consistently below 0.001 mg/kg in all collected samples from both the Sandwip Channel. In the absence of the Bangladesh Standard in the ECR 2023, the globally recommended Australian Government Initiative's toxicant default guideline values for sediment quality and Dutch Intervention Values on Soil quality standards are considered to assess riverbed sediment characteristics with toxicity level.

4.2.10.GEOLOGY

104. The geology of the project area can generally be classified as sedimentary, with limestone, including metamorphic rocks, such as travertine. Occurs as any of the following: quartzite, graphitic schist, chlorite, amphibole, mica and kyalite schist, hornblende, bitite and garnet, gneiss, acid gneiss, granular or charconite. The site is close to the sea and the Feni River and is covered with clay and sand deposits. According to the Geological Map of Bangladesh, the site is covered by beach and dune sand and water, and is classified as low and intertidal plains according to the geomorphic map of Chattogram (**Appendix 1, Baseline study, Volume-II).**

105. According to the physiography of Bangladesh, the proposed project area falls under the physiographic unit "Delta (Tidal), Coastal Plain". The Chattogram Coastal Plain is exposed to cyclones, and low-lying coastal areas are subject to saline storm surges. According to the UNDP and FAO (1988), young tidal floodplains occupy a narrow strip along the study area. It comprises saline mud flats and marshes exposed at low tide. The landscape is almost

level and is crisscrossed by numerous tidal creeks. Heavy silts and clay predominate. Many soils are actually or potentially extremely acidic in the reaction due to acidic sulfate conditions, but acid sulfate layers inland have generally been buried by 50 cm of Acid River or Piedmont alluvium. Seasonal flooding is found in the higher parts and in embanked areas, mainly due to rainwater. On lower land and near the coast, the land is tidally flooded with saline water.

4.2.11.SEISMICITY

106. In 1979, the Geological Survey of Bangladesh (GSB) suggested a seismic zoning plan for Bangladesh, separating the country into three seismic zones to promote earthquake-resistant architecture. Later, an updated seismic zoning map and specific seismic design criteria were included in the Bangladesh National Building Code (BNBC, 2020). Recently, GSB and BNBC introduced a new seismic zone map for Bangladesh, which includes four zones. The zone coefficients (Z) for the four zones are: Z=0.12 g (Zone 1), Z=0.20 g (Zone 2), Z=0.28 g (Zone 3), and Z=0.36 g (Zone 4). The most severe earthquake-prone zone is Zone 4, which is in the northeast section of the country, encompassing Sylhet, and has a maximum peak ground acceleration of 0.36g. However, the sub-project locations are often classified as Zone III, which means that if a significant earthquake occurs, it will have a severe impact.

107. The land use and land cover is a VC because there will be a sub-project interaction with the current landscape in the immediate vicinity. The landscape is almost level and is crisscrossed by numerous tidal creeks. Heavy silts and clay predominate. Many soils are actually or potentially extremely acidic in reaction due to acid sulfate conditions, but acid sulfate layers inland have generally been buried by 50 cm or less by Acid River or Piedmont alluvium. Seasonal flooding is found in higher parts and embanked areas, and is mainly caused by rainwater. On lower land and near the coast, the land is tidal flooded with saline water.

108. **Agro-Ecological Zoning:** The physiographic unit of the project is: Chattogram Coastal Plain (AEZ# 23), sub-regions are Piedmont Plains and River Floodplain (23a) and Young Tidal Floodplain (23b) with general soil type Non-Calcareous Grey Flood Plain Soils (non-saline) in both sub-region soils (Map). The soil texture in both sub-region soils is loamy. The landscape of the area is comprised mainly of medium-high to high land. The soil type predominates with Non-Calcareous Grey floodplain soils (no saline).

4.3. BIOLOGICAL ENVIRONMENT

109. The study covers both flora and fauna (including fish), and a marine ecology survey (zooplankton, phytoplankton, and benthos study) within the influence area of the sub-project. The baseline biological survey sought to determine the diversity and distribution of the flora and fauna, and the extent to which that may be impacted due to the project activities. A team visited the proposed project and its surrounding site on 8-13 December 2023 and January 2024 to collect first-hand data on floral and faunal diversity. The study was conducted only during the day. The herpetic-faunal and mammalian survey was done through visual search and also through discussion with local people (farmers, fishermen), local government representatives, Upazila Agriculture Officer, BEZA officials at NSEZ, Forest Beat Officer, and literature review (especially from previous reports and scientific publications).

110. Aural and visual searching was the main method for ornithological surveys. Information on fisheries was collected through local fish market surveys and interviews with fishermen. Rapid field survey and discussions with local people was the main method for floral surveys. A terrestrial fauna/ wildlife survey has been done using direct observation methods and interviews with local people. The collected data were cross-checked with information from available literature. However, this baseline information will be used in the relevant section of this report to identify and assess the impact of the proposed project activities on the existing ecological resources, and finally, to suggest mitigation measures for those impacts. An overview of the ecological resources in observed are given Error! R eference source not found.**.** The brief discussion is presented in the ensuing subsection and detailed in **Appendix 1, Section B, Vol-II.**

Table 4-9: An Overview of Ecological Resources within Sub-project Study Area

Terrestrials Ecology	Number of Species
Terrestrial Ecology	
Terrestrial plants	123
Terrestrial Wildlife:	
-Amphibians	10
-Reptiles	08
-Mammals	10
-Aves	70
Aquatic Ecology /	
Freshwater fish	59

Terrestrials Ecology	Number of Species
Aquatic Plants	23
Total	**303**
Marine ecology	
Phytoplankton	24
Zooplankton	15
Benthos	19
Marine fish species	95
Total	**153**

Source: Surveyed 2022, 01 December 2023 to 31 January 2024

4.3.1.TERRESTRIAL ECOLOGY

4.3.1.1. TERRESTRIAL PLANTS

111. Plant: Terrestrial plants have been investigated using the Random Meander method in December 2023 using the quadrat method. Local people were interviewed during the survey. A total of 123 species of important terrestrial plants under 116 genera of the family 61 have been recorded in the project area. Among them, 44% are trees, 41% are herbs, and the rest are shrubs. Out of 123 species of terrestrial plants, mostly used as medicinal and which is 56 in number and used as timber 27, fruit-bearing 28, ornamental 08, and fuel 04. 23 species of aquatic plants have also been identified.

112. Native Tree species (Banana, Papaya, Custard Apple, Lemon, Date, and Coconut) are also noticed in the project areas' homestead areas. Various trees like Akashmoni, Jhao, coconut trees, etc., exist on the side of the road. A list of the trees along the access roads & homestead areas and photographs of the vegetation are given in **Appendix 1, Baseline study, Section B-1, Table-22, Volume-II.**

4.3.1.2. TERRESTRIAL ANIMAL

113. In general, terrestrial fauna includes all wildlife under the classes Amphibia, Reptilia, Mammalia, and Aves. Terrestrial fauna, particularly Wildlife surveys, have been done using direct observation methods 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. During field observation, the team 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 to determine cryptic mammals and reptiles and seasonal variations of migratory wildlife. (**Appendix 1 Baseline study, Section B-1, Volume-II).**

114. **Amphibian:** A total of 10 species of amphibians were observed in the project area Asian Common Toad, Skipper Frog, green pond frog, Crab-eating Frog, Bombay Wart Frog, Indian Bullfrog, Green puddle frog, Painted Bull Frog, Common Tree Frog, and Indian tree frog etc., however, these species are least concerned and not listed as endangered or threatened or near to threaten category. Details in **Appendix 1, Baseline study, Section B-2, Table 24, Vol-II.**

115. **Reptile: A** total of 8 species of reptiles, mainly Spotted House Lizard, Common Garden Lizard, Common Skink, Checkered Keelback Snake, Stripped Keelback snake, Rat Snake, Grey Indian Monitor, and Striped Roof Turtle, etc. were recorded in the study areas. All these identified species are least concerned and not listed as endangered or threatened or near to threatened category. Details in **Appendix 1, Baseline study, Section B-2, Table 25, Vol-II.**

116. **Avifauna:** The current ecological survey study identified a total of 70 species of birds. were identified from the terrestrial site of our current study. 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. Details in **Appendix 1, Baseline study, Section B-2, Table 27, Vol- II.**

117. **Mammals:** As per the discussion with local people, deer and fox are found in planted mangrove forests (Chor sorot mangrove area but none were spotted during the visit. However, Ramgarh forest does not fall within a 10 km radius. In total, 10 species of mammals were recorded in the study area such as the Lesser bandicoot rat, Irrawaddy squirrel, Golden jackal, greater short-nosed fruit bat, Jungle cat, Crab-eating mongoose, Rhesus macaque,

Fishing cat, Indian flying fox, Black rat, and it was confirmed with the consultation of community people. **Appendix 1, Baseline study, Section B-2, Table 26, Vol-II.**

118. **Livestock and Poultry**: Livestock and poultry, being an essential sector of an integrated farming system, play an important role in the economy of the study area and provide significant draft power for the 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 are a ready source of funds. Most of the households raise poultry and livestock, a practice that significantly reduces poverty by generating employment and income.

119. During the visit, the site observed three types of domestic animal grazing surrounding the sub-project zones, mainly buffalo, cow, and sheep, in three locations distinctly. The owners of the livestock population are facing problems concerning the availability of fodder and feed during the months from March to December due to a shortage of grazing fields.

4.3.2.AQUATIC ECOSYSTEM

120. **Aquatic plant:** Aquatic plants have been investigated using the Random Meander method (Cropper,1993) using the quadrat method. Local people were interviewed during the survey. Aquatic habitats in the sub-project area are ponds, canals, and wetlands. The aquatic flora is mainly named in Bangla Mushak Dana, Malanchai, Brahmisak, Kanaidoga, Kachuripana, Topapana, Helencha, Arail, Khudipana, Kalmishak, Dholkolmi, Keshordam, Sushnishak, Pani Biskhatali, etc. The list of local names, common names, scientific name, and family with their IUCN[21] Global Status is presented in **Appendix 1, Baseline study, Section B-2, Table -23, Volume.**

121. **Fish Resource**: The fish habitats of the area are creeks, *khal*, rivers, aquaculture ponds, natural ponds, and bills. Water in these bodies varies from fresh to brackish. Both natural and cultured 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. Details in **Appendix 1, Baseline study, Section B-2, Volume II.**

4.3.2.1. FRESHWATER FISH

122. **Fish:** 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 in the field by the local people. IUCN Red List of Threatened Species (Online Version 2020-1) (IUCN, 2015[22]) was also reviewed for the determination of globally threatened categories of fish.

123. A total of 59 species of freshwater and brackish water fish were identified within the impact sites. 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.

124. Consultation was carried out with the fishermen in the study area to gain knowledge about the fish species in canals, River Feni, Khals, Beels, ponds, etc. Fish species occurring in Canals & ponds are: Golda chingri, Bagda chingri, Chiring, Pangash fish, Coral fish, Promphet fish, Catla, Ruhi, Hilsa, Bata fish, Gulla, Pua, Riksha/Taposhi, Lorka, Senuwa, Loitta, Nylotika, Mud crabs, Holona, mrigal, silver carp, grass carp, karpo, barbs (putis), Chitol, Folai, catfish (Tengra, Singi, Magur, Boal, Pungus), Snakehead (Shol, Taki), bele, etc.

125. For fish species identification, some fish markets were visited, such as Abu Torab Bazar, Jolodas para, Sarker para, Ichakhali Bazar, Bamon Sundar Dorgar Hat, and so on. Fishermen fishing at the Ichakhali, Shaherkhali and Bamonsundar Khal, and fish farms. Details in **Appendix 1, Baseline study, Section B-2, Table -28, Volume II.**

4.3.2.2. MARINE ECOLOGY

126. This ecological baseline survey of current flora and fauna aimed to compile an inventory of the existing flora and fauna, including plankton and benthos composition in the project zone, identifying endangered species, types of ecosystem and wildlife habitats, and potential treats. Details of the assessment is appended in **Appendix 1, Baseline study, Section B-3, Volume-II.**

127. The baseline survey of flora and fauna conducted under this study aimed to conduct an inventory of the existing flora and fauna, including plankton (phytoplankton and zooplankton) and benthos composition in the sub-

[21] IUCN 2024. The IUCN red list of threatened species. Version 2023-1. Https://www.iucnredlist.org

[22] IUCN, 2015. Red List of Bangladesh Volume 5: Freshwater Fishes. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. 360

project zone. In addition, identifying endangered species of both plants and animals and ecosystems and wildlife habitats within the area. This survey study aims to identify potential threats to wild plants, animals, critical habitats, and ecosystems arising from sub-project activities.

128. **Flora:** Major floral species are generally absent from the sandy beaches along the coast. *Ipomoea pescaprae*, often known as beach morning glory, is the main type of native vegetation on these sandy beaches. It was also noted that some beach agriculture was being done in small spots.

129. **Mangrove Plantation:** The Chattogram Coastal Forest Division began planting mangroves on this area. *Avicennia officinalis* and *Avicennia marina* are the species most frequently applied in plantations.

130. **Phytoplankton:** The survey encountered 24 phytoplankton genera belonging to Chlorophyta (green algae), cyanobacteria (blue-green algae) and Bacillarophyta (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 nearly at all sites and were abundant. Phytoplankton belonging to Chlorophyta were only recorded in riverine side. The phytoplankton density varied from 279-1659 cells L^{-1} with the highest count observed in the Sandwip channel. An abundance of Phytoplankton Genus at various sites in the Sandwip Channel is given in **Table 4-10** and the community composition is depicted in Figure 4-12.

Table 4-10: An Abundance of Phytoplankton Genus at Various Sites in the Sandwip

Type of Phytoplankton	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
	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

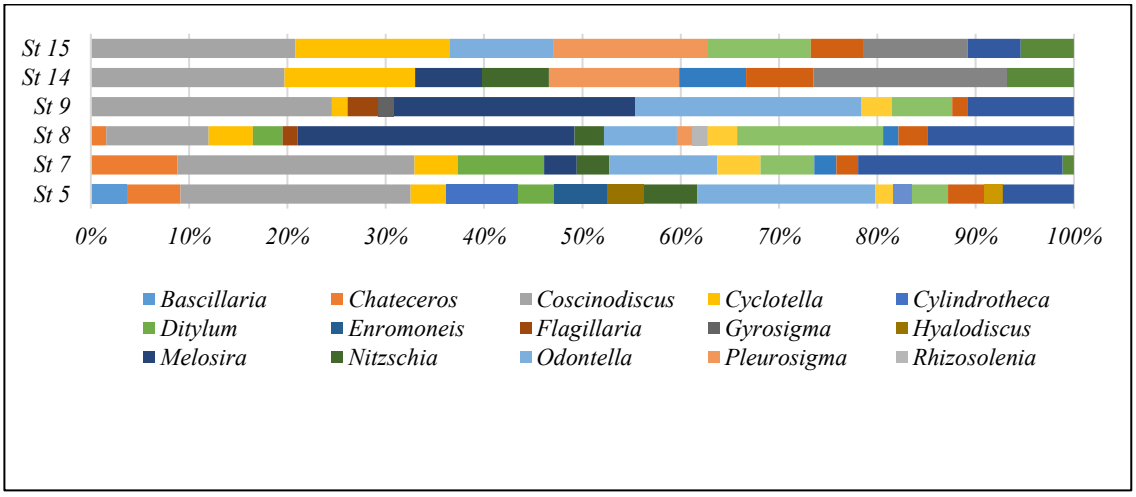


Figure 4-12: Community Composition of Phytoplankton
Source: Surveyed 01 December 2023 to 31 January 2024

131. **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, did not find any rotifer species which could be due to high salinity of all sites (>15ppt). The notable finding in this study is that the density of small size 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.

132. Details of the assessment is appended in **Appendix 1, Baseline study, Section B-3, Table-29, Vol-II**. An abundance of Phytoplankton Genus at various sites in the Sandwip Channel is given in **Table 4-11** and the community composition is depicted in **Figure 4-13.**

Table 4-11: An Abundance of Zooplankton Genus at Various Sites in the Sandwip Channel

Group	Sub group	Genus	St 5	St 7	St 8
Cladocera	Daphnia	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

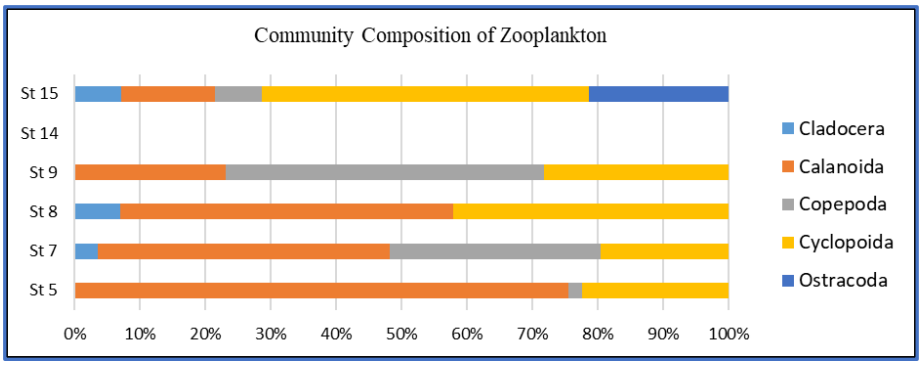


Figure 4-13 : Community Composition of Zooplankton
Source: Surveyed 01 December 2023 to 31 January 2024

133. **Benthos:** A total of 19 taxa (families) of soft-bottom macrobenthos were recorded of which 14 families were identified over the six sampling sites. The mean abundance (individual/m2) was 707.8±210.2. St 9 had the lowest density of macrobenthos, followed by St 14. The other sites demonstrated similar density but were >1.5 times higher in abundance than that of L-09 and 14. The community composition is depicted in Figure 4-14. Details of the assessment is appended in **Appendix 1, Baseline study, Section B-3, Table-30, Vol-II.**

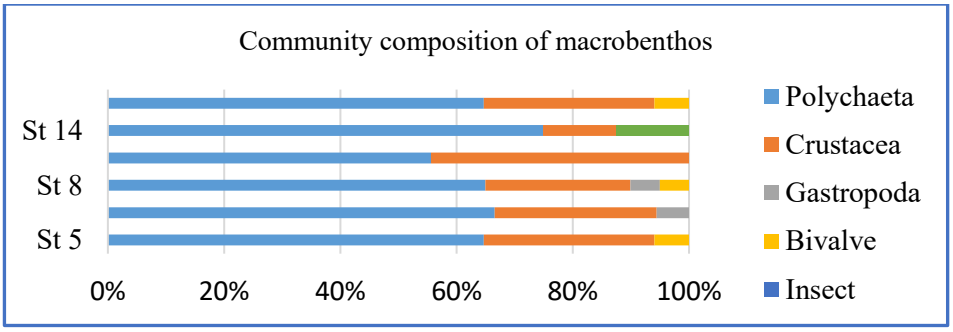


Figure 4-14 : Community Composition of Benthos
01 December 2023 to 31 January 2024

4.3.2.2.1.MARINE FISH RESOURCES

134. A total of 95 species of marine fishes were recorded from the marine habitat or Chandwip Channel while 51 species from Muhuri reservoir in Bangladesh near sampling points 14, 15, and 16. For marine species identification, the 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.

135. For identification of marine fish species visited the fish landing centre, market survey, consultation with fishers that fished in the Sandwip Channel and Pictorial view. 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[23] (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 areas surveyed. Through pictorial view sharing with fishers those fishing in the Channel. Inventory of marine fish species details of the assessment is in **Appendix 1, Baseline study, Section B-3, Table31, Volume-II.**

136. **Marine Fish Diversity and Abundance:** 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.

[23] ooooo

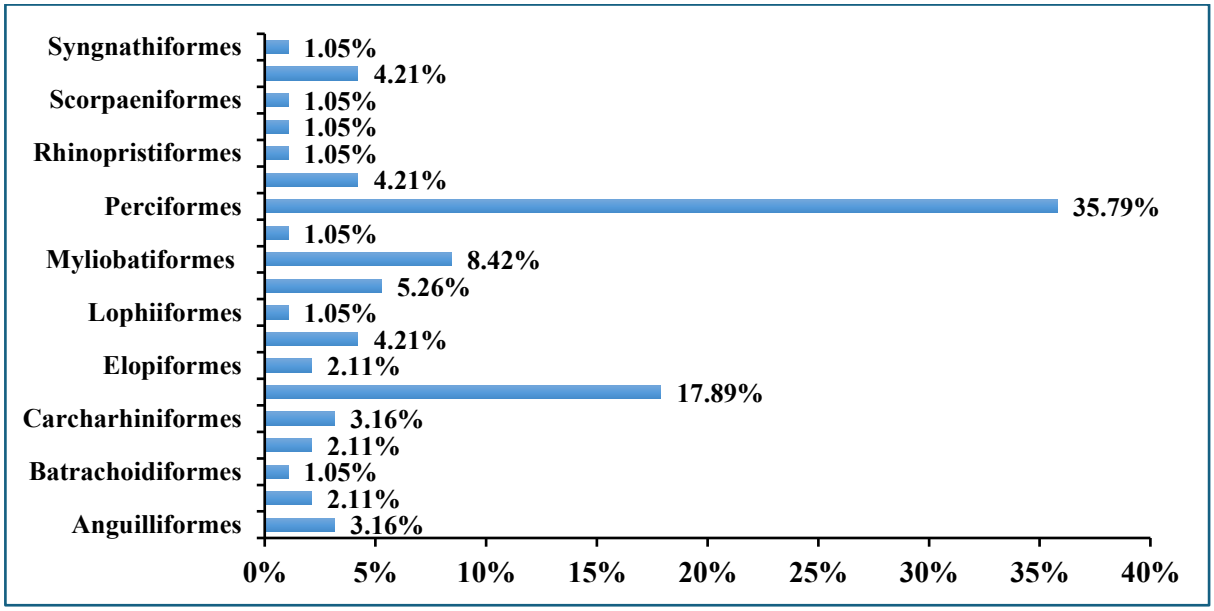


Figure 4-15 : Composition of Identified Marine Fish Species based on Taxonomic Order
Source: Surveyed 01 December 2023 to 31 January 2024

4.3.2.2.2.HILSA FISH

137. Hilsa fish (Tenualosa ilishais) is the national fish of Bangladesh and significantly contributor to the country's economy, 12% of total fish production and about 1.15% of GDP to the country's fish production and is deeply intertwined with the livelihoods of millions of Bangladeshis. In 2022-23 FY, the total fish production reached 4.915 million MT, which exceeds the targeted fish production of 4.782 million MT[24].

138. Hilsa fish are primarily marine but are also found in freshwater and brackish water environments. Hilsa fish are anadromous, meaning they migrate from saltwater to freshwater to spawn, meaning they migrate from the sea into freshwater to reproduce.

139. **Reasons behind migration:** Migrations are mainly for spawning or feeding purposes and are generally time oriented. Many; Chemical factors: salinity, alkalinity, dissolved gases, odor, tastes, and pollutants and biological factors include factors influence migratory movements. They may be physical, chemical and biological factors (Lagler et al., 1962). The physical factors include bottom materials, water depth, current and tide, turbidity, temperature, and light intensity. The biological and chemical factors include sexual development, blood pressure, social response, hunger, food, physiological clock, and endocrine state. The migration journey, which can span over hundreds of km, is triggered by monsoon-related changes in water flow and temperature, freshwater stretches with soft sediment, moderate current, and ample food supply for spawning. Hilsa fish migrate from the sea into rivers for spawning and in the river they tend to move in deeper zones near the bottom. The breeding season is from September to October, with a peak in October to early November, around the full moon. A secondary peak is observed in February-March or March-April. From the Gonado-somatic index (GSI) value, it was observed that Hilsa spawn throughout the year[25].

140. During breeding time, the Mother Hilsa Conservation Campaign starts for 22-day fishing ban to protect the Mother Hilsa while they are spawning and led to a significant increase in Hilsa participation in the breeding process, with a notable increase in the number of fertilized eggs and juvenile fish. Hilsa production has increased by 78% in the last 11 years due to conservation measures. Despite the conservation measures, challenges such as water pollution, illegal fishing, and climate change impact the sustainability of Hilsa. The major breeding grounds for Hilsa include the Padma, Meghna, and Jamuna Rivers, the Lower Brahmaputra River, and estuarine regions near Chandpur, Bhola, Barisal, and Patuakhali. Among these, the Meghna River near Chandpur is considered one of the most significant breeding zones.

141. **Migratory Pattern, Route and Abundance of Hilsa shad:** During entire life, Hilsa shad migrates both from sea to freshwater and freshwater to sea to meet the biological demand. Hilsa shad lives in the sea for most of its life but migrates at least 1,200-1,300 km upstream from estuarine region for spawning purpose and it also found

[24] Bangladesh Department of Fisheries (DoF), "Fisheries Statistical Report of Bangladesh," 2022-23.
[25] Hilsa Fisheries Research and Development in Bangladesh, June 2020

about 250 km distance from coastal region (Halder and Islam, 2008[26]). As this is one of the flagship fish species of Bangladesh, conservation of this species is indeed needed. Therefore, knowledge on migratory pattern and route of this species demand more attention to boost awareness and enhance conservatory practice for them in Bangladesh. Typically, a migration includes one or more returns to the starting location" (Lagler et al., 1962[27]). Generally, two types of migratory pattern are seen for Hilsa shad in Bangladesh. These are-

- **South-west monsoon migration:** During this migration, Hilsa fish mainly live in the sea and around the monsoon, when consequent flooding of all the rivers and it is time to spawn, swims against the tide and goes back to the river where its mother had given birth to it. Earlier, the Hilsa would move from the Bay of Bengal to Bangladesh rivers, the Padma, and the Meghna, for spawning. It would also take the western route to the Ganga. Now there is more hilsa in the west, in areas bordering Indian waters.
- **Winter migration:** Migration of Hilsa shad is not limited to monsoon only, but it also migrates short period during winter. It happens during the month of February to March.

142. **Hisha Breeding ground:** The District Fisheries Officer (DFO) in Feni district has mentioned that one Hilsa breeding site is predicted at the confluence of the Sandwip channel and the Feni River (also called as Muhuri River), which is within the study area.

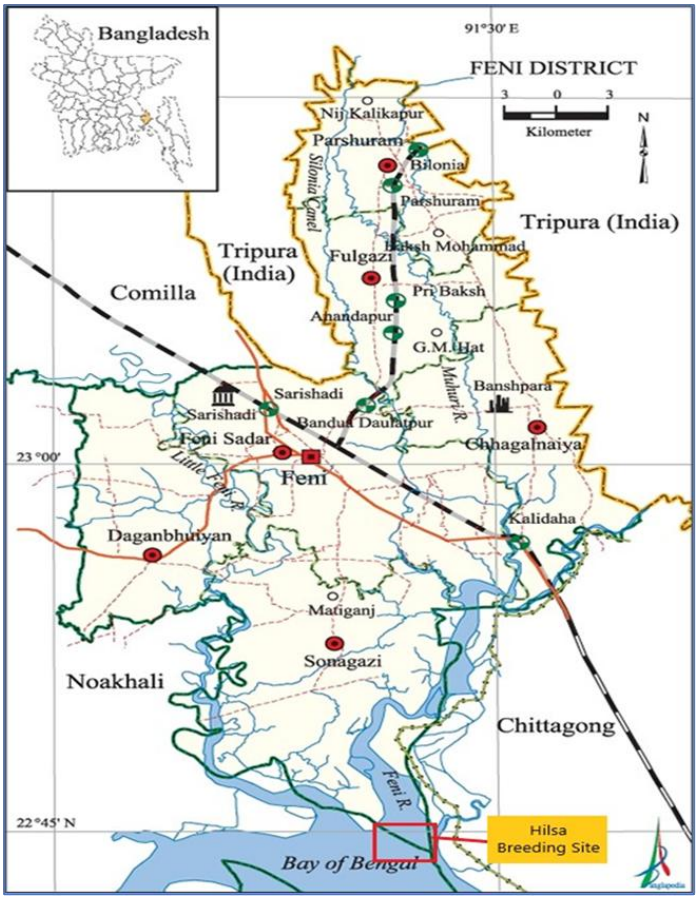


Figure 4-16: Predicted Hilsa breeding ground

143. **Mayani Hilsa Spawning Ground**: The Mayani point is another Hilsa Spawning Ground (91°32.15′E and 22°42.59′N), located in the Shaerkhali canal inside Mirsharai plain land, notified in the Gazette in 2014 by the DoF (Department of Fisheries). But the current condition of this spawning ground in the Shaerkhali canal is silted up, and the local people have reported that there is no evidence of this Hilsa spawning ground. A supplementary study was conducted to confirm whether the existence of the Hilsa breeding ground at Mayani Point in the Shaerkhali canal at Mirsharai, or not. The study finding indicates that Mayani Point, once known as a Hilsa breeding ground, has been

[26] Halder, N. H., & Islam, M. N. (2015). Water Pollution and Its Impact on Human Health. Journal of Environment and Human, 2, 36-46.

[27] Karl F. Lagler, John E. Bardach, and Robert R. Miller. Wiley: Marine Science: Ichthyology., New York, 1962

significantly affected by environmental changes, particularly siltation and the construction of sluice gates, which impedes Hilsa migration. There is a clear consensus among the local stakeholders and relevant officials that the Hilsa fish breeding ground has not been present in the area for the last 4-5 years. Details of the study are documented in **Appendix 11, Vol-II.**

4.3.3.DESIGNATED PROTECTED AREA AND IMPORTANT BIODIVERSITY AREA AROUND THE STUDY SITE

144. No designated protected areas are present inside the project area. There are some areas far away and outside of AoI of 10Km to the project site , such as Patenga Beach (40km), Baraiyadhala National Park (10.5km), Mohamaya Lake (30 km), Khoiyachara Waterfalls (35 km) and Napittachara Waterfalls (35 km). Among the locations indicated, 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.

4.3.4.PROTECTED AREA

145. 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 to reach 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.

146. There are no marine protected areas within a 10 km radius of EZ site. No sensitive aquatic species like dolphins are also reported in the Sandwip Channel stretch within a 10 km radius of the EZ site. (Ref. Addendum EIA report on PSDSP of BEZA). Protected ecological areas, designated protected areas such as Baroiyadhala National Park: IUCN Category II national park, Ramgarh Sitakunda Reserved Forest, and ecologically sensitive areas for example Mohamaya Lake, Khoiyachora Waterfall**,** Napittachora Waterfall, Komoldoho Waterfall at Sitakundo, Chattogram, Chandranath Hill, Guliakhali sea beach, Sohosrodhara Waterfall, Suptadhara waterfall*,* Horinmara Hatuvanga Trail etc., are located near the project areas but out of the AOI. Details of these areas are briefly described in Appendix 1, Vol. II

4.4. SOCIAL ENVIRONMENT

4.4.1.ADMINISTRATIVE STRUCTURE

147. Sub-project ESIA study area includes zones 5, 12 13, and 18 in Mirsharai Upazila of Chattogram district will impact Ichakhali Union and Shaerkhali Union in Mirsharai Upazila.

Mirsharai Upazilla

148. Mirsharai Upazilla is in Chattogram district and is bounded by the Tripura state of India, Chhagalnaiya and Feni Sadarr Upazilla on the north, Shaunda Upazilla and Bay of Bengal on the south, Fatikchari Upazilla on the east, Sona Gazi and Campaniganj (Noakhali) Upazila on the west. Mirsharai Upazilla area 482.88 sq km. According to BBS data of 2022, [28] [29] the total population was 111,009; male 472,777, female 228303; Mirsharai Thana was formed in 1901 and it was turned into an Upazilla in 1983. In Mirsharai Upazilla, Municipality 2, Union 16, Mouza 109, Village 216, Urban population 31206, Rural population 387510., Population density 826 per sqkm.

149. Main sources of income 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%. Literacy rate averages 55.1%; males 57.1%%, females 53.3%. Access to electricity in all the wards and unions of the Upazilla is under the rural electrification network. 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%. The presence of arsenic has been detected in 39% of the shallow tube-well water of the Upazilla. Sanitation 76.2% of dwelling households of the Upazilla use sanitary latrines and 21.7% of dwelling households use non-sanitary latrines; 2.1% of households do not have latrine facilities. Health centers in Upazilla Health Complex 1, Family Planning Center 16, and Satellite Clinic 11. BRAC, Proshika, Seba, ASA, CARE, and Hunger Project working on this Upazilla.

[28] BBS (2022) Census 2022, Bangladesh Bureau of Statistics, Ministry of Planning, GoB of Bangladesh
[29]BEZA (2019) Social Impact Assessment (SIA) of Mirershorai Economic Zone Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh

4.4.2.SOCIO-ECONOMIC ACTIVITIES

150. The sub-project 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 the 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% and indicating the predominance of economically active members in the HHs. Therefore, there is a huge chance for local people to be involved in the sub-project development activity. To assess the present condition of economic activity 150 HHs of the sub-project area were conducted.

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

152. Out of the 150 HH surveys conducted (94.67% male and 5.33% female) under this ESIA study area, the average household size and the percentage distribution of HHs by different sizes. The average family size of the BEZA area is 4.28 persons. While 55.33% of total sample HHs have 4-5 members, 23.33% of 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) are considered as Vulnerable and 64% (96 HH) were considered as general type of HH.

Access to electricity in all the wards and unions of the Upazilla is under a rural electrification network. 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%.

4.4.3.EDUCATIONAL STATUS OF HHS POPULATION

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

4.4.4.OCCUPATION AND EMPLOYMENT

4.4.4.1. OCCUPATION OF SURVEYED HH POPULATION

154. Considering only the population within the age range 15-65 years, who constitute about 66.04% of the total population of the sampled HHs, the survey result shows the distribution of the 15-65 years population by main occupations. It appears that the absolute unemployment rate in the NSEZ influence zones 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 labor are the main occupations for about 25.95%, agricultural labor is the main income source.

4.4.4.2. OCCUPATION OF SURVEYED HH HEADS

155. The distribution of household heads by occupation shows that the business, day labor, and driver categories dominate the project area as they account 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 (source: Baseline survey, BCL, 2023).

4.4.4.3. EMPLOYMENT STATUS OF HH POPULATION

156. Children (a total of 85) aged below 6 combined with students (157) constitute about 37.64% of the total population (excluding housewives) of the surveyed HHs. While about 56.80%of total males and 57.05% of females are fully employed, 6.34% of males and 3.52% of female members are unemployed (source: Baseline survey, BCL, 2023).

4.4.5.ASSETS AND CAPITAL RESOURCES LAND

157. It is evident that 60.67 % of the interviewed HHs land less, 30.67% of HHs reported having below 0.5 acres or another type of land, and 3.33% have land between 0.05-1.00 acre; while only 2.67% have land above acres. The rest 1.33% has land above 3.5 acres (source: Baseline survey, BCL, 2023). For those who have land ownership, the survey team tried to identify the average land portion owned per HH under different categories. A large portion of

land is cultivable (23.11 acres), 8.34 acres are homestead land and 1.5 acres are under a pond/ditch.

4.4.5.1. LAND VALUE:

158. As per the current Mouza rate, the average present market rate is for Agriculture (130400 BDT per decimal), Homestead (210570 BDT/decimal), and Pond/Ditch (324016.2 BDT/decimal).

4.4.5.2. LIVESTOCK AND POULTRY

159. The baseline survey result shows, that about 58.93% of interviewed HHs reported having one or other type of livestock; while another 47.32% of HHs reported having poultry/ birds and HHs having 18 bullocks.

4.4.5.3. AVERAGE VALUE OF LIVESTOCK AND POULTRY

160. Error! Reference source not found. The baseline result shows the estimated average value of livestock and p oultry birds per household of the sampled households. The average value per unit of buffalo Tk 100,000, cows per unit is TK 94,960, chickens TK 450, and ducks TK 462. The total value of all livestock and poultry stands at TK7411487.

4.4.6.INCOME AND EXPENDITURE[30]

161. Estimated the income and expenditure of the sample HHs to have an idea of their overall economic conditions and standard of living, income estimate Farm Income (covered all agricultural income including the sales proceeds of crops, vegetables, fruits, livestock, poultry, fish culture) and 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 purchase value of any capital asset during the same reference period.

162. Out of the total 150 HHs interviewed, agricultural farming (including livestock, poultry, and fishery) is the only income source for 24.11% of HHs and 98.21 % depend exclusively on off-farm income, while the rest 14.29% HHs depend both on farm and non-farm income sources. The average monthly income of surveyed HHs is TK 17048.67/- HH and the annual average expenditure per HHs. Of them, farm income was Tk 443,800, off-farm income was Tk 2113500, and both types of income were Tk 2,557,300.

4.4.7.ANNUAL EXPENDITURE

163. 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 TK1716422.6/HH; leaving a balance of TK 626.07/- per HH.

4.4.8.OVERALL ECONOMIC CONDITION SAMPLE HHS

164. Based on the poverty rate in Bangladesh[31] . The overall economic status in the study areas is evident that 66% of total HHs have faced a deficit and 18.67% fell deficit at times or medium income families. On the other hand, 15.33% of HHs have surpluses.

4.4.9. ACCESS TO UTILITY AND WASH FACILITY

165. As a socio-economic indicator, the surveyed HHs were investigated regarding access to electricity, water, and toilet facilities. The survey result shows**,** that only 4% of the HHs are connected to a piped water supply system; while 92% depend on hand tube wells, and 4% of HHs collect water from other HHs. Having sanitary latrines only 13.33% of HH have sanitary latrines and 68% 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.

4.4.10.ACCESSIBILITY TO HEALTH CARE FACILITIES

166. As it is evident from the survey about 52% of people in the surveyed area mainly go to the govt. hospitals and 21.33% of HHs go to private doctors/clinics for health care services, 98.67% of HHs go to village doctors and 12.67% of HHs go to pharmacies when any of their members are sick. Whereas 2% of HHs reported having qualified

[30] Analysis is based on figures collected from 100 HHs sampled from both sides within 1KM of the proposed road alignment.

[31] Source: ***https://en.wikipedia.org/wiki/Poverty_in_Bangladesh#Poverty_rate_by_division***

doctors is available in their locality, 98% of HHs reported having no qualified doctor available in their locality.

4.4.11.COMMUNITY SAFETY AND SOCIAL CONFLICT

167. The community safety and social conflict have been considered as VCs, due to sub-project 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 labor engagement in the sub-project also issues regarding social conflicts.

168. Road construction is the number one problem with 74.67% of respondents; Unemployment is a common problem reported by 39.33% of respondents. Local conflicts and poverty issues are mentioned by 92% of HHs. Among the proposed measures against poverty assistance from Govt. and general demand for industrial establishment; it is recommended to develop new industries and create employment opportunities to alleviate unemployment and poverty. Those who mentioned unemployment as a problem wanted govt. assistance towards establishing a new factory**.**

4.4.12.STATUS OF WOMEN

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

Education

170. Even though women constitute half of the population, analysis of survey findings reveals that women in many aspects fall behind men. The survey result shows, that 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 graduation/post-graduation level are far behind their male counterparts.

Occupation and Employment

171. It is evident from the survey, that 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 female are fully employed. The absolute unemployment rate for males is 2.79% and 0.31%; absolute housewives are considered employed.

Participation in Social Organizations and NGOs

172. Whereas, 36% of total sampled HHs reported having any family member associated with NGOs like ASA, BRAC, and Grameen Bank.

Women's Mobility and Accessibility to Markets

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

Women's Participation in Decision Making

174. The survey findings about women's participation in important family matters like children's education, children's marriage, and own 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.

175. 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 to make decisions; while about 2.68% cannot make decisions.

Women's Awareness of STDs and HIVs

176. Although HIV/AIDS-infected people in Bangladesh are still at a relatively low level, there is, however, a concentrated HIV epidemic among injecting drug users (IDU), primarily due to the 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 rising32. 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 the 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 the question of 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.

Violence Against Women

177. 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, the consequences were physical, sexual, reproductive, psychological, and economic. For the children of the victims, the consequences were mostly behavioral and psychological, while for the family members of the victims, the consequences were mainly economic and psychological. The survey results show that violence against women; about 36.67% of the survey people hear about violence and 34% do 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, 22.7% multiple marriages, and so on. So, dowry, physical violence, and polygamy are the main violence in this society.

[32] **Feature story; HIV/AIDS in Bangladesh, July 10, 2012, World Bank**

5. ANALYSIS OF ALTERNATIVES

5.1. INTRODUCTION

178. Dredging is defined as the removal of sediments from the underwater, which involves an excavation process to construct and /or build new lands. Dredging is a necessary activity required to increase the depth of channels or rivers. It removes the unwanted deposits for the safe passage of boats and ships. However, the dredging will be carried out for this sub-project to develop low-lying land under Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ. The amount of dredging material required has been estimated[33] to fill the existing land of 1560 acres will 15.85 MCum from the Sandwip Channel. An alternative analysis for the identification of dredging location sources is carried out for the entire area of 1560 acres of land development under this ESIA study

179. The dredging material will be collected from the Sandwip Channel, But by its very nature, dredging will change the aquatic environment. Dredged areas may present bathymetry-promoting changes due to variations in the velocities of flow and erosion/accretion cycles of the channel. Dredging activities potentially affect not only the site itself, but also the surrounding areas, there are so many impact factors, such as turbidity, sedimentation, resuspension, and release of contaminants. But if dredging must go ahead then there are more sustainable/targeted ways it can be undertaken to minimize its impact on geomorphology and marine ecology[34].

180. Dredging may affect the channel's morphological features, diversity, marine ecology, and resiliency in several ways. After dredging, channel banks may become prone to erosion. Eroded banks will stimulate further build-up of silt, exacerbating rather than improving problems with navigation. The turbidity of the surface water also changes because of this alteration in the underwater soil composition during dredging activities. This poses the creation of newer and harmful organisms and, the shifting of organisms to other parts of the waterbody leading to a wider spread of contamination and organic processes by releasing extra and unwanted nutrients. Because of the said alteration, the existing habitat of creatures and organisms that depend on the original composition of the soil dies out due to the unfavorable changes caused by dredging. Sometimes, dredging is also carried out to weed out the contamination present in the soil. However, though dredging is an anthropogenic excavation activity of removing sediments from water bodies and depositing them elsewhere, it has mixed blessings as it has both beneficial and adverse impacts35. The beneficial impacts, such as the provision of materials for the reclamation of lands of the IMD Zone and part of F and B Precincts, keeping waterways navigable, flood and storm protection, and road construction. The adverse environmental and social impacts may include pollution, erosion, widespread hydrological changes, impact on marine ecology, etc. based on the source locations. The PRIDE Project authority has a plan to dredge from the Sandwip channel to fill lands. To determine the suitable dredging sources, the Consultant has carried out an alternative analysis as follows.

5.2. IDENTIFICATION OF DREDGING SOURCE LOCATIONS

181. About a 29.534 km stretch of the Sandwip Channel adjacent to the NSEZ's PRIDE project area was studied to identify the suitable dredging source locations. and it is downstream up to one (1) km of the NSEZ Project site, which is about 26 km away from the Bay of Bengal downstream. The Consultant selected 12 probable dredging source locations based on available secondary data, site observation and visualization, assessment, overlay, and creation of geospatial data using Google Earth Pro image.

182. The assessment of the physical environment, ecological environment, particularly marine ecology, was carried out for all 12 locations of the Sandwip channel. This dredging may also affect the channel's diversity and resiliency in the ecosystem. However, a Marine ecology study is also carried out from 01 December 2023 to 31 January 2024 to assess the baseline condition of the Sandwip channel bottom environment (details in **Appendix 1, B3, Vol-1**).

5.2.1.CRITERIA FOR SELECTION OF THE SUITABLE DREDGING LOCATIONS

5.2.1.1. PHYSICAL ENVIRONMENT CONSIDERATION

183. The dredging locations are determined based on a multi-criteria analysis involving the physical environment, and technical, economic, and social issues of the proposed 12 locations. Additionally, baseline data related to biodiversity (plants, planktons, benthos, fishes, and wildlife) were collected and documented from the study site across habitat types, and baseline threats were reported. The criteria for the selection of the dredging source locations

[33] Consultant has estimated the requirement filling volume of dredged materials in section 3.3.9, Chapter-3
[34] Evidence: Impacts of dredging, Environment agency, August 2013
[35] A Review of Environmental Implications of Dredging Activities, International Journal of Advanced Engineering, Management and Science (IJAEMS), Vol-3, Issue-12, Dec- 2017],

are as follows;

- Bottom Surface Topography/ elevation based on secondary Bathymetric survey data,
- For Morphological Analysis by GIS software to process the satellite images. The bank lines of the channel will be digitized on the screen from such images. The bank lines for different years will then be superimposed to determine the erosion and accretion processes of the Sandwip Channel and the changes in its bank lines;
- Erosion/accretion trend of Sandwip channel;
- Depth of the seabed locations,
- Dredged materials from the Sandwip channel within the short distance from the dredging Zones will be taken on a priority basis;
- Distance from the Channel shore needs to be considered not less than 2000 meters from the shore as BIWTA requirement;
- Sediment quality collected from the Sandwip Channel bed;
- Acquiring a No Objection Certificate (NOC) from the District Commissioner's office is a prerequisite for initiating dredging activities;
- Consideration of Bangladesh Inland Water Transport Authority (BIWTA) slated to construct a Jetty, strategically positioned about 1.5 kilometers from the Super Dyke near the Basundhara group;
- A buffer zone between dredging operations and buried pipelines. There shall be a buffer zone between dredging operations and levees, or other features subject to damage by undercutting. It is noted Super Dyke is located alongside the Channel;
- Avoid the estuarine mouth, and transboundary river system, because species diversity is higher in the estuarine mouth compared to its upstream direction. It is obvious because organisms prefer estuarine habitats.

5.2.1.2. ECOLOGICAL ENVIRONMENTAL CONSIDERATION

184. The following specific ecological criteria are considered:

- No ecologically sensitive area or biological hotspot in or around the EZ-2 or the proposed additional area,
- Avoid vulnerable marine ecological and biological hotspots in or around the NSEZ
- Less impact on sea birds due to dredging activities such as sounds
- No estuarine mouth is present because marine species diversity is higher in the estuarine mouth compared to that of its upstream direction. It is obvious because organisms prefer estuarine habitats,
- This part of the Bay of Bengal has high turbidity of water and soft bottom strata that are not suitable for the growth of seaweed (Environmental Impact Assessment Report (EIA-BSMSN-2_addendum_24092020[36]), may avoid impact on seaweed growth,
- No Hilsa
- breeding ground will be affected due to the dredging activities. According to the Fishery Department information, the predicted Hilsa spawning zone is primarily located at the confluence of the Bay of Bengal and the Feni River.
- No sensitive aquatic species like dolphins are reported in the Channel/river to stretch within a 10 km radius of the EZ site (EIA report Feni 2020[37]),
- Deep sea dredging can impact the marine ecosystem by disturbing the benthos (dwelling on the sea floor), especially sessile organisms attached to the seafloor/other physical structures, therefore avoiding deep sea areas for dredging source selection
- No sensitive aquatic species like dolphins. It is reported that dolphins are not existing in the Channel/river to stretch within a 10 km radius of the EZ site (EIA report Feni 2020[38]),

5.2.2.BOTTOM TOPOGRAPHY AND BATHYMETRY OF THE SANDWIP CHANNEL

185. Generally, the hydrographic investigation is imperative for the assessment of the baseline condition of the dredging locations of the project, encompassing an analysis of flow rate, sedimentation rate, the establishment of a navigation route, etc., but due to the time constraints, the identification process is considered without a present bathymetric survey and hydrological modeling. Therefore, the secondary data, the bathymetric survey of the Sandwip Channel and Feni River under the Kumira to Muhuri project, 2018, is collected from the BIWTA as shown in **Figure 5-1** considered for this assessment. The other relevant secondary data on the bank side elevation, groundwater

[36]BEZA (2020) Environmental Impact Assessment Report (EIA) Report of NSEZ-2 (Addendum) Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh
[37] BEZA (2020) Environmental Impact Assessment Report of Feni Economic Zone, Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh
[38] BEZA (2020) Environmental Impact Assessment Report of Feni Economic Zone, Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh

modeling, and related data are collected from the Mirsharai Development Master Plan (MUDP), 2020 under the Urban Development Directorate (UDD). The Consultant has prepared a Contour Map and DEM (Digital Elevations Model) from this bathymetric survey data for the proposed coverage of 12 dredging locations in Sandwip Channel, and presented in **Figure 5-2** and individual location in **Figure 5-3.** The proposed locations with elevated bottom levels are described below based on the bathymetric survey data from 2018[39] and Mirsarai Upazila Development Plan (MUDP), Master Plan 2017-2020 [40] under the UDD.

186. Out of 12 proposed locations, Site No.10, Site No. L-11, L-10, and L-12, are at near the Sandwip Channel confluence, and the locations numbered L-09, L- 08, L-07, L-.06, L-05, L-04, L-03, L-02, and L-01 are located onward at the Sandwip Channel's downstream (**Figure 5-2**). The assessment of the physical environment, ecological environment, particularly marine ecology, was carried out for all 12 locations in the Sandwip channel. This dredging may also affect the channel's diversity and resiliency in the ecosystem. However, a Marine ecology study is also carried out from 01 December 2023 to 31 January 2024 to assess the baseline condition of the Sandwip channel bottom environment.

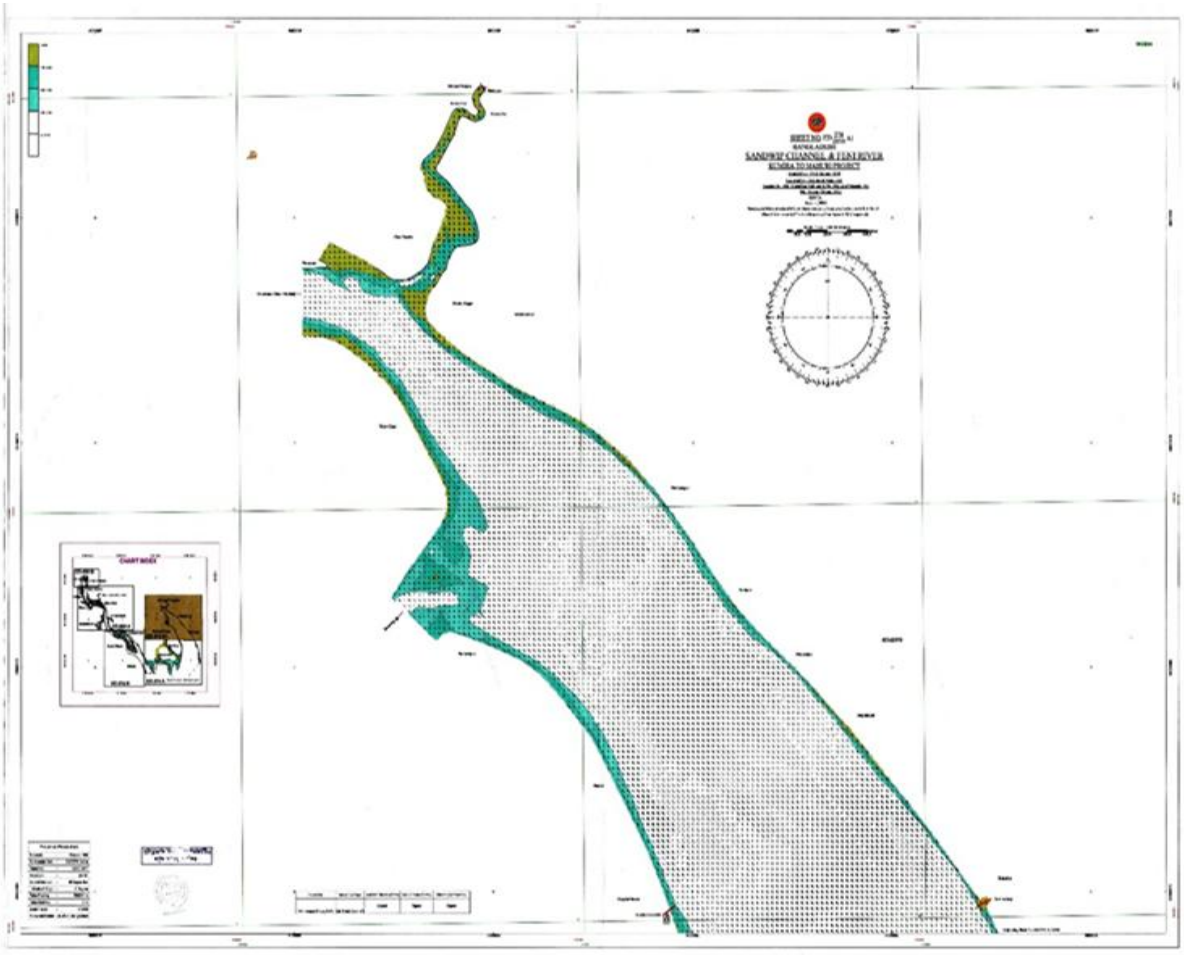


Figure 5-1: Bathymetric data of the Sandwip Channel and Feni River Under Kumira to Muhuri Project, 2018, BIWTA

187. The proposed dredging locations, sea bottom depth, distance from the shoreline, and distance from the dredging locations to the landfilling sites under the sub-project are identified, as shown in **Figure 5-4** .

[39] Bathymetric survey of Sandwip Channel and Feni River under Kumira to Mahuri project, 2018 , BIWTA

[40] Mirsharai Upazila Development Plan 2017-2020, Urban Development Authority

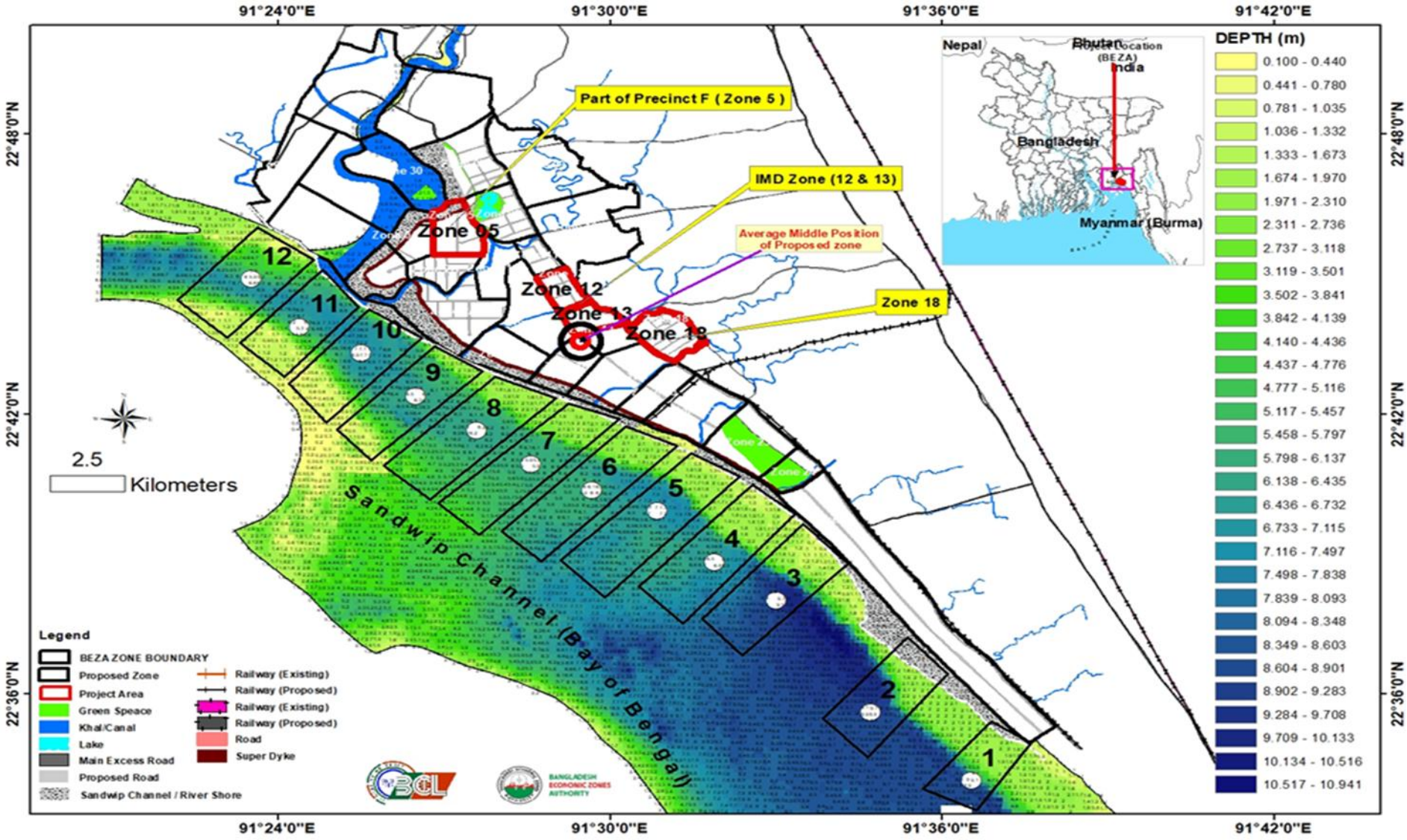


Figure 5-2 Selected 12 locations of Dredging Sources in Sandwip Channel with channel bottom depth

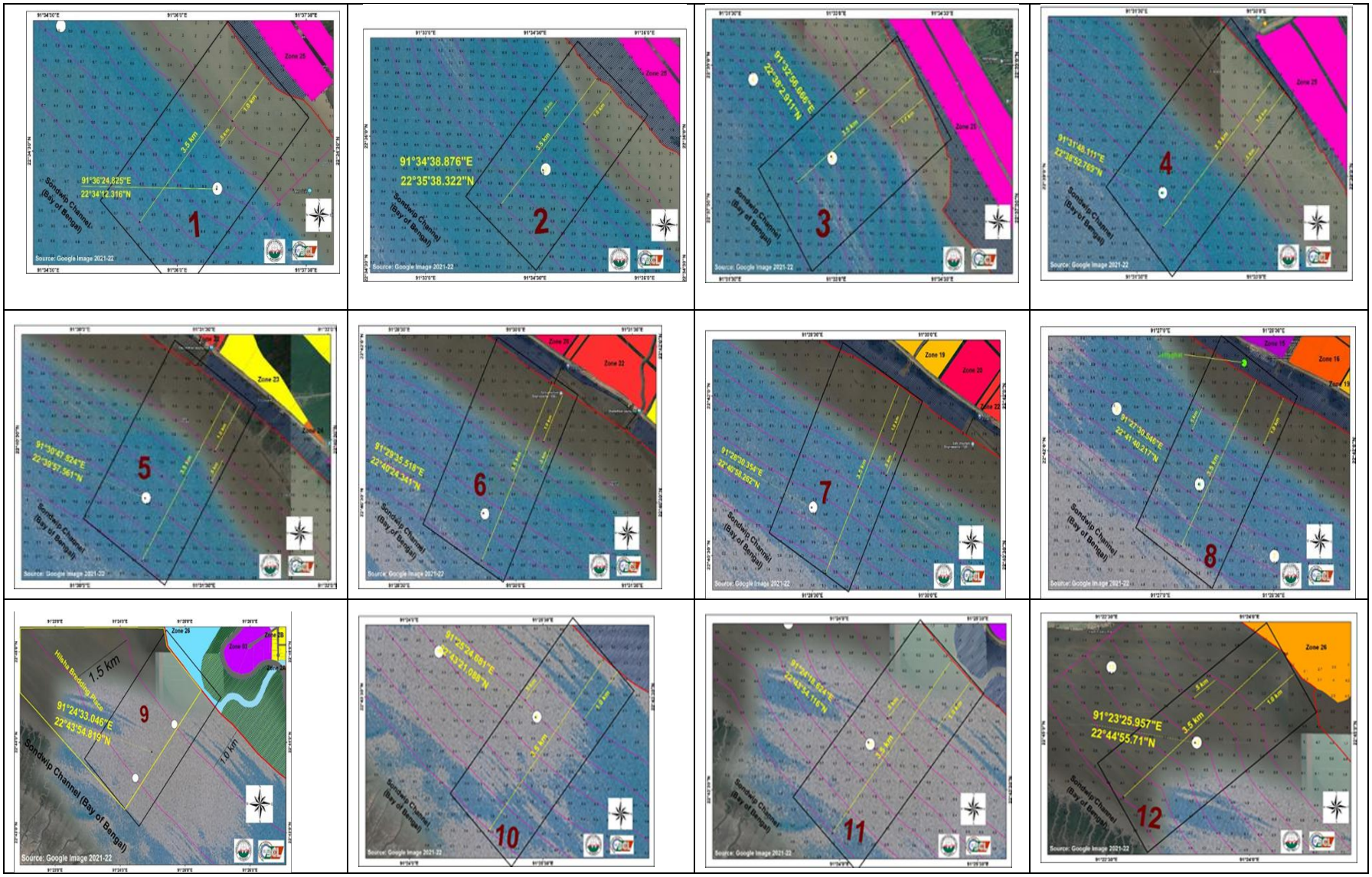


Figure 5-3 : Sandwip Channel Bottom Topography of 12 Individual Locations

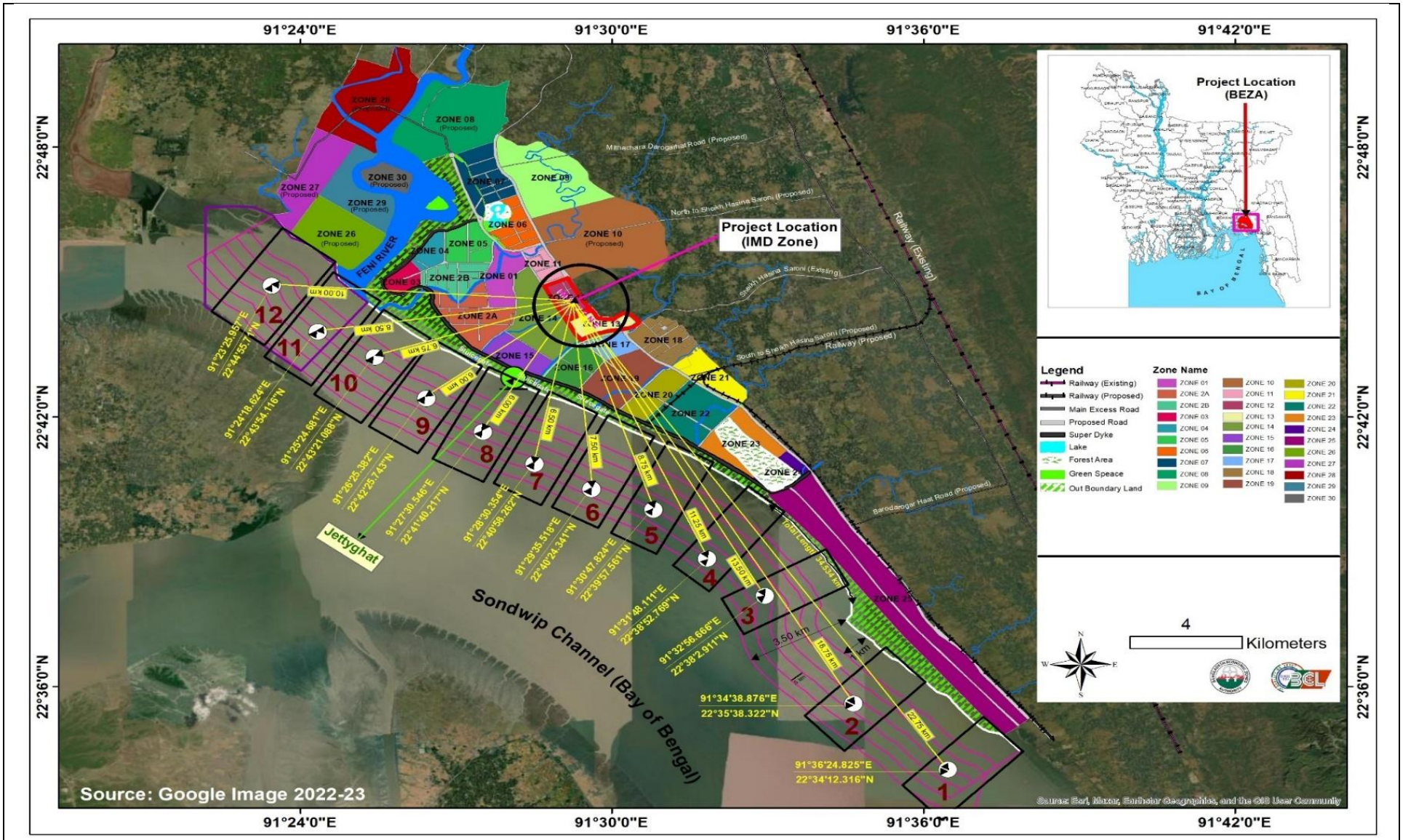


Figure 5-4: Distance of dredging sources Location in the Sandwip Channel to the landfilling sites

Table 5-1: Proposed dredging locations, Sea bottom depth, Distance from Shorelines to Land Development site

Locations No	GPS Coordinate		Sea Bottom Depth (m)	Distance from shoreline (km)	Location Distance from IMD in Km
Location No 1	22°34'12.316"N	91°36'24.825"E	8.9	2.0	22.85
Location No 2	22°35'38.322"N	91°34'38.876"E	8.8	2.25	17.65
Location No 3	22°38'2.911"N	91°32'56.666"E	9.2	2.5	13.55
Location No 4	22°38'52.769"N	91°31'48.111"E	6.5	3.0	9.47
Location No 5	22°39'57.561"N	91°30'47.824"E	6.7	2.5	6.65
Location No 6	22°40'24.341"N	91°29'35.518"E	6.5	2.75	7.50
Location No 7	22°40'58.262"N	91°28'30.354"E	5.8	2.70	5.57
Location No 8	22°41'40.217"N	91°27'30.546"E	6.2	2.25	4.97
Location No 9	22°42'25.743"N	91°26'25.382"E	6.3	2.0	4.55
Location No 10	22°43'21.088"N	91°25'24.681"E	7.0	1.5	7.00
Location No 11	22°43'45.116"N	91°24'18.624"E	6.1	2.0	5.85
Location No 12	22°44'55.71"N	91°23'25.957"E	6.5	2.0	7.27

Source: Google Earth Image visualization and assessment, BIWTA and Mirsharai Upazilla Development Plan 2017 to June 2020, UDD and field observations.

5.2.2.1. COASTAL MORPHOLOGICAL CHANGE DETECTION AND HYDROLOGICAL CHANGE DIRECTION STUDY

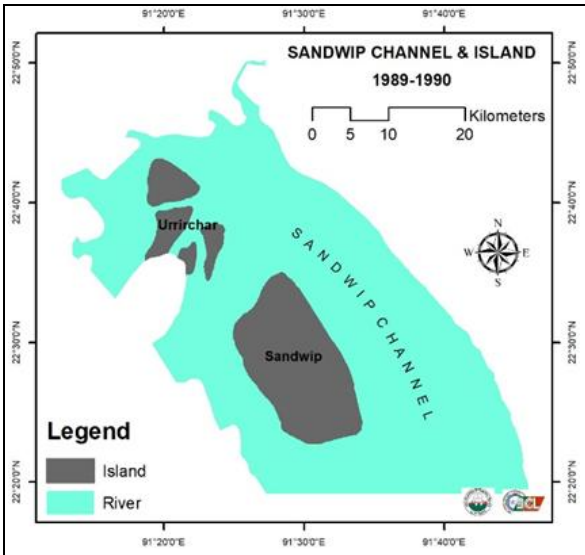
188. The dynamic coastal processes of the coast in the study areas are characterized by erosion, sediment deposition, and the formation of diverse landforms. Influenced by the Bay of Bengal, the region's geological features, including sandy beaches, mudflats, and mangrove forests, play a significant role in shaping its coastal landscape. The coastal landscape is primarily composed of alluvial deposits, which are formed by the sediment carried by rivers and tidal currents. The presence of these geological features contributes to the biodiversity of the area, providing habitats for various marine and terrestrial species. Sediment dynamics in the Mirsharai coast are influenced by both natural processes and anthropogenic activities. The interplay of tidal currents, river discharge, and wave action contributes to the continuous reshaping of the coastline. Certain areas experience significant erosion due to wave action and human activities, while others may see sediment accumulation etc., Therefore, to select the suitable dredging locations two types of studies are carried out as follows**.**

- Coastal Morphology Change Detection: Changes in Coastal Morphology (1989-1990 to 1994-1995)
- Hydrological Change Detection: Changes of Water Depth from 1990 to 2023.

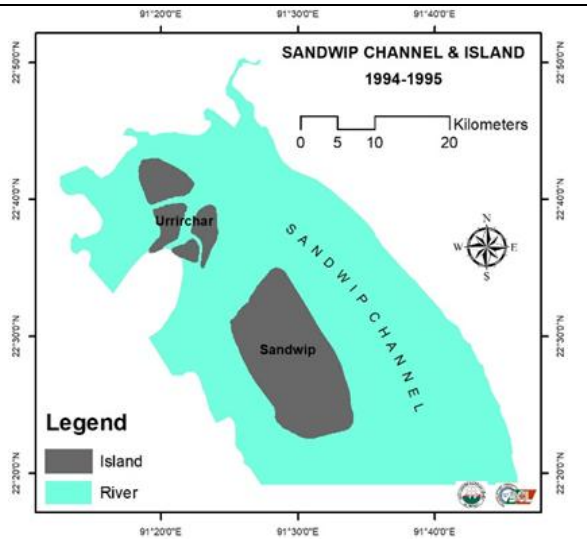
A. Coastal Morphology Change Detection: Changes in Coastal Morphology (1989-1990 to 1994-1995)

Item/ Interval of Year	1989-1990
River line Length (km)	232.171
Common (river) Area (km^2)	1311.014
Char (km^2)	275.039
Total Area (km^2)	1586.053

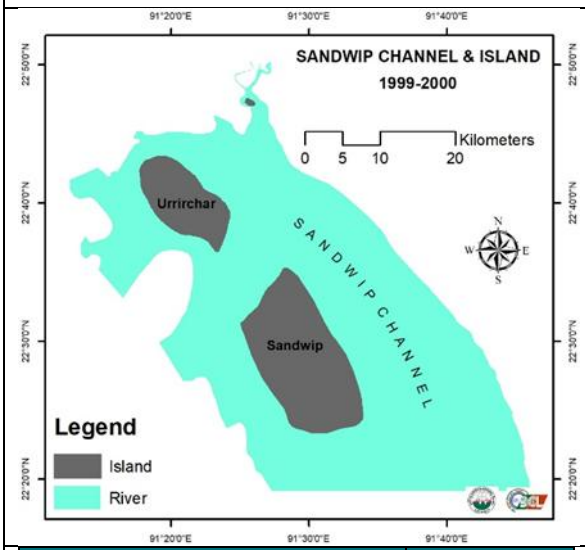
Item/ Interval of Year	1994-1995
River line Length (km)	234.731
Common (river) Area (km^2)	1307.638
Char (km^2)	278.398
Total Area (km^2)	1586.035



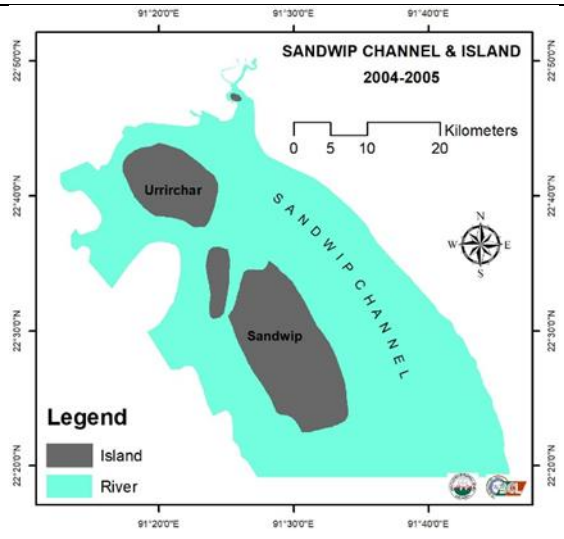
Item/ Interval of Year	1999 -2000
River line Length (km)	247.731
Common (river) Area (km^2)	1321.877
Char (km^2)	270.804
Total Area (km^2)	1592.681



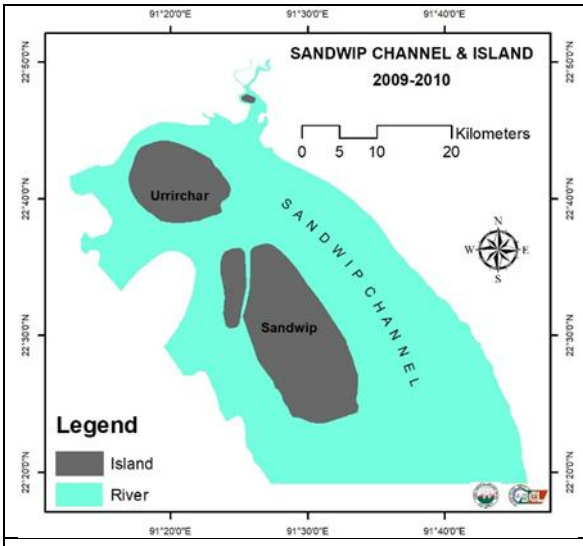
Item/ Interval of Year	2004-2005
River line Length (km)	250.528
Common (river) Area (km^2)	1267.751
Char (km^2)	326.859
Total Area (km^2)	1594.610

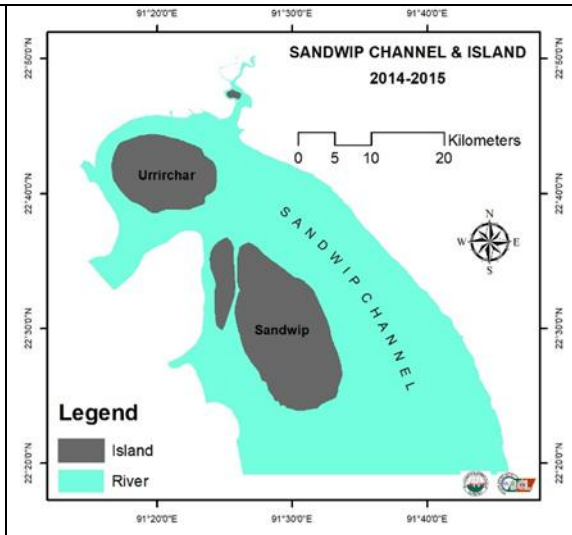


Item/ Interval of Year	2009 -2010
River line Length (km)	251.219
Common (river) Area (km^2)	1245.296
Char (km^2)	348.109
Total Area (km^2)	1593.405



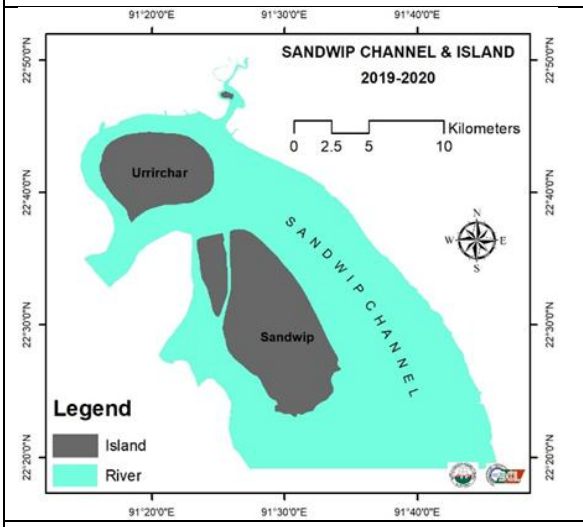
River line Length (km)	274.890
Common (river) Area (km^2)	1148.680
Char (km^2)	342.115
Total Area (km^2)	1490.796

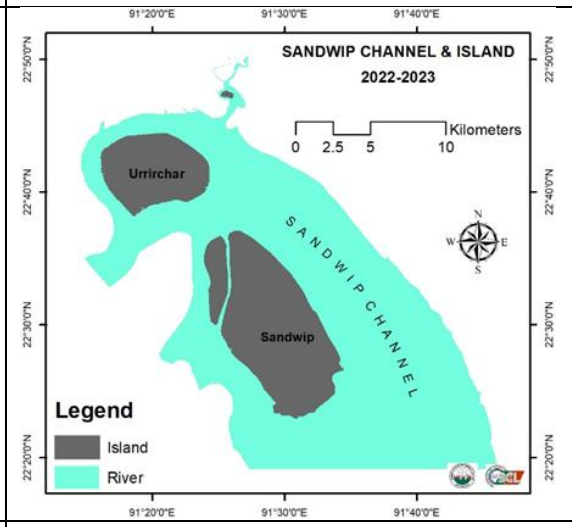




Item/ Interval of Year	2019 -2020
River line Length (km)	256.516
Common (river) Area (km^2)	1111.506
Char (km^2)	401.873
Total Area (km^2)	1513.379

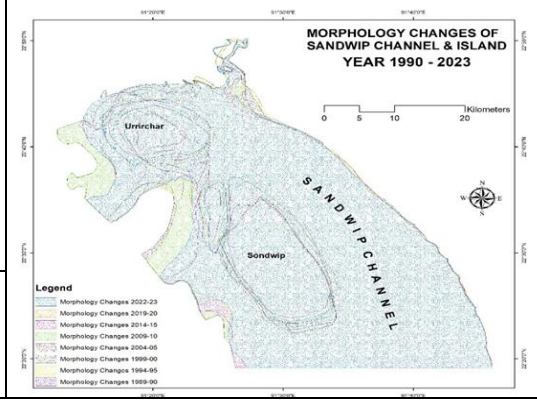
Item/ Interval of Year	2022-023
River line Length (km)	263.625
Common (river) Area (km^2)	1134.731
Char (km^2)	383.341
Total Area (km^2)	1518.072





Item/ Interval of Year	1990 -2023
River line Length (km)	232.171-263.625
Common (river) Area (km^2)	1311.014-1134.731
Char (km^2)	275.039-383.341
Total Area (km^2)	

Total Area (km^2) = (1990=1586.053)
Total Area (km^2) = (2023=1578.072)



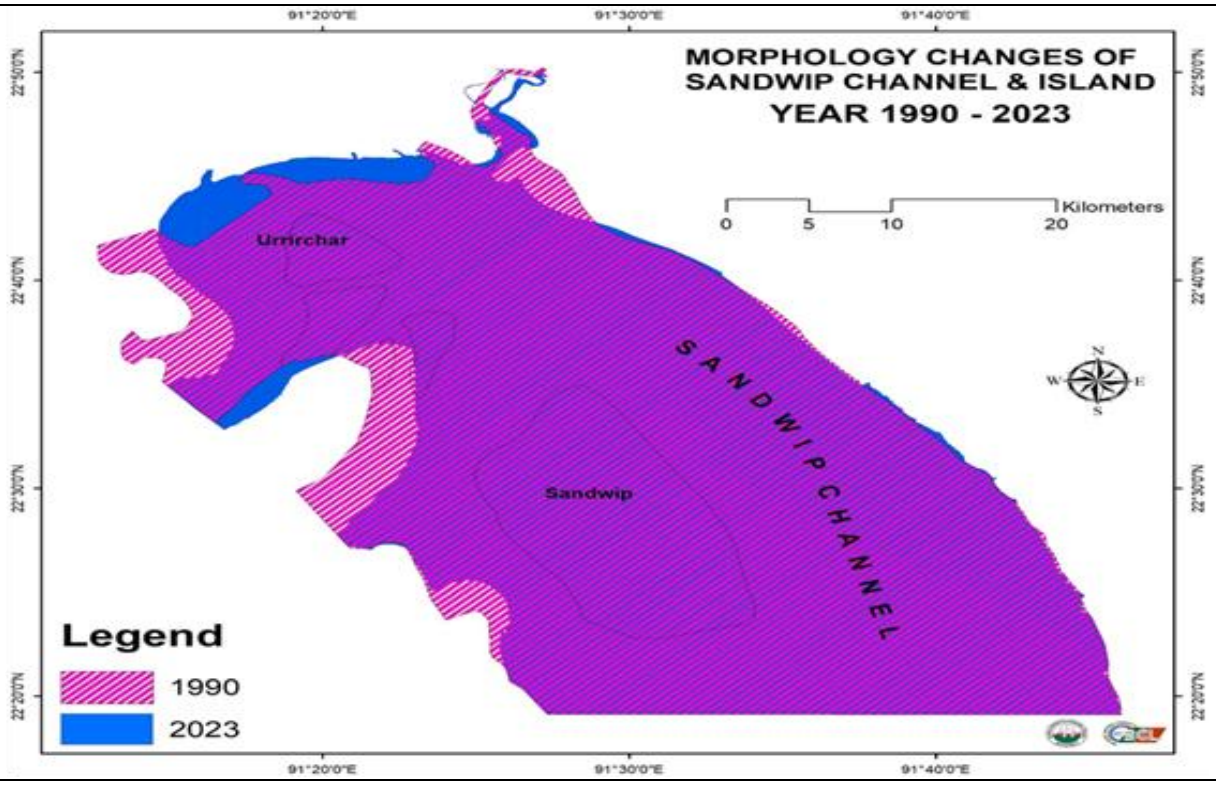
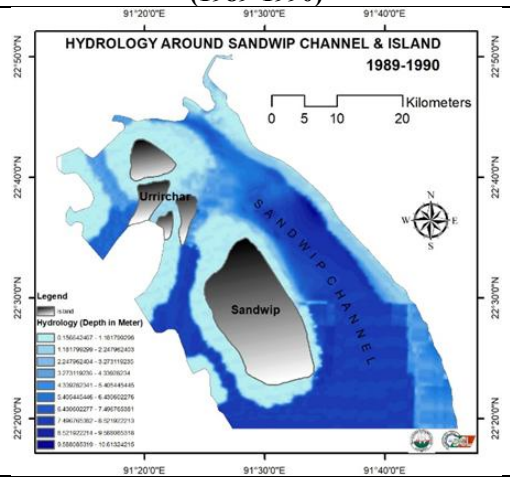
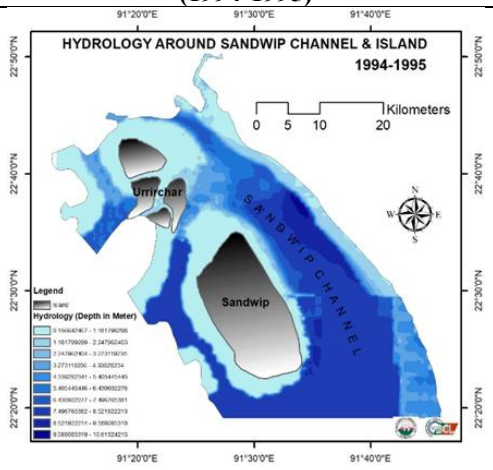
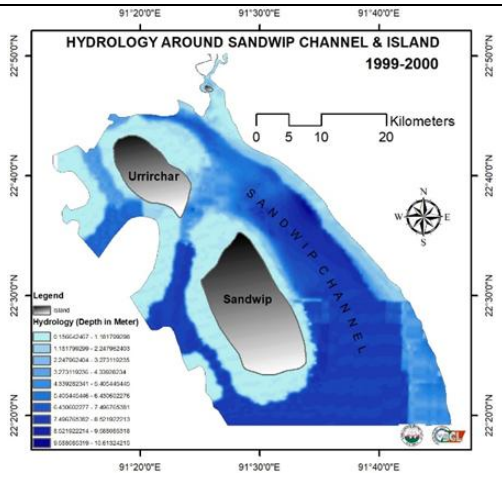


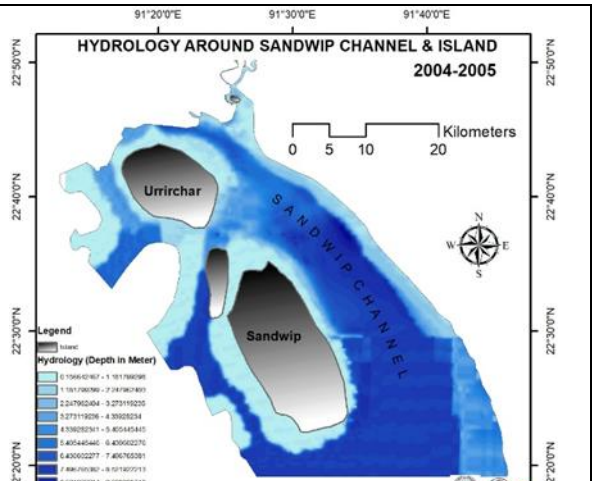
Figure 5-5: Morphological Changes of the Sandwip Channel & Island During 1990- 2023

B. Hydrological Change Detection: Changes of Water Depth from 1990 to 2023

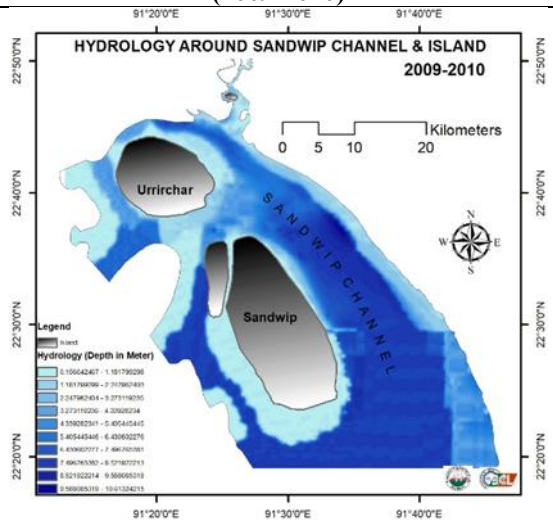
Hydrology Around Sandwip Channel & Island (1989-1990)		Hydrology Around Sandwip Channel & Island (1994-1995)
		
Hydrology Around Sandwip Channel & Island (1999-2000)		**Hydrology Around Sandwip Channel & Island (2004-2005)**



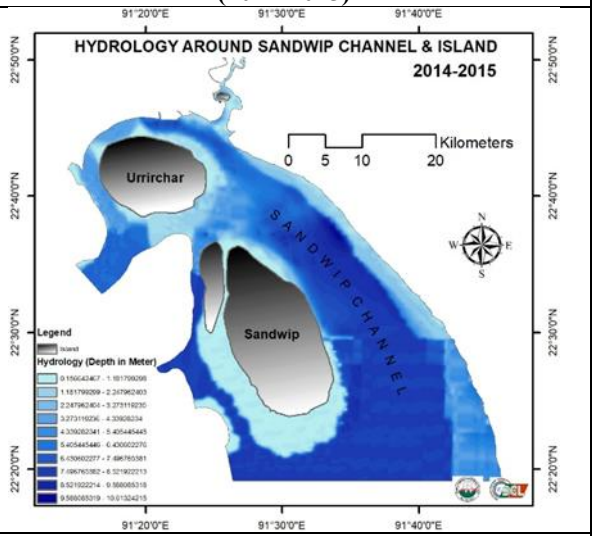
Hydrology Around Sandwip Channel & Island (2009-2010)



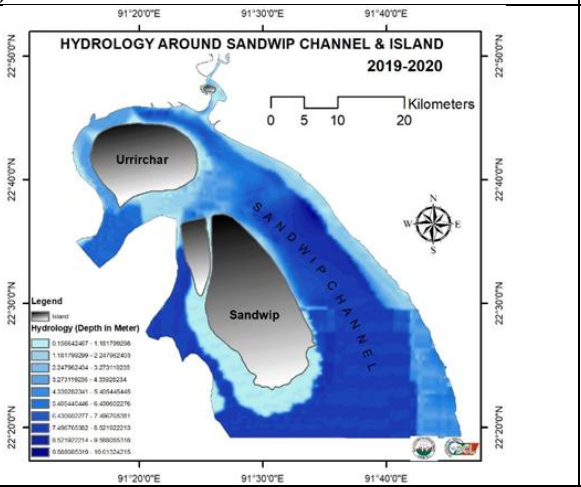
Hydrology Around Sandwip Channel & Island (2014-2015)

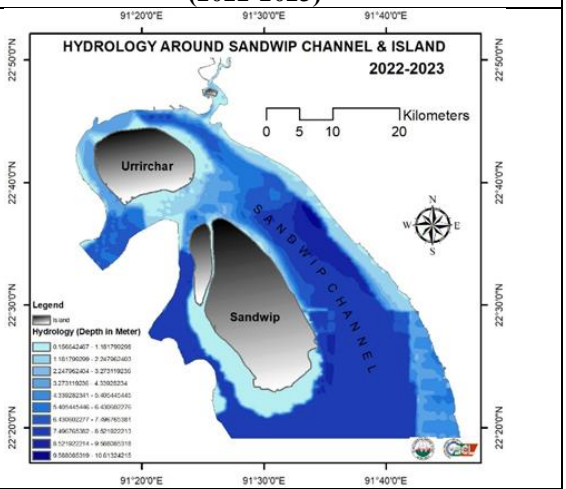


Hydrology Around Sandwip Channel & Island (2019-2020)



Hydrology Around Sandwip Channel & Island (2022-2023)





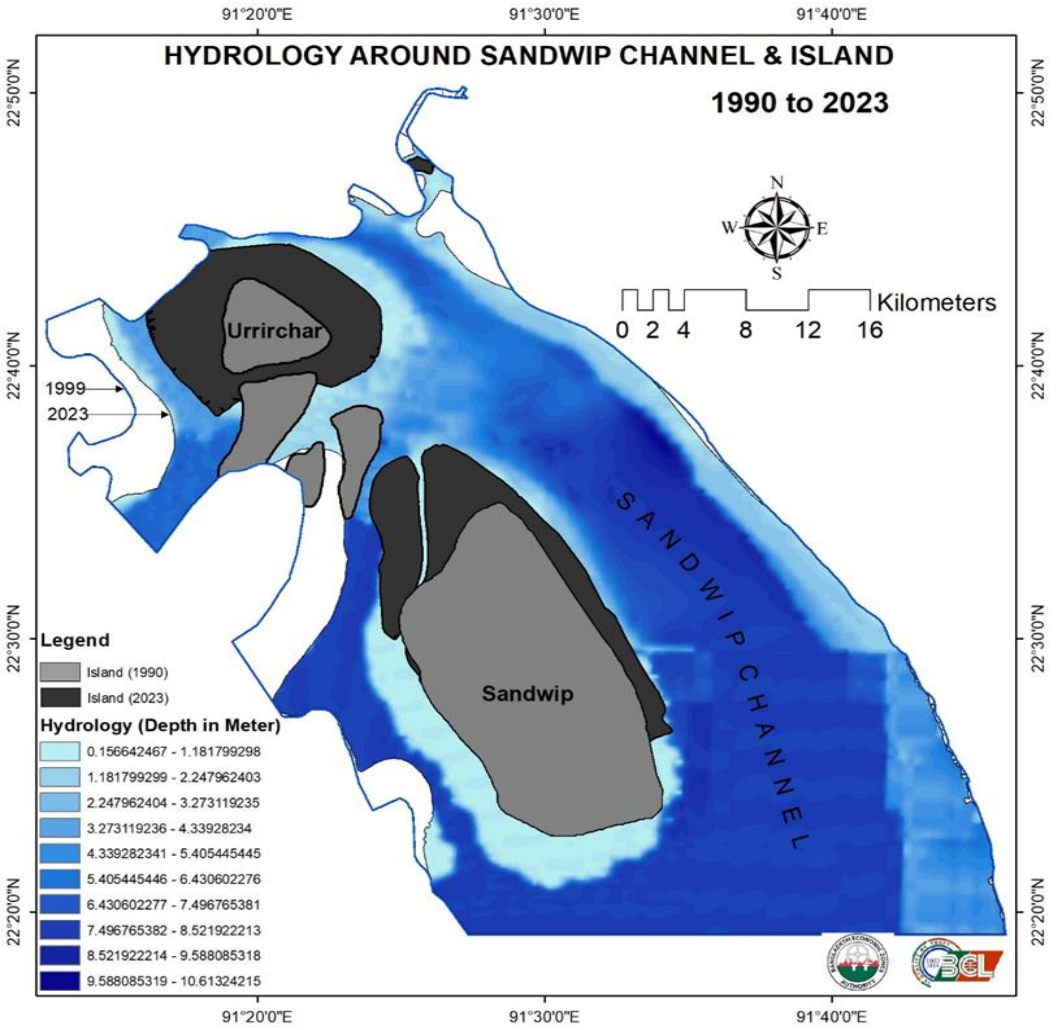


Figure 5-6: Hydrological depth around the Sandwip Channel % Island During 1990-2023

5.2.2.2. EROSION/ ACCRETION BASED ON MORPHOLOGICAL STUDY

189. The morphological studies include an assessment of the stability of the Sandwip Channel using time series satellite image analysis and field observations. The findings of other studies indicated that some areas/rivers are hydro-morphologically more active and vulnerable than others. Even the vulnerability of the same river/ channel varies depending on the location. For this study, the morphological changes of the Sandwip Channel are studied to know the stability of the channel bank, erosion, and accession-prone areas. The Morphological Changes of the Sandwip Channel at NSEZ Project Site and Bank Erosion during 1990-2023, and the trend of the Char Increased (Year 1990 to 2023) and River Bank Erosion (Year 1990 to 2023) are considered in this study.

Char Increased (Year 1990 to 2023)

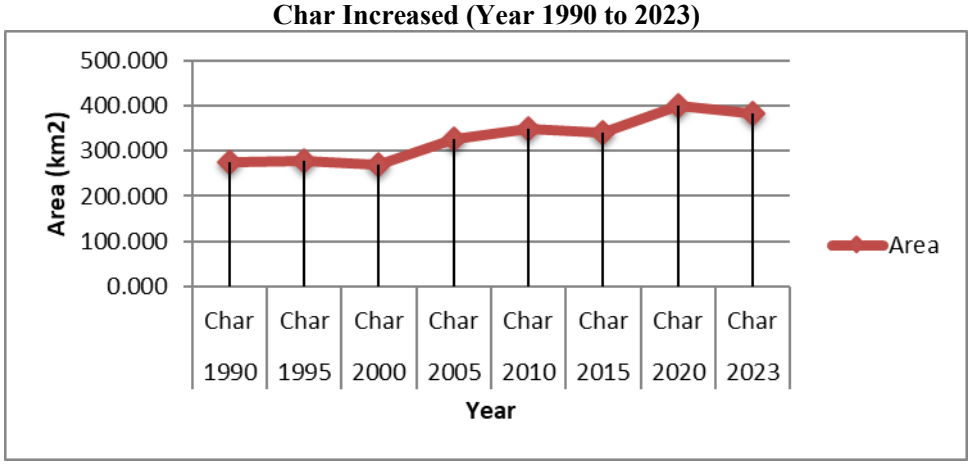


Figure 5-7: Char Land Increased due to Accretion

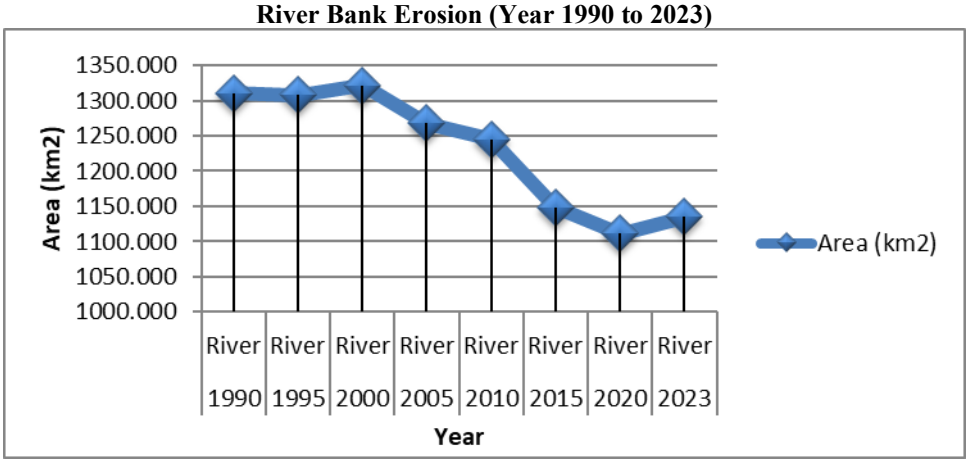


Figure 5-8: Channel/Riverbank Erosion

190. The Sandwip channel has experienced a net loss of about 176.28 km^2 over the last 33 years. Examining the temporal patterns, Char lands remained stable from 1990 to 2000, with moderate changes observed from 2000 to 2015. However, a substantial increase was found in Char land occurred after 2015. In the Northeastern part of the sub-project site, there is a noticeable rise in accretion, leading to a decrease in water depth. The analysis highlights a significant decrease in water depth from 2000 to 2023. Furthermore, it is noteworthy that the Feni River has undergone a gradual shift of approximately 0.85 kilometers from the West side to the East side over the past 33 years.

5.2.2.3. SEDIMENTATION PROCESS IN THE SANDWIP CHANNEL

191. It refers to the feasibility study conducted by the Bangladesh University of Engineering and Technology (BUET) and commissioned by the Bangladesh Inland Water Transport Authority (BIWTA) in 2019, focusing on the sediment accumulation and accretion in the coastal areas in Chattogram and Cox's Bazar district for the development of jetties and infrastructure at Mirsarai & Sandwip at Chittagong, Subang and Jaliar Dwip at Teknaf and Sonadia Dwip at Cox's Bazar. The study revealed that the seasonal sedimentation pattern in the study areas is predominantly influenced by the prevailing flow circulation. Notably, sediment deposition is observed at Mirsarai side and Sandwip char side channels higher than other three jetty sites—Sonadia, Jaliardwip, and Subrang throughout the season based on the minimum available draft, which is relatively low in these areas where sediment deposition is high, attributed to the anticlockwise oceanic circulation.

192. In contrast, the other three jetty sites—Sonadia, Jaliardwip, and Subrang—experience relatively low sedimentation during the pre-monsoon season, which can be attributed to the higher flow velocities present during both flood and ebb tides in these locations. The increased flow velocity hinders the sedimentation process, as sediments, particularly cohesive ones, are less likely to settle in areas with strong currents.

193. However, the pre-monsoon season is critical for sediment dynamics, during this time that most sediments, which originate from upstream during the monsoon and post-monsoon periods, undergo flocculation, deposition, and consolidation in a saline environment. The analysis of seasonal sedimentation patterns reveals a clear relationship between flow circulation and sediment deposition across the studied sites. Mirsharai and Sandwip channels characterized by high sediment deposition, face challenges with low available drafts. Understanding these dynamics is essential for effective coastal management and navigation planning for dredging in the IMD Zones etc.

194. **Sedimentation process:** To understand the erosion/ sedimentation processes and to quantify these phenomena at the jetty locations, a Coastal Morphology Model (CMM) was set-up using the 2D version of Deflt3D numerical model suite to study the morphological behaviors[41]. The morphology model uses the same model domain and bathymetry as that for the BCM (used in tide and storm surge analysis). While the BCM solves only flow transport equations with cyclone winds and pressures as additional external forcing, the morphology model solves both flow transport equations, suspended sediment transport equations, bed load transport equations, sedimentation/ re-suspension equations, and bank shifting algorithms. Model simulation shows that the seasonal sedimentation pattern in the region is largely dominated by this flow circulation pattern. The sedimentation pattern shows sediment deposition at Mirsarai and Sandwip throughout the season. When this sedimentation pattern is compared with the measured minimum available draft (data source: Navy data published in 2017), it is found that available drafts at Mirsarai and Sandwip are relatively low in the area where sediment deposition is high due to anticlockwise oceanic

[41] Feasibility Study and Detailed Design for Development of Jetties and infrastructure at Mirsarai & Sandwip at Chittagong, Subrang and Jaliar Dwip at Teknaf and Sonadia Dwip at Cox's Bazar, Bureau of Research, Testing and Consultation (BRTC) Bangladesh University of Engineering and Technology (BUET) Dhaka-1000, June 2019

circulation. A satellite image analysis indicated that

- **Right bank of the Sandwip Channel at Mirsarai**: The site is accretion-prone, especially near the northern side of the NSEZ-BEZA area at Mirsarai. Morphological changes are less pronounced near the middle and southern part of the site.
- **Left bank of the Sandwip Channel:** This site is accretion-prone, especially the portion near the north-west of the Sandwip island. The north-eastern part is comparatively less accretion-prone.

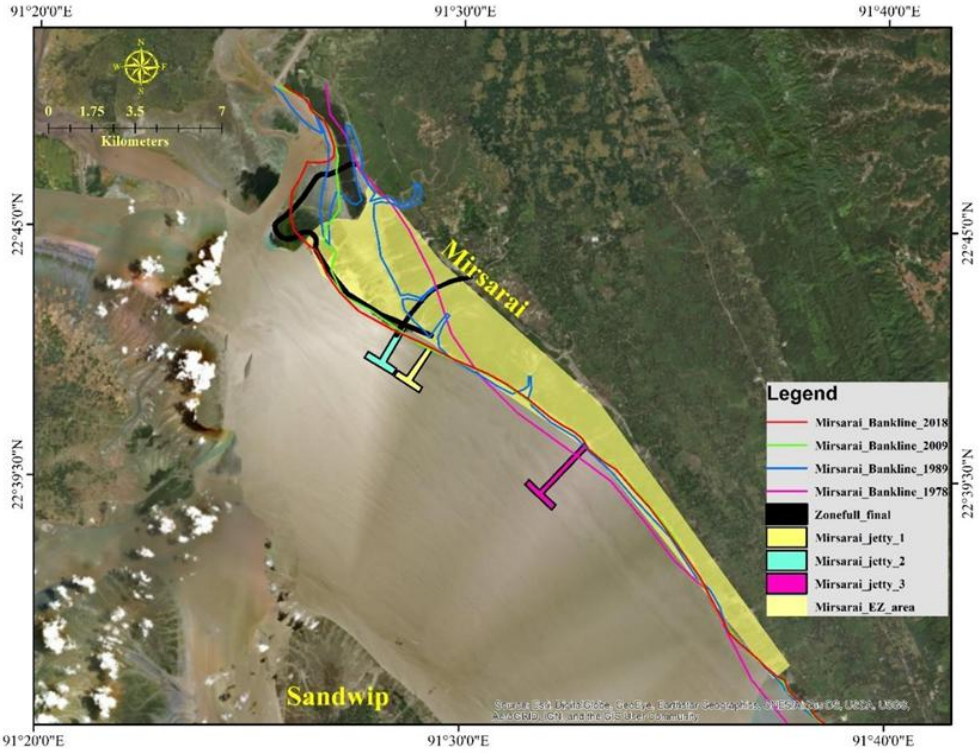


Figure 5-9 : Bankline Changes at Mirsharai

Source: Feasibility Study and Detailed Design for Development of Jetties and infrastructure at Mirsarai & Sandwip at Chittagong, June 2019

5.2.3. ALTERNATIVE ANALYSIS OF THE PROPOSED 12 DREDGING LOCATIONS

195. An alternative analysis was carried out between the proposed 12 probable dredging sources location (L) in line with the ecological points, including marine biodiversity, physical environment, morphological status, socioeconomic, and cost of the dredging activities due to the land development activities. The assessment focused on multiple parameters under four sub-criteria, i.e., physical environmental quality, ecological resources and socio-cultural resources, and economic cost. The Leopold Matrix is adopted in this study in order to evaluate the impacts on all locations. The Leopold matrix is a two-dimensional cross-referencing matrix as follows

- The activities linked to the sub-project that may have an impact on the environment and human
- The existing environmental and social conditions that could be affected by the sub-project

196. This methodology allows for a score (from 1 to 100) for each of the identified environmental impacts and parameters, which may, at the end of the process, produce a total score of environmental impacts generated by the activity or work.

197. The environmental and social impacts have been quantified in terms of Environmental Impact Value (EIV) of various environmental parameters. The relative importance of each parameter is multiplied by its environmental changes impact to assess the Environmental Impact Value(EIV) of respective environmental parameters as follows;

$$\text{EIV} = \sum_{i=1}^{N} (V_i) W_i$$

EIV = Environmental Impact Value
Vi = Relative change of the environmental quality of parameters (Degree of impacts)
Wi = Relative importance of weight or parameters
N = Total number of environmental parameters

198. Relative importance and the change of each parameter (degree of impact or magnitude) have been assumed by expert judgment. The relative change of the environmental quality parameters or magnitude is calculated within a numerical scale ranging from 1 to 10 for beneficial impacts, and -1 to -10 for negative impacts, and 0 for neutral.

199. The analysis shows that at four locations, the summary of the EIV's score was positive, whereas at eight (8) locations the scores were negative, as shown in **Table 5-2**. The positive scores are observed as + 49, +21, +23, and +21 at L-5, L-7, L-8, and L-9, respectively, and have been considered suitable locations for the dredging. The negative scores were -146 at L-1, -138 at L-2,-122 at L-3, -104 at L-4, -14 at L-6, -91 at L-10, -96 at L11 and -146 at L-12, and presumed as unsuitable locations for the dredging materials sources. The overall environmental impact value of the proposed dredging locations, the L-05 is higher than those of other locations, which indicates that the adverse environmental and social impacts will be 'Lower' due to dredging activities. Based on this alternative analysis the of identified 12 probable dredging sources are divided into two options of sources based on these scores as follows.

- **Option I: Unsuitable locations for dredging**
- **Option 2: Suitable locations for dredging**

Table 5-2: Alternative Analysis of the 12 Identified Dredging Source Locations

Environ. Aspects (a)	Environmental Parameters(b)	Activities ©	Relative Importance Value (d)	Location L-1			Location L-2			Location L-3			Location L-4			Location L-5		
				Key observation / indicator (e)	MI (f)	EIV g=(dxg)	Key observation / indicator (h)	MI (i)	EIV j=(dxf)	Key observation / indicator (k)	MI (l)	EIV m=(dxf)	Key observation /indicator (n)	MI (o)	EIV p=(dxf)	Key observation / indicator (q)	MI (r)	EIV s=(dxf)
Physical Environment	Degradation/ change of lands uses or land cover	Degradation of lands use due to improper dredging pipelines sitting. Possibilities of obstruction and interference with other infrastructure development, road networks	2	Distance of dredging source to IMD zone=22.85 km	-5	-10	Distance of dredging source to IMD zone=17.65 km	-4	-8	Distance of dredging source to IMD zone=11.55 km	-3	-6	Distance of dredging source to IMD zone=9.47 km	-3	-6	Distance of dredging source to IMD zone=6.65 km	-1	-2
	Channel bottom Depth	Channel bottom Depth impacts on dredging activities	2	Sea Bottom Depth = 8.9 m	-2	-4	Sea Bottom Depth = 8.8 m	-2	-4	Sea Bottom Depth =9.2 m	-3	-6	Sea Bottom Depth =6.5m	-2	-4	Sea Bottom Depth =6.7 m	-2	-4
	Distance from shoreline	Dredging location from shoreline impacts on costing	1	Distance =2 km	-1	-1	Distance =2.25 km	-2	-2	Distance =2.5 km	-2	-2	Distance =3 km	-3	-3	Distance =2.5 km	-2	-2
	Soil Erosion and Impact on channel bank	Channel Bank erosion	3	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0
	Surface water pollution	Surface water pollution due to dredging activities and disposal of generated waste from labor camps, and oil/ chemical mishandling during dredgers operation and disposal of dredged water into canals	3	Number of canal and water body crossing (4)	-3	-9	Number of canal and water body crossing (4)	-3	-9	Number of canal and water body crossing (4)	-3	-9	Number of canal and water body crossing (4)	-3	-9	Number of canal and water body crossing (2)	-1	-3
	Sandwip Channel sediment qualities	Presence of Heavy metals; Zn, Cu, Pb, Cd as toxicity)	4	Not toxicity level observed in sediment tested reports	0	0	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0
	Ground water pollution	Pollution groundwater due to leakage of dredging pipelines, saline water intrusion may occur	4	Distance of dredging source to IMD zone=22.85 km	-4	-16	Distance of dredging source to IMD zone=17.65 km	-4	-16	Distance of dredging source to IMD zone=11.55 km	-3	-12	Distance of dredging source to IMD zone=9.47 km	-3	-12	Distance of dredging source to IMD zone=6.65 km	-1	-4
	Ambient air quality deterioration	Air quality deterioration (movement of heavy vehicles and equipment) and sand dust generation based on the distance of the dredging source location to sand filling areas	3	Distance of dredging source to IMD zone=22.85 km	-3	-9	Distance of dredging source to IMD zone=17.65 km	-3	-9	Distance of dredging source to IMD zone=11.55 km	-3	-9	Distance of dredging source to IMD zone=9.47 km	-3	-9	Distance of dredging source to IMD zone=6.65 km	-1	-3
	Noise generation	Movement of Heavy vehicles and equipment within distance of the dredging source location to sand-filling areas	1	Distance of dredging source to IMD zone=22.85 km	-1	-1	Distance of dredging source to IMD zone=17.65 km	-1	-1	Distance of dredging source to IMD zone=11.55 km	-3	-3	Distance of dredging source to IMD zone=9.47 km	-3	-3	Distance of dredging source to IMD zone=6.65 km	-1	-1
	Drainage congestion/ Exposure to flooding	Overflow of dredged material water during dredged material filling at site may cause drainage congestion	5	Distance of dredging source to IMD zone=22.85 km	-4	-20	Distance of dredging source to IMD zone=17.65 km	-4	-20	Distance of dredging source to IMD zone=11.55 km	-3	-15	Distance of dredging source to IMD zone=9.47 km	-3	-15	Distance of dredging source to IMD zone=6.65 km	-1	-5
	Obstruction or may damage the of Super Dyke	Dredging pipelines may damage Super dyke	2	Distance of dredging source to IMD zone=22.85 km	-2	-4	Distance of dredging source to IMD zone=17.65 km	-4	-8	Distance of dredging source to IMD zone=11.55 km	-3	-6	Distance of dredging source to IMD zone=9.47 km	-3	-6	Distance of dredging source to IMD zone=6.65 km	-1	-2
	Subtotal (A)		**30**			**-74**			**-77**			**-68**			**-67**			**-26**
Ecological Environment	Loss of terrestrial flora	Loss of Vegetation during construction dredging pipelines and labor camp	3	Distance of dredging source to IMD zone=22.85 km	-3	-9	Distance of dredging source to IMD zone=17.65 km	-2	-6	Distance of dredging source to IMD zone=11.55 km	-3	-9	Distance of dredging source to IMD zone=9.47 km	-3	-9	Distance of dredging source to IMD zone=6.65 km	-1	-3
	Disturbances of birds /avifauna	Due to dredging activities like dredger operation	3	Distance of dredging source to IMD zone=22.85 km	-2	-6	Distance of dredging source to IMD zone=17.65 km	-4	-12	Distance of dredging source to IMD zone=11.55 km	-4	-12	Distance of dredging source to IMD zone=9.47 km	-3	-9	Distance of dredging source to IMD zone=6.65 km	-1	-3
	Fish Resources	Disturbances of Fish resources during the operation of dredgers	6	Distance of dredging source to IMD zone=22.85 km	-6	-36	Distance of dredging source to IMD zone=17.65 km	-5	-30	Distance of dredging source to IMD zone=11.55 km	-5	-30	Distance of dredging source to IMD zone=9.47 km	-4	-24	Distance of dredging source to IMD zone=6.65 km	-1	-6
	Marine Ecology (aquatic flora and fauna)	Impact on Benthos, zooplankton, and phytoplankton at the bottom of the channel bed.	8	An abundance of Marine biodiversity	-5	-40	Distance of dredging source to IMD zone=17.65 km	-5	-40	Distance of dredging source to IMD zone=11.55 km	-4	-32	Distance of dredging source to IMD zone=9.47 km	-4	-32	Distance of dredging source to IMD zone=6.65 km	-1	-8
	Distance from the Muhuri Reservoir (Feni River) to Confluence of Sandwip channel	Disturbance of aquatic/marine biodiversity for dredging activities, since at the confluence, biodiversity is rich and dynamic.	4	Distance about=20.85 km	-1	-4	Distance about=18.0 km	-1	-4	Distance=11.55 km	-1	-4	Distance=9.0km	-1	-4	Distance=6.0km	-1	-4
	Impact on the predicted Hilsa breeding ground	Dredging activities may impact Hilsa Ground	6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground	-1	-6
	Subtotal (B)		**30**			**-101**			**-98**			**-93**			**-84**			**-30**
Social Issues	Disturbances of communities	Disturbance due to dredged pipeline installation e.g., barriers to access, roads, and fishing activities	3	Distance of dredging source to IMD zone=22.85 km	-4	-12	Distance of dredging source to IMD zone=17.65 km	-4	-12	Distance of dredging source to IMD zone=11.55 km	-3	-9	Distance of dredging source to IMD zone=9.47 km	-3	-9	Distance of dredging source to IMD zone=6.65 km	-1	-3
	Labor Influx and Working Conditions	Labor required for construction of dredging pipeline	3	Distance of dredging source to IMD zone=22.85 km	-3	-9	Distance of dredging source to IMD zone=17.65 km	-3	-9	Distance of dredging source to IMD zone=11.55 km	-3	-9	Distance of dredging source to IMD zone=9.47 km	-3	-9	Distance of dredging source to IMD zone=6.65 km	-1	-3
	Occupational Health and Safety	During construction works (operation dredgers, dredging pipeline fixing and related works, etc.)	6	Distance of dredging source to IMD zone=22.85 km	-2	-12	Distance of dredging source to IMD zone=17.65 km	-2	-12	Distance of dredging source to IMD zone=11.55 km	-3	-18	Distance of dredging source to IMD zone=9.47 km	-3	-18	Distance of dredging source to IMD zone=6.65 km	-1	-6
	Public safety/accidents	Movement of Heavy vehicles and equipment through the local road	3	Distance of dredging source to IMD zone=22.85 km	-2	-6	Distance of dredging source to IMD zone=17.65 km	-2	-6	Distance of dredging source to IMD zone=11.55 km	-3	-9	Distance of dredging source to IMD zone=9.47 km	-3	-9	Distance of dredging source to IMD zone=6.65 km	-1	-3
	Employment Generation	Labor required for construction of dredging pipelines and associated works	10	Distance of dredging source to IMD zone=22.85 km	8	80	Distance of dredging source to IMD zone=17.65 km	8	80	Distance of dredging source to IMD zone=11.55 km	8	80	Distance of dredging source to IMD zone=9.47 km	8	80	Distance of dredging source to IMD zone=6.65 km	8	80

Environ. Aspects (a)	Environmental Parameters(b)	Activities ©	Relative Importance Value (d)	Location L-1			Location L-2			Location L-3			Location L-4			Location L-5		
				Key observation / indicator (e)	MI (f)	EIV g=(dxe)	Key observation / indicator (h)	MI (i)	EIV j=(dxf)	Key observation / indicator (k)	MI (l)	EIV m=(dxf)	Key observation /indicator (n)	MI (o)	EIV p=(dxf)	Key observation / indicator (q)	MI (r)	EIV s=(dxf)
	Traffic and Transport	Increased traffic volume due to the dredging activities	2	Distance of dredging source to IMD zone=22.85 km	-3	-6	Distance of dredging source to IMD zone=17.65 km	-3	-6	Distance of dredging source to IMD zone=11.55 km	-3	-6	Distance of dredging source to IMD zone=9.47 km	-3	-6	Distance of dredging source to IMD zone=6.65 km	-1	-2
	Construction cost	The construction cost of dredging pipelines installation, land development, construction yard and construction labor camps and associated works	8	Distance of dredging source to IMD zone=22.85 km	-7	-56	Distance of dredging source to IMD zone=17.65 km	-6	-48	Distance of dredging source to IMD zone=11.55 km	-5	-40	Distance of dredging source to IMD zone=9.47 km	-4	-32	Distance of dredging source to IMD zone=6.65 km	-1	-8
	Development of lands for infrastructure	Infrastuctures will be developed	5	Entire Sub-project area	10	50	Entire Sub-project area	10	50	Entire Sub-project area	10	50	Entire Sub-project area	10	50	Entire Sub-project area	10	50
	Subtotal (C)		**40**			**29**	**0**		**37**	**0**		**39**	**0**	**-1**	**47**			**105**
	Grand Total = (A+B+C)		**100**			**-146**			**-138**			**-122**			**-104**			**49**

Environ. Aspects (a)	Environmental Parameters(b)	Activities ©	Relative Importance Value (d)	Location L-6			Location L-7			Location L-8			Location L-9			Location L-10			Location L-11			Location L-12		
				Key observation / indicator (t)	MI (u)	EIV v=(dxf)	Key observation / indicator (w)	MI (x)	EIV, y=(dxi)	Key observation / indicator (z)	MI (aa)	EIV, ab=(dxm)	Key observation / indicator (ac)	MI (ad)	EIV ae=(dxn)	Key observation / indicator (af)	MI (ag)	EIV ah=(dxn)	Key observation / indicator (ai)	MI (aj)	EIV ak=(dxn)	Key observation / indicator (al)	MI (am)	EIV an=(dxam)
Physical Environment	Degradation/ change of lands uses or land cover	Degradation of lands use due to improper dredging pipelines sitting. Possibilities of obstruction and interference with other infrastructure development, road networks	2	Distance of dredging source to IMD zone=7.5 km	-1	-2	Distance of dredging source to IMD zone=5.57 km	-1	-2	Distance of dredging source to IMD zone=4.97 km	-1	-2	Distance of dredging source to IMD zone=4.55 km	-1	-2	Distance of dredging source to IMD zone=7 km	-2	-4	Distance of dredging source to IMD zone=5.85 km	-1	-2	Distance of dredging source to IMD zone=7.27 km	-2	-4
	Channel bottom Depth	Channel bottom Depth impacts on dredging activities	2	Sea Bottom Depth =6.5 m	-2	-4	Sea Bottom Depth = 5.8 m	-1	-2	Sea Bottom Depth = 6.2 m	-2	-4	Sea Bottom Depth = 6.3 m	-2	-4	Sea Bottom Depth = 7.0 m	-2	-4	Sea Bottom Depth = 6.1 m	-2	-4	Sea Bottom Depth = 6.5 m	-2	-4
	Distance from shoreline	Dredging location from shoreline impacts on costing	1	Distance =2.75 km	-3	-3	Distance =2.7 km	-3	-3	Distance =2.5 km	-2	-2	Distance =2 km	-1	-1	Distance =1.5 km	-1	-1	Distance =2 km	-1	-1	Distance =2 km	-1	-1
	Soil Erosion and Impact on channel bank	Channel Bank erosion	3	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	Stable for Super Dyke	0	0	No Super Dyke	-4	-12	No Super Dyke	-4	-12
	Surface water pollution	Surface water pollution due to dredging activities and disposal of generated waste from labor camps,and oil/ chemical mishandling during dredgers operation and disposal of dredged water into canals	3	Number of canal and water body crossing (2)	-1	-3	Number of canal and water body crossing (2)	-2	-6	Number of canal and water body crossing (2)	-1	-3	Number of canal and water body crossing (2)	-2	-6	Number of canal and water body crossing (4)	-2	-6	Number of canal and water body crossing (3)	-3	-9	Number of canal and water body crossing (3)	-3	-9
	Sandwip Channel sediment qualities	Presence of Heavy metals; Zn, Cu, Pb, Cd as toxicity)	4	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0	Not toxicity level	0	0
	Ground water pollution	Pollution groundwater due to leakage of dredging pipelines, saline water intrusion may occur	4	Distance of dredging source to IMD zone=7.5 km	-2	-8	Distance of dredging source to IMD zone=5.57 km	-1	-4	Distance of dredging source to IMD zone=4.97 km	-1	-4	Distance of dredging source to IMD zone=4.55 km	-1	-4	Distance of dredging source to IMD zone=7 km	-2	-8	Distance of dredging source to IMD zone=5.85 km	-1	-4	Distance of dredging source to IMD zone=7.27 km	-2	-8
	Ambient air quality deterioration	Air quality deterioration (movement of heavy vehicles and equipment) and sand dust generation based on the distance of the dredging source location to sand filling areas	3	Distance of dredging source to IMD zone=7.5 km	-2	-6	Distance of dredging source to IMD zone=5.57 km	-1	-3	Distance of dredging source to IMD zone=4.97 km	-1	-3	Distance of dredging source to IMD zone=4.55 km	-1	-3	Distance of dredging source to IMD zone=7 km	-3	-9	Distance of dredging source to IMD zone=5.85 km	-1	-3	Distance of dredging source to IMD zone=7.27 km	-3	-9
	Noise generation	Movement of Heavy vehicles and equipment within distance of the dredging source location to sand-filling areas	1	Distance of dredging source to IMD zone=7.5 km	-2	-2	Distance of dredging source to IMD zone=5.57 km	-1	-1	Distance of dredging source to IMD zone=4.97 km	-1	-1	Distance of dredging source to IMD zone=4.55 km	-1	-1	Distance of dredging source to IMD zone=7 km	-2	-2	Distance of dredging source to IMD zone=5.85 km	-1	-1	Distance of dredging source to IMD zone=7.27 km	-2	-2
	Drainage congestion/ Exposure to flooding	Overflow of dredged material water during dredged material filling at site may cause drainage congestion	5	Distance of dredging source to IMD zone=7.5 km	-2	-10	Distance of dredging source to IMD zone=5.57 km	-1	-5	Distance of dredging source to IMD zone=4.97 km	-1	-5	Distance of dredging source to IMD zone=4.55 km	-1	-5	Distance of dredging source to IMD zone=7 km	-2	-10	Distance of dredging source to IMD zone=5.85 km	-1	-5	Distance of dredging source to IMD zone=7.27 km	-2	-10
	Obstruction or may damage the of Super Dyke	Dredging pipelines may damage Super dyke	2	Distance of dredging source to IMD zone=7.5 km	-2	-4	Distance of dredging source to IMD zone=5.57 km	-1	-2	Distance of dredging source to IMD zone=4.97 km	-1	-2	Distance of dredging source to IMD zone=4.55 km	-1	-2	Distance of dredging source to IMD zone=7 km	-2	-4	Distance of dredging source to IMD zone=5.85 km	-1	-2	Distance of dredging source to IMD zone=7.27 km	-2	-4
	Subtotal (A)		**30**			**-42**			**-28**	**0**		**-26**	**0**		**-28**	**0**		**-48**	**0**		**-43**	**0**		**-63**
Ecological	Loss of terrestrial flora	Loss of Vegetation during construction dredging pipelines and labor camp	3	Distance of dredging source to IMD zone=7.5 km	-2	-6	Distance of dredging source to IMD zone=5.57 km	-1	-3	Distance of dredging source to IMD zone=4.97 km	-1	-3	Distance of dredging source to IMD zone=4.55 km	-1	-3	Distance of dredging source to IMD zone=7 km	-2	-6	Distance of dredging source to IMD zone=5.85 km	-1	-3	Distance of dredging source to IMD zone=7.27 km	-2	-6
	Disturbances of birds /avifauna	Due to dredging activities like dredger operation	3	Distance of dredging source to IMD zone=7.5 km	-2	-6	Distance of dredging source to IMD zone=5.57 km	-1	-3	Distance of dredging source to IMD zone=4.97 km	-1	-3	Distance of dredging source to IMD zone=4.55 km	-1	-3	Distance of dredging source to IMD zone=7 km	-2	-6	Distance of dredging source to IMD zone=5.85 km	-1	-3	Distance of dredging source to IMD zone=7.27 km	-2	-6

Environ. Asnects (a)	Environmental Parameters(b)	Activities ©	Relative Importance Value (d)	Location L-6			Location L-7			Location L-8			Location L-9			Location L-10			Location L-11			Location L-12		
				Key observation / indicator (t)	MI (u)	EIV v=(dxf)	Key observation / indicator (w)	MI (x)	EIV, y=(dxi)	Key observation / indicator (z)	MI (aa)	EIV, ab=(dxm)	Key observation / indicator (ac)	MI (ad)	EIV ac=(dxn)	Key observation / indicator (af)	MI (ag)	EIV ah=(dxn)	Key observation / indicator (ai)	MI (aj)	EIV ak=(dxn)	Key observation / indicator (al)	MI (am)	EIV an=(dxam)
	Fish Resources	Disturbances of Fish resources during the operation of dredgers	6	Distance of dredging source to IMD zone=7.5 km	-2	-12	Distance of dredging source to IMD zone=5.57 km	-2	-12	Distance of dredging source to IMD zone=4.97 km	-2	-12	Distance of dredging source to IMD zone=4.55 km	-1	-6	Distance of dredging source to IMD zone=7 km	-4	-24	Distance of dredging source to IMD zone=5.85 km	-5	-30	Distance of dredging source to IMD zone=7.27 km	-6	-36
	Marine Ecology (aquatic flora and fauna)	Impact on Benthos, zooplankton, and phytoplankton at the bottom of the channel bed.	8	Distance of dredging source to IMD zone=7.5 km	-2	-16	Distance of dredging source to IMD zone=5.57 km	-1	-8	Distance of dredging source to IMD zone=4.97 km	-1	-8	Distance of dredging source to IMD zone=4.55 km	-1	-8	Distance of dredging source to IMD zone=7 km	-4	-32	Distance of dredging source to IMD zone=5.85 km	-5	-40	Distance of dredging source to IMD zone=7.27 km	-2	-16
	Distance from the Muhuri Reservoir (Feni River) to Confluence of Sandwip channel	Disturbance of aquatic/ marine biodiversity for dredging activities, since at the confluence, biodiversity is rich and dynamic.	4	Distance=6.0km	-1	-4	Distance=6.0km	-1	-4	Distance=5.0km	-1	-4	Distance=4.9 km	-1	-4	Distance=3.0 km	-3	-12	Distance=2.4 km	-5	-20	Distance=1.5 km	-6	-24
	Impact on the predicted Hilsa breeding ground	Dredging activities may impact on Hilsa Ground	6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground	-1	-6	Distance of dredging source to Hilsa Breeding ground 4.5 km	-2	-12	Distance of dredging source to Hilsa Breeding ground	-5	-30	Distance of dredging source to Hilsa Breeding ground	-6	-36	Distance of dredging source to Hilsa Breeding ground	-8	-48
	Subtotal (B)		**30**			**-50**			**-36**			**-36**	**0**	**-7**	**-36**	**0**	**-20**	**-110**	**0**		**-132**			**-136**
Social Issues	Disturbances of communities	Disturbance due to dredged pipeline installation e.g., barriers to access, roads, and fishing activities	3	Distance of dredging source to IMD zone=7.5 km	-2	-6	Distance of dredging source to IMD zone=5.57 km	-1	-3	Distance of dredging source to IMD zone=4.97 km	-1	-3	Distance of dredging source to IMD zone=4.55 km	-1	-3	Distance of dredging source to IMD zone=7 km	-2	-6	Distance of dredging source to IMD zone=5.85 km	-1	-3	Distance of dredging source to IMD zone=7.27 km	-3	-9
	Labor Influx and Working Conditions	Labor required for construction of dredging pipeline	3	Distance of dredging source to IMD zone=7.5 km	-2	-6	Distance of dredging source to IMD zone=5.57 km	-1	-3	Distance of dredging source to IMD zone=4.97 km	-1	-3	Distance of dredging source to IMD zone=4.55 km	-1	-3	Distance of dredging source to IMD zone=7 km	-3	-9	Distance of dredging source to IMD zone=5.85 km	-3	-9	Distance of dredging source to IMD zone=7.27 km	-4	-12
	Occupational Health and Safety	During construction works (operation dredgers, dredging pipeline fixing and related works, etc.)	6	Distance of dredging source to IMD zone=7.5 km	-2	-12	Distance of dredging source to IMD zone=5.57 km	-1	-6	Distance of dredging source to IMD zone=4.97 km	-1	-6	Distance of dredging source to IMD zone=4.55 km	-1	-6	Distance of dredging source to IMD zone=7 km	-2	-12	Distance of dredging source to IMD zone=5.85 km	-1	-6	Distance of dredging source to IMD zone=7.27 km	-2	-12
	Public safety/accidents	Movement of Heavy vehicles and equipment through the local road	3	Distance of dredging source to IMD zone=7.5 km	-2	-6	Distance of dredging source to IMD zone=5.57 km	-1	-3	Distance of dredging source to IMD zone=4.97 km	-1	-3	Distance of dredging source to IMD zone=4.55 km	-1	-3	7Distance of dredging source to IMD zone=7 km	-2	-6	Distance of dredging source to IMD zone=5.85 km	-1	-3	Distance of dredging source to IMD zone=7.27 km	-2	-6
	Employment Generation	Labor required for construction of dredging pipelines and associated works	10	Distance of dredging source to IMD zone=7.5 km	8	80	Distance of dredging source to IMD zone=5.57 km	6	60	Distance of dredging source to IMD zone=4.97 km	6	60	Distance of dredging source to IMD zone=4.55 km	6	60	Distance of dredging source to IMD zone=7 km	7	70	Distance of dredging source to IMD zone=5.85 km	8	80	Distance of dredging source to IMD zone=7.27 km	8	80
	Traffic and Transport	Increased traffic volume due to the dredging activities	2	Distance of dredging source to IMD zone=7.5 km	-3	-6	Distance of dredging source to IMD zone=5.57 km	-1	-2	Distance of dredging source to IMD zone=4.97 km	-1	-2	Distance of dredging source to IMD zone=4.55 km	-1	-2	Distance of dredging source to IMD zone=7 km	-2	-4	Distance of dredging source to IMD zone=5.85 km	-3	-6	Distance of dredging source to IMD zone=7.27 km	-3	-6
	Construction cost	The construction cost of dredging pipelines installation, land development, construction yard and construction labor camps and associated works	8	Distance of dredging source to IMD zone=7.5 km	-2	-16	Distance of dredging source to IMD zone=5.57 km	-1	-8	Distance of dredging source to IMD zone=4.97 km	-1	-8	Distance of dredging source to IMD zone=4.55 km	-1	-8	Distance of dredging source to IMD zone=7 km	-2	-16	Distance of dredging source to IMD zone=5.85 km	-3	-24	Distance of dredging source to IMD zone=7.27 km	-4	-32
	Development of lands for infrastructure	Infrastructures will be developed	5	Entire Sub-project area	10	50	Entire sub-project site	10	50	Entire sub-project site	10	50	Entire sub-project site	10	50	Entire sub-project site	10	50	Entire sub-project site	10	50	Entire sub-project site	10	50
	Subtotal (C)		**40**			**78**			**85**			**85**			**85**			**67**			**79**			**53**
	Grand Total = (A+B+C)		**100**			**-14**			**21**			**23**			**21**			**-91**			**-96**			**-146**

5.2.3.1. OPTION-1: UNSUITABLE LOCATIONS FOR DREDGING

200. All sites require special attention while conducting dredging. Therefore, the sampling sites were selected as representative covering both upstream and downstream of the channel. Eight out of 12 are identified as non-suitable sources for the dredging, and a few of those (L-1, L- 2, L- 3, and L 4) are downstream from the sub-project locations far away from the landfilling zones. 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 can be deemed as not viable for dredging activities.

201. Furthermore, deep-sea dredging can impact the marine ecosystem by disturbing the benthos (dwelling on the seafloor), especially sessile organisms attached to seafloor/other physical structures (ESIA-NSEZ-2019, Christiansen[42] et al. 2020, Helmons[43] et al. 2022), therefore needs to avoid deep-sea areas for dredging. The depth of the seafloor locations may lead to erosion; therefore, soil condition, erosion, and geology suggest avoiding these sites for dredging.

202. Similarly, the dredging sources sites (L) L-10, L-11, and L-12 are not suitable due to sites L10 - L12 are close to the predicted as Hilsa breeding ground, and if it is true, should be ecologically sensitive habitat, Although, our study did not find such evidence after sampling for biodiversity analysis at those sites (Islam[44] et al., 1987; Hossain[45] et al., 2014). Furthermore, locations L-11, and L-12 are close to the confluence, that rich in marine biodiversity that makes infeasible for dredging sites also.

203. The distance of dredging locations to the land development site is also considered. The downstream (**L** no 1, 2, 3, 4, 11, 12**)** are far away from the part of Precinct F (IMD Zone12-13, Zone 5, Zone 18) landfilling site, will not suitable be liable for dredging activities **(Figure 5-10**). 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.

[42] , Christiansen, 2020, Potential effects of deep seabed mining on pelagic and benthopelagic Biota. https://doi.org/10.1016/j.marpol.2019.02.014

[43] Helmons et al. 2022, Dispersion of Benthic Plumes in Deep-Sea Mining: What Lessons Can Be Learned From Dredging, 10.3389/feart.2022.868701

[44] Islam et al. 1987, Hilsa fishery in Bangladesh in 1985–1986. Hilsa Investigations in Bangladesh. FAO-UNDP Project on Marine Fisheries Resource Management, BOBP/Rep/36, 46–63 (Bay of Bengal, Colombo, Sri Lanka).

[45] Hossain et al., 2014, Discovering spawning ground of Hilsa Shad (Tenualosa ilisha) in the coastal waters of Bangladesh 10.1016/j.ecolmodel.2014.03.001

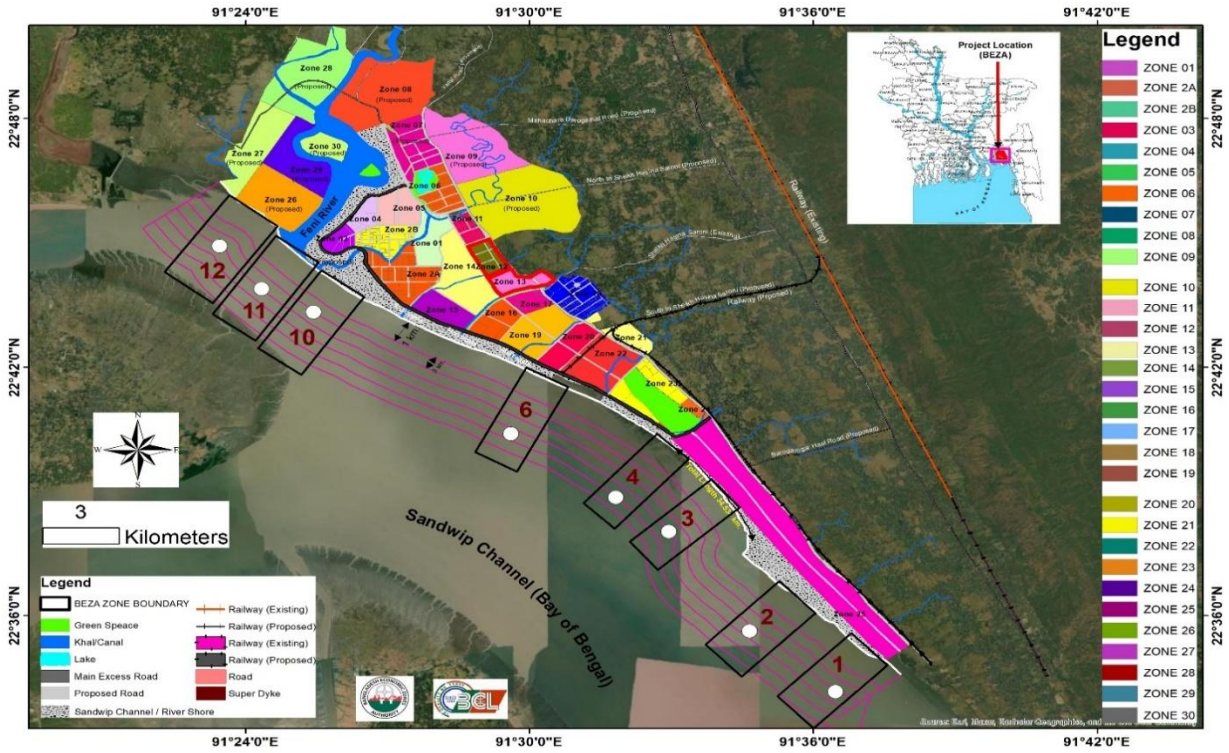


Figure 5-10 : Unsuitable dredging source locations under Option 1

5.2.3.2. OPTION-2: SUITABLE LOCATIONS FOR DREDGING

204. After screening in line with the ecological points, physical environmental, and morphological views, multiple locations instead of single locations were selected for dredging due to considering the sediment availability all year round. In this case, four (4) out of 12 locations were identified as potentially suitable for dredging sources, considering low significant impacts on the marine ecological biodiversity, physical environment, short distance from the landfilling site, and other factors due to the dredging activities for the landfilling. These four locations are Sites .L-05, L-07, L-08, and Site L-09 on Sandwip Channel and are considered as Option 2. The average distances of all Zones of the proposed sub-project from the Dredging Locations are depicted in **Figure 5-11**.

Ecological Assessment

205. Among these 12 locations, the suitable four locations 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 is present because species diversity is higher in the estuarine mouth compared to that of its upstream direction. It is obvious because organisms prefer estuarine habitats,
- This part of the Bay of Bengal has high turbidity of water and soft bottom strata that are not suitable for the growth of seaweed (Environmental Impact Assessment Report (EIA-BSMSN-2_addendum_24092020[46]), may avoid impact on seaweed growth,
- Though some researchers have predicted Sites 8-10 are Hilsa breeding for Hilsa fish (Islam et al., 1987; Hossain et al., 2014 [47]) but our study did not find any evidence of a breeding ground for Hilsa fish, which is an ecologically sensitive habitat. Nonetheless, this study suggests giving special attention while conducting dredging. Therefore, Sandwip Channel in the Bay of Bengal, including some sampling points (e.g., 5, 7, 8, and 9) has been considered for a marine biodiversity survey, including benthos and fish breeding ground samplings as the representative covering both upstream and downstream of the channel.
- According to the Fishery department information, the predicted Hilsa spawning zone is primarily located at the confluence of the Bay of Bengal and the Feni River, approximately 5 km away from the nearest dredging

[46]BEZA (2020) Environmental Impact Assessment Report (EIA) Report of NSEZ-2 (Addendum) Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh

[47]Hossain, M. Shahadat & Sarker, Subrata & Chowdhury, Sayedur & Sharifuzzaman. 2014. Discovering the spawning ground of Hilsa Shad (Tenuous ilisha) in the coastal waters of Bangladesh. Ecological Modelling. 282. 59–68. 10.1016/j.ecolmodel.2014.03.001.

location L-09. The Mayani point at Mirsharai, another Hilsa breeding zone in the Shaerkhali canal, is silted. Notably, this point is also upstream inside the Mirsharai, about 5.32km away from the nearest suitable dredging location L-05 in the Sandwip Channel (Error! Reference source not found.). Therefore, no negative i mpact is anticipated due to carrying out dredging activities in the Sandwip channel at the downside of the Mayani point Hilsa spawning ground.

- During dredging operations in the dredging sites 9, 8, 7, and 5, sediment movement is likely to be from the upstream area to the downstream site, and consequently, the breeding site is expected to remain unaffected by the dredging activities in these areas.
- Very few species of birds were found in the sub-project site (ESMF[48], 2020 and BSMSN EIA and SIA[49](2019) that may have less impact on sea birds,
- No sensitive aquatic species like dolphins are reported in the Channel/river to stretch within a 10 km radius of the EZ site (EIA report Feni 2020[50]),
- Deep sea dredging can impact the marine ecosystem by disturbing the benthos (dwelling on the sea floor), especially sessile organisms attached to the seafloor/other physical structures), therefore avoiding deep sea areas for dredging and
- At the downstream (sites no 1, 2, and 3) and upstream sites no 11 and 12 are far away from the sub-project site landfilling site, and will not be liable for dredging activities.

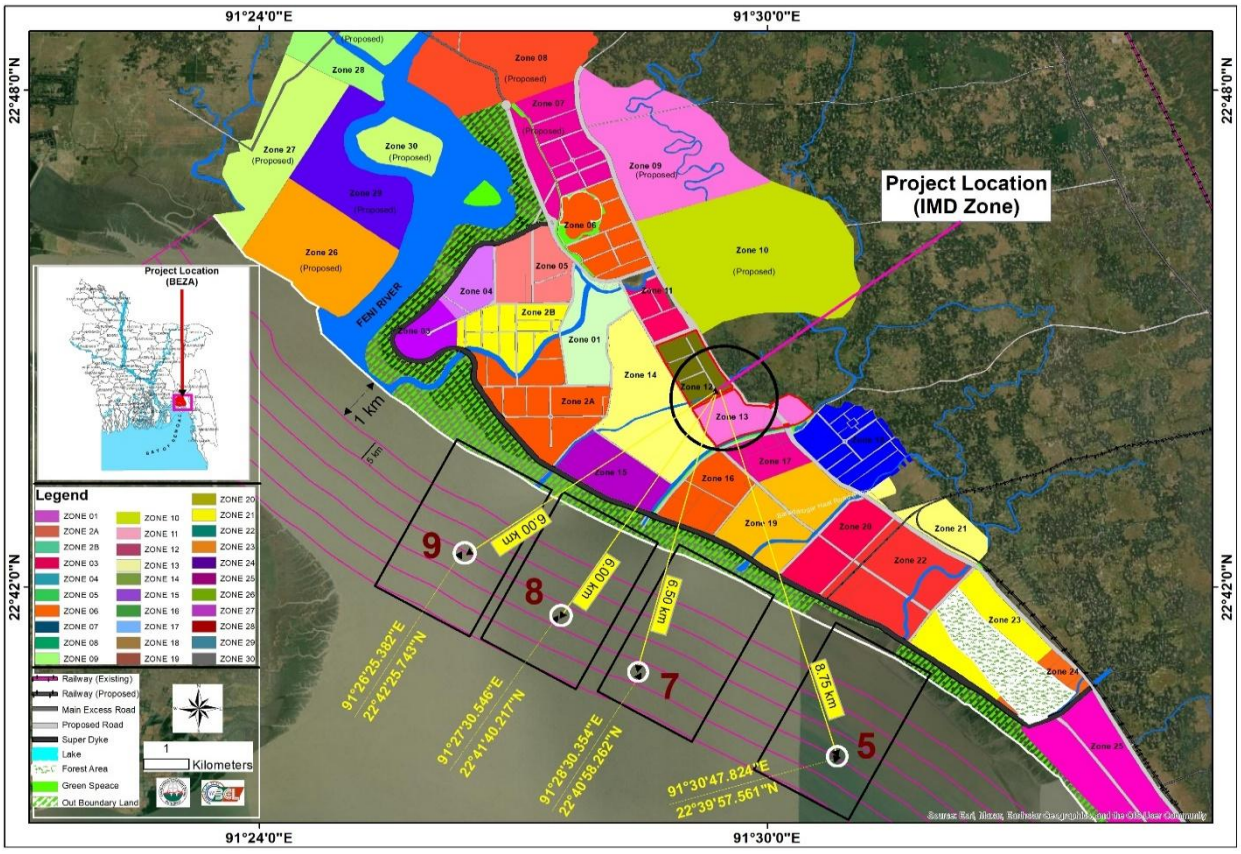


Figure 5-11: Suitable Locations of dredging locations under Option 2.

206. According to the Fishery department information, the predicted Hilsa spawning zone is primarily located at the confluence of the Bay of Bengal and the Feni River, approximately 5 km away from the nearest dredging location L-09. The Mayani point at Mirsharai, another Hilsa breeding zone in the Shaerkhali canal, is silted. Notably, this point is also upstream inside the Mirsharai, about 5.32km away from the nearest suitable dredging location L-05 in the Sandwip Channel (Error! Reference source not found.). Therefore, no negative impact is anticipated due to c arrying out dredging activities in the Sandwip channel at the downside of the Mayani point Hilsa spawning ground.

[48] BEZA (2020) Environmental and Social Management Framework (ESMF). Bangladesh Economic Zones Authority Prime Minister's Office
[49] BEZA (2019) Social Impact Assessment (SIA) of Mirershorai Economic Zone, Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh
[50] BEZA (2020) Environmental Impact Assessment Report of Feni Economic Zone, Bangladesh Economic Zones Authority (BEZA), Prime Minister's Office, Government of the People's Republic of Bangladesh

207. During dredging operations in the dredging sites 9, 8, 7, and 5, sediment movement is likely to be from the upstream area to the downstream site, and consequently, the breeding site is expected to remain unaffected by the dredging activities in these areas.

5.2.3.3. COMPARISON OF TWO OPTIONS

208. Comparison in terms of environmental, social, and Economic Aspects of the two options is as follows

Table 5-3 : Comparison Between Environmental and Socioeconomic Aspects of Two Options

Issues	Option-1: (Unsuitable for dredging)	Option-2: (Suitable for dredging)
Economic Analysis:	Comparatively costly, time-consuming, and requires less dredging material lifting since the average sea bottom depth is 6.6 meters, the average distance from the shore is 2.075 kilometers, the average distance from the IMD Zones is 11.447 kilometers, etc.	It is relatively inexpensive, takes less time, and lifts more dredge materials because the average sea bottom depth is 4.7 meters, the average distance from the shore is 1.825 kilometers, the average distance from the IMD Zones is 6.248 kilometers, etc.
Environmental Analysis:	Site/L-1, site-2, site-3, site 4 are at the most downstream from the sub-project locations.	Site/L-5, 7, 8, and 9 are in the downward direction also, but near the sub-project Zone s areas.
	Site/L 10, 11 and 12 are located near the predicted Hilsa breeding grounds, so ecologically sensitive habitats should be avoided at these sites for dredging.	Sites L-05, L-07, L-08, and L-09 have been thoroughly evaluated, and dredging activities will not have significant impact on eco-habitat of these four locations, including the important Hilsa breeding ground. This assessment supports the ongoing commitment to environmental stewardship and responsible site development.
	Deep-sea dredging can impact the marine ecosystem by disturbing the benthos (dwelling on the seafloor), especially sessile organisms attached to the seafloor/other physical structures	Dredging at shallow depths may not have a significant effect on the marine environment or other marine life. because the majority of marine life naturally inhabits deep-sea regions.

5.2.4.AN ALTERNATIVE ANALYSIS OF FOUR SUITABLE LOCATIONS UNDER OPTION 2

209. To identify the most suitable dredging location out of four identified locations under Option-2, an alternative analysis was carried out based on collected primary data and secondary data on the physical environment and social environment, particularly marine ecology as well as social issues at all proposed locations. For the identification of dredging locations and the landfilling activities in the sub-project area, the following Valued Components (VC) are considered based on the baseline conditions. After screening in line of the ecological points, physical environmental, and morphological view, four out of 12 locations were identified as potential for dredging sources considering less significant impacts on the marine ecological biodiversity, physical environment, short distance from the landfilling site, and other factors due to the dredging activities for the landfilling These four locations are Site/L No. 5, Site No. 7, Site No. 8 and Site No. 9 in Sandwip Channel and considered as Option 2, Baseline of the four suitable locations.

5.2.4.1. PHYSICAL ENVIRONMENT

5.2.4.1.1.SANDWIP CHANNEL BOTTOM ELEVATION

210. The Sandwip Channel bottom elevation for four locations is presented in **Figure 5-12**. The consultant has prepared a Contour Map and DEM (Digital Elevations Model) from this bathymetric survey data.

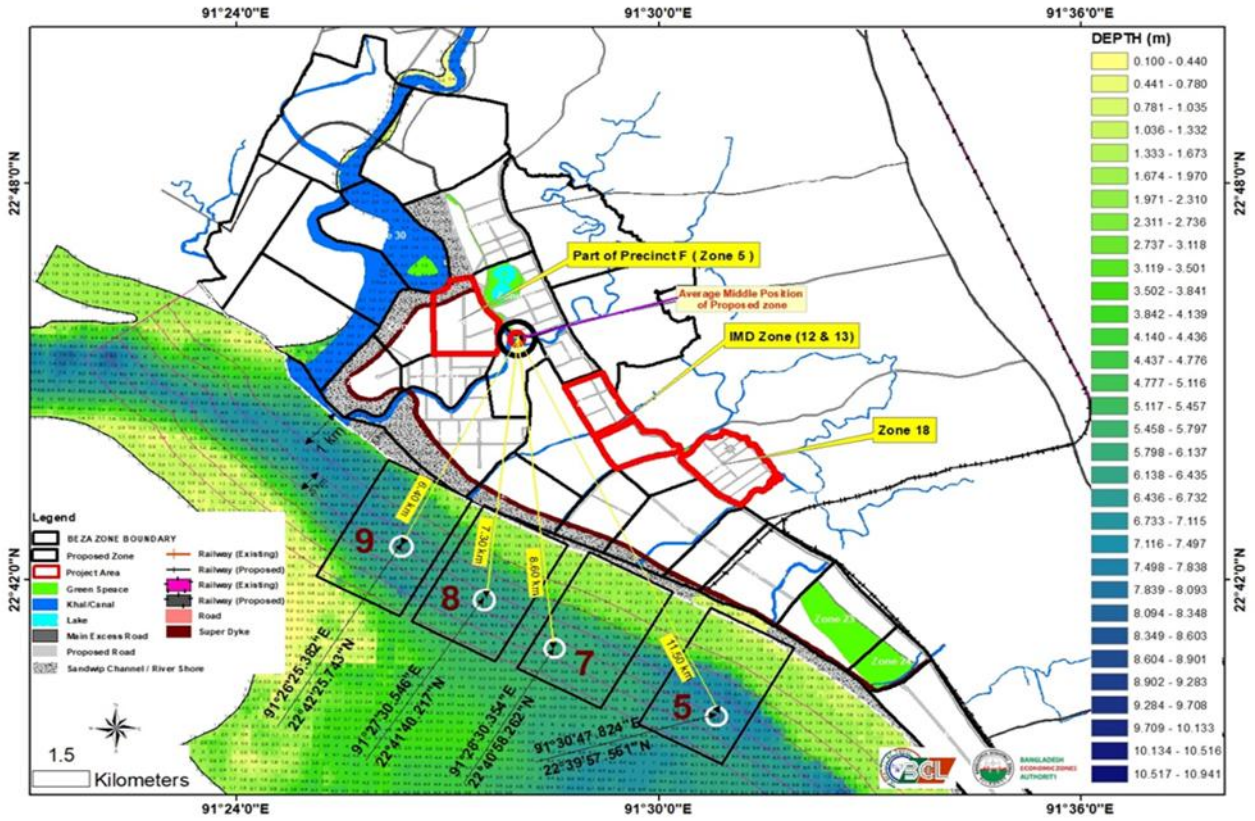


Figure 5-12: Sandwip Channel Bottom Elevation for Four Locations

5.2.4.1.2.SURFACE WATER QUALITY

211. Surface water samples from four probable dredging locations were collected after preliminary screening and identifying suitable locations for dredging sources. These four locations represent different areas where dredging activities could be done within the Sandwip Channel, allowing for a comprehensive analysis of the water quality across the channel. The surface water analysis results were compared with the Bangladesh Standards (ECR, 2023) and the findings indicate that all parameters adhere to the national standard limits, whereas many parameters for surface water are not standardized in ECR, 2023. Detailed discussions on water quality parameters are provided in Chapter 5.

212. Tested results indicate the recorded temperature across all the locations ranged from 24.7 to 25.3 degrees. The highest TSS concentration was identified at 903mg/l in the L-09 and the lowest was 403mg/L in L-05 from the Sandwip Channel. Electrical conductivity (EC) levels varied from 27300 to 27500 µS/cm at L08 and L05 respectively. The maximum turbidity, reaching 683 NTU, was observed in the L-09. The pH values ranged from 7.9 to 8.0, complying with the standards outlined in the Bangladesh ECR 2023 - Schedule 2 (Standards for Inland Surface Water, Water Usable for Fisheries). The turbidity also causes existing contaminations to spread further into the waterbody which also affects the marine environment adversely. Dredging operations in the sea are expected to increase surface water turbidity, which will impact the composition of the soil beneath the surface. The increased turbidity will be detrimental to underwater life since it will release excess and under-watered nutrients. Salinity levels ranged from 16.9 ppt at L-09 to 16.6 (L-05 and L-09. The COD and BOD values were found to be within the stipulated standards of the Bangladesh ECR, 2023. Cadmium and Zn concentrations in all collected samples were below 0.001 mg/l and 0.05 mg/l, respectively. The concentrations of Hg, Pb, and Cd for all collected samples adhered to the standards set by the Bangladesh Environment Conservation Rules, 2023 - Schedule 2. Furthermore, the numbers of total coliform for all samples were found to be less than 1.8, indicating the value of total coliforms within the standard.

5.2.4.1.3.CHANNEL-BED SEDIMENT QUALITY

213. The sediment samples' test results indicate four different types of textural classes: silty clay, silty clay loam, loam, and clay loam. Clay texture percentage varies from 22.87% to 43.64%, silt texture varies from 38.32% to 53.91%, while sand texture varies from 2.46% to 33.94% according to the test results. The percentage of clay in the textural classes is under 50%. The sediment. test results exhibit Zn concentrations in the sediment samples ranged from 24.3 mg/kg to 35.3 mg/kg, with the highest and lowest levels observed at L-07 (Sandwip Channel) respectively. Copper values ranged from 17.1 mg/kg to 23.3 mg/kg in the collected samples, with the highest concentration found

in the L-07 sample from Sandwip Channel. Mercury levels were consistently below 0.001 mg/kg for all locations. The highest concentration of Lead was observed in the L-07 sample at Sandwip Channel (9.91 mg/kg), while the lowest was recorded in the L-05 sample (8.58 mg/kg). Cadmium values were consistently below 0.001 mg/kg in all collected samples. However, the analysis findings indicate that the levels of heavy metals in the collected sediment samples are within the recommended toxicant default guideline values. Therefore, all sediment samples from the different locations are free from heavy metal toxicity and will not impact the sub-project areas due to landfilling.

5.2.4.2. ECOLOGICAL ENVIRONMENT

214. The Marine Ecological Assessment was carried out at four selected sampling sites, aiming to cover both upstream and downstream areas of the channel. The details of the marine ecological assessment are described in Chapter 4 and **Appendix 1**, **B 3, Volume II**. The findings of this baseline assessment are briefly described in below:

- Plankton (phytoplankton and zooplankton) and benthic macroinvertebrates (hereafter benthos) constitute the base of pelagic and benthic food webs, respectively in estuarine ecosystems. Therefore, plankton and benthos communities were assessed along the river-estuary-coastal continuum and 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. The phytoplankton density varied from 279-1659 cells L^{-1} with the highest count observed in the Sandwip channel. The phytoplankton density at all sites were very low compared to other reports from surrounding or nearby estuaries. This study recorded 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.
- The zooplankton density almost followed the spatial pattern of phytoplankton. The notable finding in this study is that the density of small-size zooplankton was very low. It could be due to low productivity as suggested by phytoplankton, or due to unfavorable conditions created by high suspended particulate matter (SPM) resulting from dredging or other activities. A total of 19 taxa (families) of soft-bottom macrobenthos were recorded of which 14 families were identified over the four sampling sites. The mean abundance (individual/m^2) 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 in abundance than that of St 9.
- The benthos communities were dominated by the polychaetes, followed by crustaceans, which is typical of the ecosystem of similar regions. Among the recorded samples, there was no keystone species or endemic species. 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. Overall, phytoplankton and zooplankton abundance and composition suggest that L 5-9 is low productive and has a similar pelagic ecosystem structure. The Muhuri Reservoir is already very low in pelagic and benthic faunal abundance. None of these sites had any plankton or benthos declared as ecologically critical. The mid areas of the Sandwip Channel could be the most suitable place for dredging.
- Wildlife observation was done focusing on the morning and evening when wildlife is most active. The study identified 82 species, including 4 mammals and 78 bird species from all types of habitats (mangrove forests, mudflats, and offshore areas). This study indicates that no ecologically sensitive habitats were detected within the study area and that the project's dredging interventions are not impacting them.
- The sub-project area is the home of several aquatic biodiversity and biological resources, especially for migratory birds. Every year, some wetland aquatic birds visit the study area. So, aquatic birds should be another environmental component for the study area. However, almost all species of birds are of least concern and do not qualify for conservation importance.
- A study showed[51] that at local scales, tributary junction sites/ confluence might be ecologically important and even act as biodiversity hotspots due to their supplemental nutrients and energy are supplied, the juxtaposition of distinctive environments enhances the ecological processes, water quality, hydraulics, and channel morphology are atypical and there is enhanced environmental heterogeneity. Whereas at larger scales, confluences are locations where water-borne tributary inputs and main-stem geomorphological adjustments are most acute. Confluences are therefore important sites of longitudinal discontinuity that contribute to the landscape-scale structure of lotic ecosystems. The ecological importance of confluences has long been recognized the physical changes associated with tributary confluences; however, the physical changes can be associated with ecological changes. Therefore, in this ESIA study, the distances of the four suitable dredging sources from the Sandwip Channel - Feni River / Muhuri River confluence are considered. The longest distance

[51] The Ecological Importance of Tributaries and Confluences, September 2008, In book: River Confluences, Tributaries and the Fluvial Network (pp.209 - 242)DOI:10.1002/9780470760383.ch11,

of the confluence site is 13.99 km from L-05, and others are 9.99 km from L-07, 7.91km from L-08, and 5.81 km from L-09 locations, as shown in **Figure 5-13**Error! Reference source not found. Therefore, the dredging activities will have a lower impact on marine biodiversity at location L5 than at the other three locations, comparatively.

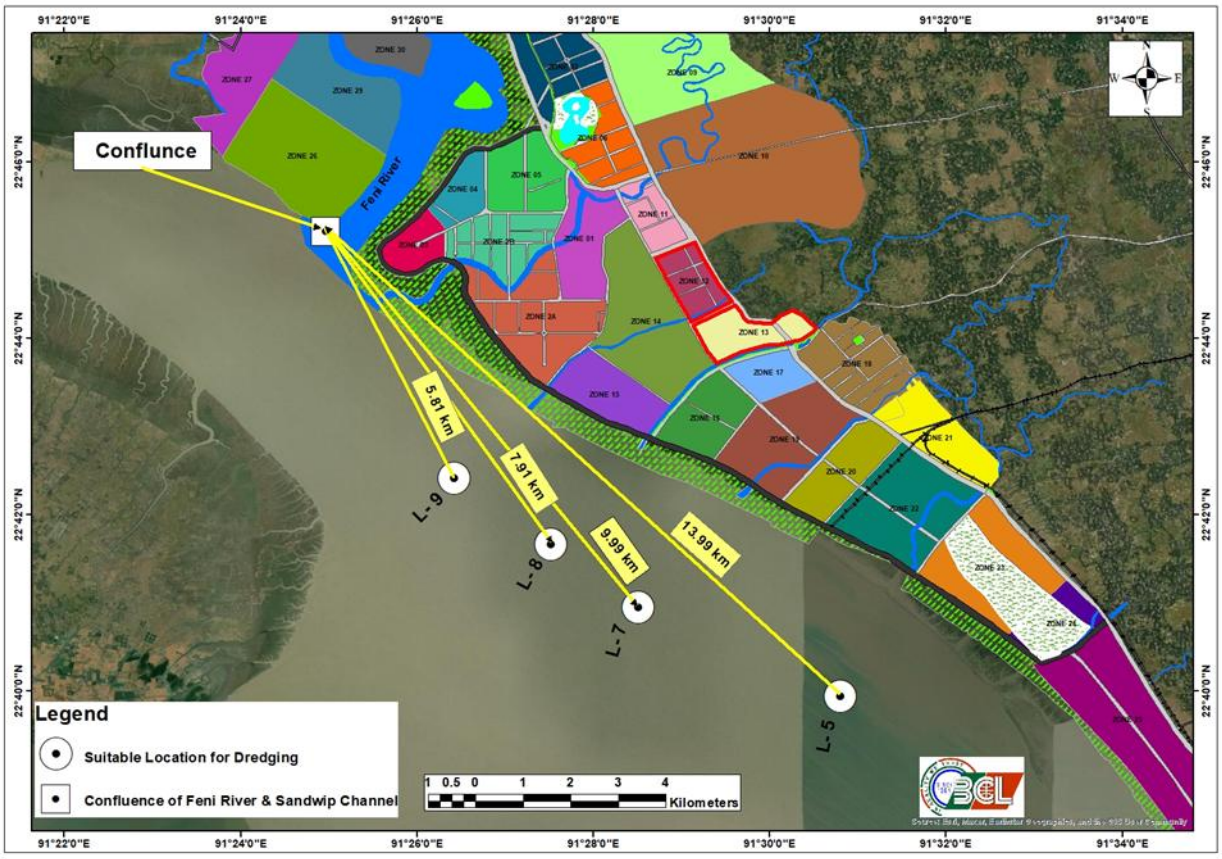


Figure 5-13: Distances of Four Suitable Dredging Sources from the Sandwip Channel-Feni River / Muhuri River Confluence

5.2.4.3. COMPARISON OF FOUR SUITABLE LOCATIONS

215. A comparative analysis between the proposed four suitable locations under Optio-2 is carried out, following the Leopold Matrix to evaluate the impacts on the four locations. The analysis shows that the summary of EIV's highest weighted scores is 80 for L-5, 61 for L-7, 48 for L-8, followed by 43 for L-9, as shown in **Table 5-4**. According to comparative analysis, it may be concluded that the L-5 is the best dredging location compared to other three locations (L-7, L-8 and L-9) in terms of less impacts on marine biodiversity and other factors, mainly because of highest distance of this location from Sandwip-Feni confluence compared to other locations, as well as it is far away from the predicted Hilsa fish breeding ground has less detrimental effects and is viable.

Table 5-4 : Alternative Analysis of Four Suitable Dredging Locations under Option-2

Environ. Aspects (a)	Environmental Parameters(b)	Activities (c)	Relative Importance Value Wi= (d)	Location L-5			Location L-7			Location L-8			Location L-9		
				Key observation/ indicator (e)	Vi (f)	EIV g=(dxf)	Key observation/indicator (i)	Vi (j)	EIV, k=(dxj)	Key observation/ indicator (l)	Vi (m)	EIV, n=(dxm)	Key observation/ indicator (O)	Vi (p)	EIV Q=(dxp)
Physical Environment	Degradation/ change of lands use or land cover	Degradation of lands use due to improper dredging pipelines sitting. Possibilities of obstruction and interference with other infrastructure development, road networks	2	Distance of dredging source to IMD zone=6.65 km	-1	-2	Distance of dredging source to IMD zone=6.57 km	-1	-2	Distance of dredging source to IMD zone=4.97 km	-2	-4	Distance of dredging source to IMD zone=4.55 km	-1	-2
	Channel bottom Depth	Channel bottom Depth (m) impacts on dredging activities5	1	6.7	-2	-2	5.8	-1	-1	6.2	-2	-2	6.3	-1	-1
	Distance from shoreline	Distance from shoreline (km)	1	2.5	-2	-2	2.7	-3	-3	2.25	-3	-3	2	-4	-4
	Soil Erosion and Impact on channel bank	Channel Bank erosion	2	Stable for Super Dyke	-2	-4	Stable for Super Dyke	-4	-8	Stable for Super Dyke	-4	-8	Stable for Super Dyke	-4	-8
	Surface water pollution	Surface water pollution due to dredging activities and disposal of generated waste and oil/ chemical mishandling during dredgers operation	2	Number of canal and water body crossing (4)	-2	-4	Number of canal and water body crossing (4)	-2	-4	Number of canal and water body crossing (4)	-2	-4	Number of canal and water body crossing (4)	-2	-4
	Sandwip Channel sediment qualities	Presence of Heavy metals; Zn, Cu, Pb, Cd as toxicity)	5	Not toxicity level	5	25	Not toxicity level	5	25	Not toxicity level	5	25		5	25
	Ground water pollution	Pollution groundwater due to leakage of dredging pipelines	2	Pollution from leakage of dredging pipeline	-1	-2	Pollution from leakage of dredging pipeline	-1	-2	Pollution from leakage of pipeline	-1	-2	Pollution from leakage of pipeline	-1	-2
	Ambient air quality deterioration	Air quality deterioration (movement of heavy vehicles and equipment) and sand dust generation based on the distance of the dredging source location to sand filling areas	2	Length of route=6.65 km	-2	-4	Length of route= 5.57 km	-2	-4	Length of route: 4.97 km	-2	-4	Length of route= 4.55 km	-2	-4
	Noise generation	Movement of Heavy vehicles and equipment within distance of the dredging source location to sand-filling areas	1	Length of route=6.65 km	-2	-2	Length of route= 5.57 km	-3	-3	Length of route: 4.97 km	-3	-3	Length of route= 4.55 km	-2	-2
	Drainage congestion	Possibility of soil erosion channel embankment sliding during dredging activities	3	Length of route=6.65 km	-1	-3	Length of route= 5.57 km	-1	-3	Length of route: 4.97 km	-1	-3	Length of route= 4.55 km	-1	-3
	Obstruction or may damage the of Super Dyke	Dredging pipelines may damage Super	2	2 km away from Super Dyke	-1	-2	2 km away from Super Dyke	-1	-2	2 km away from Super Dyke	-1	-2	2 km away from Super Dyke	-2	-4
	Exposure to flooding	Overflow of drainage water due to drainage congestion during dredged material filling at site	2	Length of route=6.65 km	-1	-2	Length of route= 5.57 km	-3	-6	Length of route: 4.97 km	-3	-6	Length of route= 4.55 km	-3	-6
	Subtotal (A)		**25**			**-4**			**-13**			**-16**			**-15**

Ecological	Loss of terrestrial flora	Loss of Vegetation during construction dredging pipelines and labor camp	3	Length =6.65 km	-1	-3	Length of route= 5.57 km	-1	-3	Length: 4.97 km	-1	-3	Length of route= 4.55 km	-1	-3
	Disturbances of birds /avifauna	Due to dredging activities like dredger operation	4	Length of route=6.65 km	-1	-4	Length of dredging route= 5.57 km	-1	-4	Length of route: 4.97 km	-1	-4	Length of route= 4.55 km	-1	-4
	Fish Resources	Disturbances of Fish resources during the operation of dredgers	6	Length of route=6.65 km	-1	-6	Length of route= 5.57 km	-1	-6	Length of route: 4.97 km	-2	-12	Length of route= 4.55 km	-2	-12
	Marine Ecology (aquatic flora and fauna)	Impact on Benthos, zooplankton, and phytoplankton at the bottom of the channel bed.	6	Length of route=6.65 km	-2	-12	Length of route= 5.57 km	-2	-12	Length of route: 4.97 km	-2	-12	Length of route= 4.55 km	-2	-12
	Distance from the Muhuri Reservoir (Feni River) to Confluence of Sandwip channel	Disturbance of aquatic/ marine biodiversity for dredging activities, since at the confluence, biodiversity is rich and dynamic.	6	Location distance from the confluence =13.99 km	-1	-6	Location distance from the confluence =9.99 km	-2	-12	Location distance from the confluence =5.81km	-3	-18	Location distance from the confluence =6.65 km	-3	-18
	Impact on the predicted Hilsa breeding ground	Dredging activities	5	No Breeding ground observed	0	0	No Breeding ground observed	0	0	No Breeding ground observed	-1	-5	No Breeding ground observed	-1	-5
	Subtotal (B)		**30**			**-31**			**-37**			**-54**			**-54**
Social Issues	Disturbances of communities	Disturbance due to dredged pipeline installation e.g., barriers to access, roads, and fishing activities	4	Sub-project site	-1	-4	Sub-project site	-1	-4	Sub-project site	-1	-4	Sub-project site	-1	-4
	Labor Influx and Working Conditions	Labor required for construction of dredging pipeline	4	Sub-project site	-2	-8	Sub-project site	-3	-12	Sub-project site	-2	-8	Sub-project site	-2	-8
	Occupational Health and Safety	During construction works (operation dredgers, dredging pipeline fixing and related works, etc.)	8	Entire sub-project site	-2	-16	Entire sub-project site	-2	-16	Entire sub-project site	-2	-16	Sub-project site	-2	-16
	Public safety/accidents	Movement of Heavy vehicles and equipment through the local road	3	Entire sub-project site	-3	-9	Entire sub-project site	-3	-9	Entire sub-project site	-2	-6	Entire sub-project site	-2	-6
	Employment Generation	Labor required for construction of dredging pipelines and associated works	8	Entire sub-project works	8	64	Entire sub-project works	8	64	Entire sub-project works	8	64	Entire sub-project works	8	64
	Traffic and Transport improvement	Increased traffic volume due to the development of internal road networks	4	Entire sub-project site	7	28	Entire sub-project site	7	28	Entire sub-project site	7	28	Entire sub-project site	7	28
	Construction cost	The construction cost of dredging pipelines installation, land development, construction yard and construction labor camps	6	Length of route=6.65km	-2	-12	Length of route=5.57km	-2	-12	Length of route=4.97km	-2	-12	Length =6.55km	-3	-18
	Development of lands for infrastructure	Industrial and housing Infrastructure will be developed	8	Entire Sub-project area	9	72	Entire sub-project site	9	72	Entire sub-project site	9	72	Entire sub-project site	9	72
	Subtotal (C)		**45**			**115**			**111**			**118**			**112**
	Grand Total = (A+B+C)		**100**		**0**	**80**			**61**			**48**			**43**

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5.2.5.ANALYSIS OF DREDGING MATERIAL AVAILABILITY FROM EACH SUITABLE LOCATION

216. To determine how much dredging is possible from the bed level of the Sandwip Channel, Bangladesh, it is essential to follow a structured approach using bathymetric data and GIS analysis tools such as ArcGIS. This document outlines the requirements, methodology, and tools needed for accurate volume estimation.

217. To calculate dredging volume using the following data.

– **Bathymetric Data or Digital Elevation Model (DEM):** Raster (GeoTIFF, IMG) or TIN format showing the existing bed level. Obtainable from BIWTA Hydrography Department /from custom surveys.

– **Design Dredging Level:** The target depth (e.g., -5.0 m PWD) to be achieved through dredging.

– **Channel Boundary Polygon:** Defines the area of interest where dredging will occur.

218. **Methodology in ArcGIS**

Method 1: Cut and Fill Analysis (Raster-Based) in ArcGIS Spatial Analyst toolbox**:**

– Load the bathymetric raster into ArcGIS (representing current bed levels).
– Create a raster of the design dredge level using Raster Calculator, e.g.: Con(Is Null("Bathymetry"), NULL, -5.0).
– Use the Cut Fill tool from Spatial Analyst Tools > Surface > Cut Fill.
– The tool calculates cut volumes (material to be dredged) and fill volumes (if any).

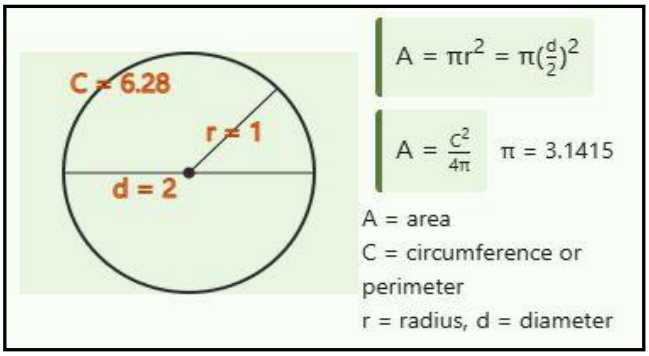
Method 2: TIN-Based Volume Calculation as uses 3D Analyst's Surface Difference tool.

– Convert bathymetric point data into a TIN surface.

– Create a flat design TIN surface at the target dredge depth.

– Use the Surface Difference tool from 3D Analyst Tools > Functional Surface > Surface Difference.

– The tool outputs the volume difference between existing and design surfaces.

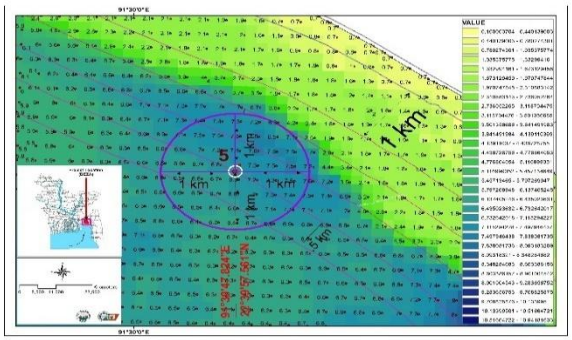


219. The estimated dredged material volume would be a total of 70.74MCum from the cutting up to a depth of 5 m. Whereas the 35,37 MCum would be available from the cutting up to 2.5 m depth dredging, as shown in Table 5-5 and the Values and Elevation Values of the four Suitable Locations are shown in **Figure 5-14.**

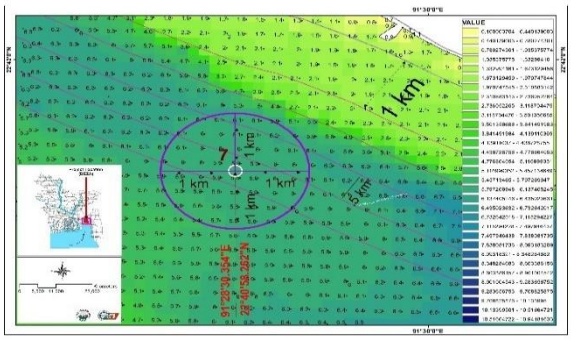
Table 5-5 : Estimated Dredged Materials Quantity can be Excavated from Four Locations

Suitable Locations No	Dredged Material Volume (Cum) up to 5 m Excavation	Dredged Material Volume (Cum) up to 2.5 m Excavation
Location L-5	18,039,945	9,019,973
Location L-7	17,307,073	8,653,537
Location L-8	17,481,254	8,740,627
Location L-9	17,908,553	8,954,277
Total	70,736,825	35,368,413

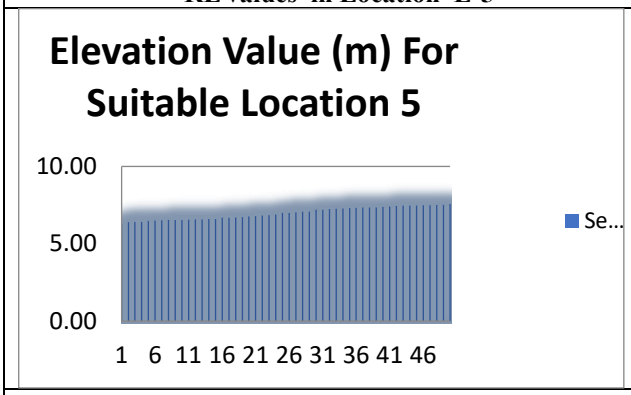
220. Therefore, two locations will be required for dredging if the depth is up to 2.5 m. Whereas one location is fairly sufficient if dredged filling materials are excavated from 5m for the landfilling the target areas.



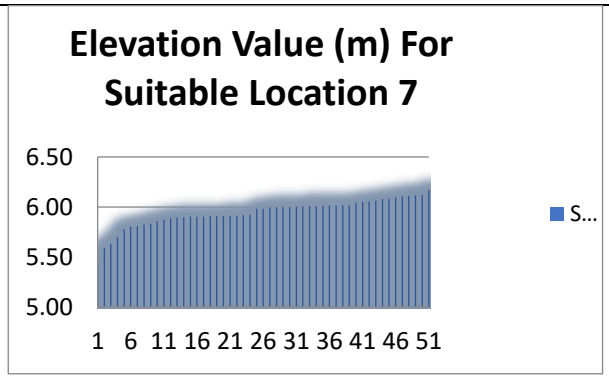
RL values in Location L-5



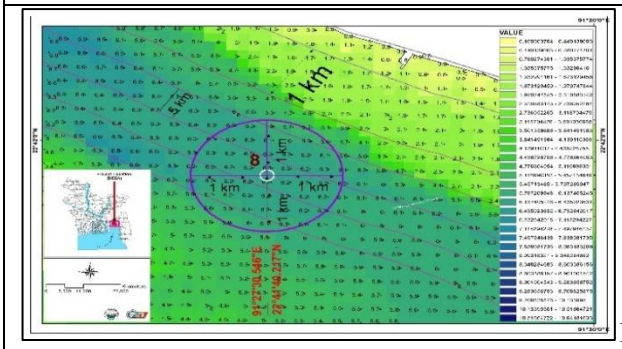
: RL values in Location L-7



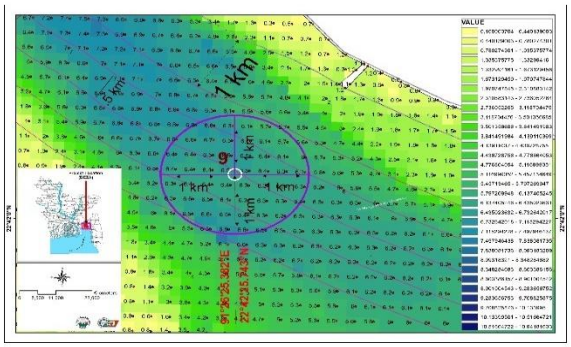
RL values in Location L-5



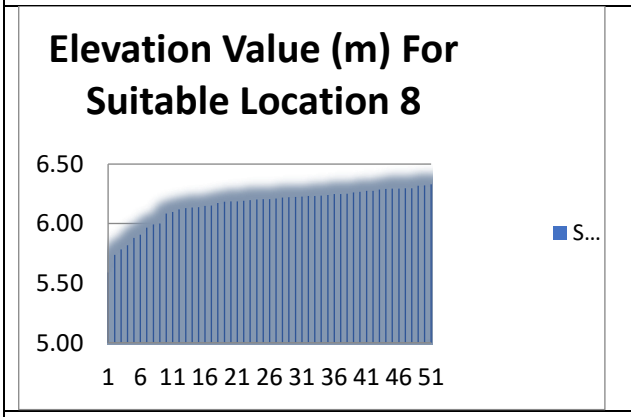
RL values in Location L-7



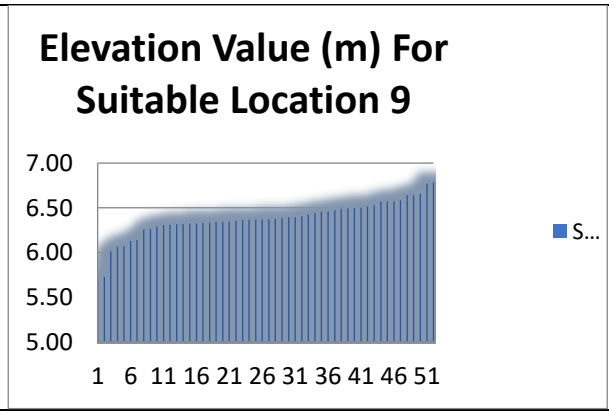
RL values in Location L-8



RL values in Location L-9



RL values in Location L-8



RL values in Location L-9

Figure 5-14:RL Values and Elevation Values for Four Suitable Locations

221. The Calculation Sheet is presented in **Appendix 13, Vol II**

5.2.6.OPTION-3 'NO SUB-PROJECT SCENARIO'

222. No Project would allow the area to be established as an Economic Zone, there might be random development without any plan. No possibility of job opportunities increasing, existing areas will remain as fellow land or utilized char land. 'Without the sub-project, local people's professions will remain the same. Without the sub-project, the environmental impact would be the same, and there would be no implications on the social impacts.

223. Without Project Alternative, this report was based on the situation before starting the development work of the zones. The 'With project' scenario is considered the construction of land development. A comparison between the 'without project' and 'with project' scenarios is shown in the table below:

Table 5-6:"Without Sub-project" and "With Sub-project" Scenarios

Aspects		"Without Project" Scenario	"With Project" Scenario
Technical Aspect	Development planning of the area	Random development might be implemented without any plan for overall land development. Then, the future development plan might be restricted after disorderly development	The Economic Zone would be developed efficiently by the planned land development plan.
	Distribution of industries	The distribution of industries would have been sporadicand haphazard.	A well-studied and eco-friendly Master Plan has been prepared, and clustering of industries(light/ medium & heavy), and zoning of other supportive facilities such asresidential, educational,health, administrative, institutional, open Space, etc. will be developed
	Utility and network	There is no possibility of road, transport, gas, water supply, internet, and mobile network on under-development land/ low-lying lands	EZ development will require a power plant, substation, and power grid distribution network. Moreover, gas supply and associated road infrastructure will be available
	Green industrialization	The concept of green industrialization would not have been considered in the caseof unplanned and haphazard land development.	Resource-efficient and green industries will be able to establish the followinginternational norms and guidelines.
Economic Aspect	Employment	Job opportunities would not increase from the current situation	Job opportunities would increase for the local communityduring the construction phase of the Economic Zone.
	Profession	No need to change the occupation of the local people	Local people will have an opportunity to increase theirskills by changing theirprofession based on the demands of the industries
	Infrastructural Development	Infrastructural developmentof the entire area would be limited.	Plannedand systematic developmentof railways, access roads,waterway communication, educational facilities, health facilities, and different utilityservices such as water supply, gas supply,telecommunication, and power supply would be on developed land
	National economy	The national economic development of this entire area would be limited.	Large industrial development by local & foreign investors and thousands of job holders will contribute to national economic growth.
Environmental and Social Aspects	Environment	The impact on the natural environment due to existing farming and aquaculture will not be significant	Impact on the naturalenvironment and pollution caused by the constructionwork would occur.
	Social	The impact on the social environmentcaused by the development of EZ will not occur.	Impact on the socialenvironment (road accident, social conflict, Communityhealth and safety) caused bythe construction work
	Living environment	The living environment of the adjoining area of NSEZ will not improve	The living environment for residents would be enhanced due to the development of the surrounding infrastructure.
	Source of labor	The main source of labor is local residents.	In with project conditions,major sources of labor will be from migrant workerscoming from across the country.

5.3. ALTERNATIVE ANALYSIS FOR THE DRAINAGE OPTIONS

224. Different types of drain systems will be considered. To manage the dredge spoil runoff and rainwater, four types of suitable drainage options have been considered in this sub-project. All of these drainage systems will be site-specific during the dredging. and can be implemented according to the drainage congestion site-specific requirements.

- Construction of a new embankment or ring dike
- Construction of diversion canal
- Construction of side drain
- Cross drain

225. Construction of new embankment or ring dike diversion channel, cross-drainage structures, and side drains, all four kinds of drainage need to be considered to manage drainage-related spoil runoff and huge rainwater. All four options or 2-3 options may be implemented according to the drainage congestion at the site-specific requirement. A detailed analysis of the implementation of the four options is carried out as follows

Table 5-7: Analysis of Drainage Options

	Brief Description
Construction of new embankment or ring dike	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., and this type of construction can be constructed in and around dredging sites to temporarily settle sediment.

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
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

Construction of diversion canal

There are numbers 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 easily been discharged by a diversion canal in Zone-7, and Zone-8 of the project. A typical Diversion Canal has been presented below:

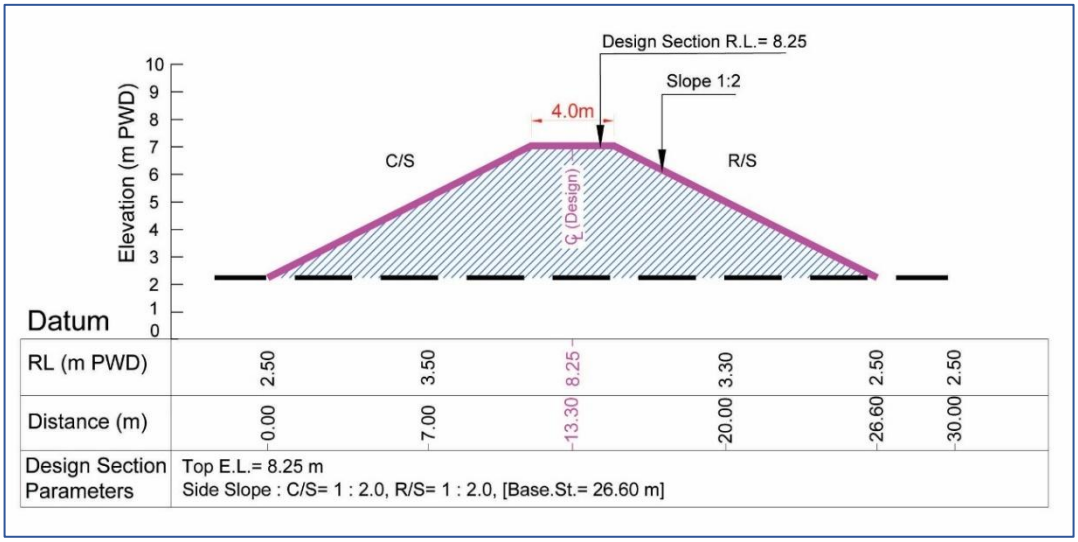
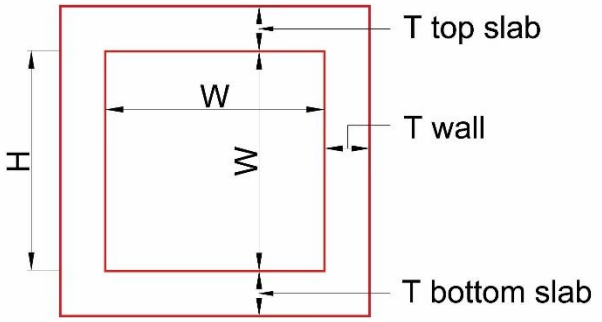
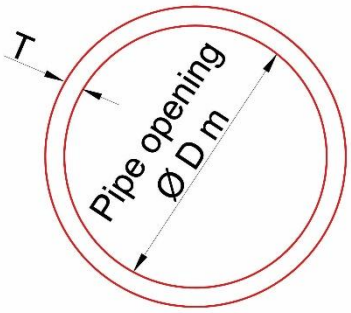
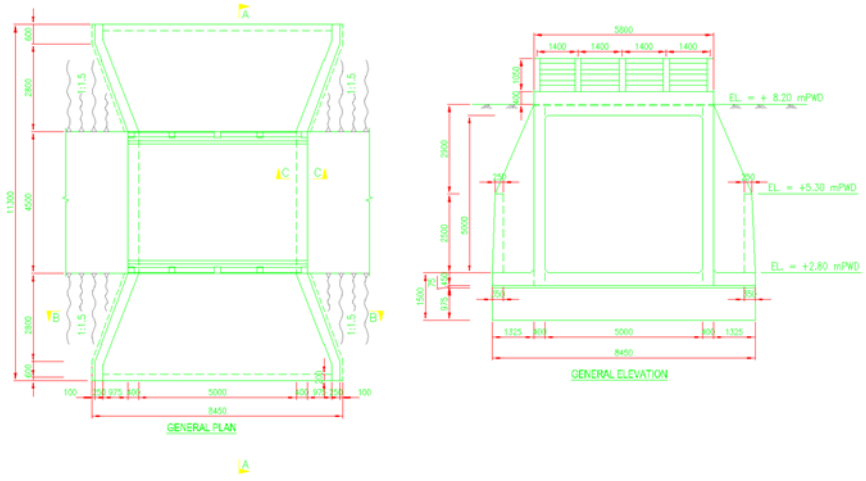


Figure 5-15: A Typical Embankment Section.

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 drain

Side drain construction may 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 a culvert, that discharges spoil runoff immediately to the desired destinations of surface water sources, it's an 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-5, they can easily discharge or drain out the rainwater and spoil runoff from the dredging sites. A typical cross-section of drains has been presented in the following design

	Brief Description	
	RCC DRAIN	**PIPE**
		
Cross Drain	If a Cross-drainage structure is made adjacent to the project areas (Zone-5, Zone-7, Zone-17, 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 generally a structure of culverts, or regulators, etc. The typical section of Culvert is given below	
		

5.4. ALTERNATIVE ANALYSIS OF DREDGERS

226. The selection of dredgers is based on a few factors that have implications on the selection of the plant and equipment for dredging. The key factors of the selection of a dredger are:

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

227. 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, the 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 zones either dredgers requiring only draft available are selected or dredgers that 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.

228. Similarly, wind waves and swells are the main meteorological and oceanographic conditions that affect the working of the dredger. The high wind may make anchoring the dredger and loading onto the barge operation difficult. The dredgers that are located using spuds are susceptible to waves, which may lead to damage of the spuds, spud carriages, and guides. Anchored vessels are less susceptible to the waves except 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 dredgers suffer a reduction of efficiency due to a lack of control of the excavation process and intermittent loss of contact of the cutting edge with the seabed and/or the relative motion between a barge and

the dredger if the barge is used for dumping of the dredged spoil.

229. Two types of hydraulic dredgers are mostly used in alluvial environments as follows,

- Hydraulic Trailing Suction Hopper Dredger and
- Hydraulic Cutter Suction Dredger.

230. The Technological aspect, environmental and social impacts'[52] for both dredgers' operation are presented in Error! Reference source not found..

Table 5-8: Dredger Options Analysis in Terms of Technological, Environmental and Social impacts' Consideration

Aspects	Trailing Suction Hopper Dredger	Cutter Suction Dredger
Technological Aspect and cost	❖This kind of dredger is practically a ship that, by the use of dredging equipment, can dredge the desired location and discharge into the ship's container and can sail it to release the dredge elsewhere. dredger can be used in deepening riverbeds in maintaining navigable waterways; to construct/raise new land or dredges can be dumped into the sea when spoil management becomes a problem either in-stream or on land. ❖The THSD has self-loading and unloading capacity; if required, a pressurized discharging aid can be equipped. As an operation procedure, one or two suction pipes have trailing suction heads connected to the end and descend onto the riverbed at desired dredging location. There are nozzles in the head for a high-pressure installation that are capable of loosening the bed material (sand). Since a vacuum is created inside the pipe, the dredge is sucked and conveyed into the holding vessel. As a discharging method, dumping is done somewhere else, usually into the sea. However, by pressing method – liquefying the dredge inside the hopper with high-pressure water, and discharge can be made possible over a long distance. ❖The trailer dredgers are normally rated according to its maximum hopper capacity, which is typically 750 to 10000 cum, but exceptionally may be larger. ❖It is a much higher cost and a complicated mechanism.	❖This Cutter Suction Dredger consists of a centrifugal pump and a suction tube with a 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 a transportation pipeline by design could be 2-3 km. However, by adding a booster pump to the pipeline, the dredge-spoil can be transported/dumped to a further distance. ❖These CSD are highly adaptable, as they can be equipped with a variety of blades and scoops designed to handle different types of materials, ranging from soft silt and sand to hard clay and rock[53]. ❖The cutter suction dredger is usually rated according to either the 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. ❖This is a simple and low-cost solution, but there are different types of CSD in varying production capacities and expensive
Environmental impact consideration	❖The main environmental concern is creating high turbidity caused by overflow from the hopper, since TSHD is a .mobile vessel that sails while dragging a suction pipe along the seabed to suck up loose material. ❖When vessel fills with dredged material, excess water is released, often with fine sediment particles, creating a sediment plume. This plume can travel long distances, reduce light	❖A major environmental impact is the direct disturbance of the seabed and the potential for a localized turbidity plume at the cutter head, since CSD is a stationary dredger that use a rotating cutter head to break up hard or consolidated soil before it sucks up ❖This plume is generally more contained than a TSHD's overflow plume, it can still release

[52] *International Association of Dredging Companies (IADC) and the Central Dredging Association (CEDA), The Netherlands*

[53] 8 most common types of dredgers and their applications, https://www.usdredge.com/learn/understanding-types-of-dredgers

	penetration, affect aquatic plant life, and potentially harm the marine ecosystem ❖It is less suitable for dredging contaminated sediment as they can cause wider dispersal and mixing of the material. ❖The noise from their operations can also be a concern for nearby marine life and coastal communities ❖TSHDs are also more effective at dredging loose material. But not dredge from hard packed material.	contaminants into the water column ❖The CSD is usually better suited for environmental dredging of contaminated materials because their precision allows for the removal of specific thin layers with minimal over-dredging, ❖It reduces the overall volume of contaminated material that needs disposal. ❖CSDs are also more effective at dredging hard-packed or consolidated soil materials, which TSHDs cannot do.
Social Impacts Consideration	❖It is self-propelled and doesn't require anchors or cables, so they don't significantly disrupt other vessel traffic ❖Its dredging and dumping activities, often in different locations, can affect communities and industries in both areas. For example, dredging for beach nourishment can protect coastal communities from erosion, while the disposal of dredged material elsewhere may impact fishing grounds ❖. TSHDs operate continuously, making them suitable for maintaining busy shipping channels and ports.	❖CSDs are less mobile and typically anchor in a specific location for an extended period. This can disrupt navigation and other water-based activities in the immediate area. ❖The dredged material is often transported through floating pipelines to a discharged location, which can also be an inconvenience for local boat traffic. ❖On the other hand, CSDs are often used for land reclamation and infrastructure projects, which can have significant long-term social benefits by creating new land for development

231. Analysis indicates that a cutter suction type dredger would be the more feasible option than TSHD in terms of technical and environmental and social impacts' consideration for the landfilling. A 32-inch cutter suction dredger can be considered that would not significantly increase the turbidity of the surface water during the dredging operation at the dredging location and will cause less harm to the marine ecosystem and surrounding environment. Furthermore, the detailed study on physical, ecological, and particularly baseline study of marine biodiversity indicated that environmental components may be impacted at a recoverable scale by sub-project dredging interventions at the proposed four locations in the part of Precinct F of the NSEZ, and most of the dredging will be about 200 m away from the shoreline. Therefore, a cutter suction type dredger would be the feasible option for both technical, environmental and social considerations.

232. There are different types of CSD with varying capacities of dredged material production in m/per hour, and some of them are presented in **Table 5-9** for the analysis. A tentative Plan is prepared to dredge and fill 15.85 million cubic meters (cum) of soil within 2 years using different capacities of CSD in the Sandwip Channel. It is noted the dredging operation must follow the government instruction on fish breeding time.

Assumptions:

- Working hours: 18 hours/day
- Working days/month: 26
- Total time: 24 months
- Includes pumping distance adjustment (2 km) for erosion control
- Production rates are gross estimates; actual rates depend on soil type, pumping distance, maintenance, and downtime
- All dredgers assumed to have pipeline discharge to filling site (no barge transfer)

Table 5-9 : Different Capacities of Production of Dredged Material by Using CSD

Machine Type CSD	Capacity (m^3/hr)	Daily Production(m^3/ day @ 18 hrs./day)	Monthly Production(m^3/ month @ 26 days)	Production in two years, m^3	Target Filling Volume, m^3	Number of Dredgers Required
Small CSD	500	9,000	234,000	5,616,000	15,850,000	2.77
Medium CSD	1,000	18,000	468,000	11,232,000	15,850,000	1.39

Machine Type CSD	Capacity (m^3/hr)	Daily Production(m^3/ day @ 18 hrs./day)	Monthly Production(m^3/ month @ 26 days)	Production in two years, m^3	Target Filling Volume, m^3	Number of Dredgers Required
Large CSD	2,000	36,000	936,000	22,464,000	15,850,000	0.69
Extra Large CSD	3,000	54,000	1,404,000	33,696,000	15,850,000	0.46

233. **Recommendation:** One small CSD with a capacity of 500 m^3 per hour and one medium CSD with a capacity of 1,000 m^3 per hour may be deployed to dredge to fill the target volume 15.85 MCum. If a large CSD operates and the dredging will be up to 5m deep in the channel, then one CSD is sufficient to dig the 15.85 MCm filling material from one location (Table 5-5). While considering distances of the proposed land development zones and cost for delivery pipelines the Contractor may do dredging from four suitable locations with shallow cutting depth following a safe sequence as shown in **Table 5-10** to avoid erosion as the immediate impacts of dredging operation.

Table 5-10: A Safe Sequence of CSD Operation with Shallow Cutting Depth to Avoid Erosion

Dredger number	Operation Year	Cutting Location	Dredge volume per month, m^3	Dredge volume per year, m^3
Dredger-1 (Medium CSD)	1st year	L-5	468,000	5,616,000
Dredger-2 (Small CSD)	1st year	L-8	234,000	2,808,000
Dredger-1 (Medium CSD)	2nd year	L-7	468,000	5,616,000
Dredger-2 (Small CSD)	2nd year	L-9	234,000	2,808,000
			Total	**16,848,000**

6. STAKEHOLDER ENGAGEMENT, CONSULTATION AND OUTCOMES

6.1. INTRODUCTION

234. Stakeholder communication and engagement is an important process to ensure the effectiveness, accountability, and transparency of any development program. Through the process of consultation and participation, people can participate in project activities, raise their voices, and give their opinions on project design, planning, and implementation. Environmental Social Standards (ESS10) discuss the importance of open and transparent engagement between project proponents and project stakeholders, according to the World Bank guidelines (ESS 10) and following the Stakeholder Engagement Plan, BEZA[54]. This section describes the different methods of consultations, public participation, and information disclosure that have been prepared and proposed guidelines for implementing the consultation process and stakeholders' engagement throughout the life cycle of the project, starting from design preparation to implementation. The E&S consultants held fresh consultations and incorporated their suggestions and recommendations into the project design.

235. Based on literature review, desk research, and meetings with BEZA, key stakeholders or informants have been identified who are currently playing pivotal roles in the smooth operation of the NSEZ. The stakeholders for land development within the part of Precinct F (IMD Zone and Housing Facilities) of NSEZ are both internal and external. However, as with many aspects of the technical, economic, environmental, and social compliance requirements are managed by stakeholders.

236. A tentative list of stakeholders for the economic zone is as follows:

- Key Government Agencies: Bangladesh Economic Zone Authority (BEZA), Bangladesh Export Processing Zones Authority (BEPZA), DPHE, DoF, BWDB, BIWTA, RHD, LGED
- Regulatory Bodies: Department of Environment (DoE).
- Utility service providers: Karnaphuli Gas Distribution Company Limited.
- Local Government Agencies: Mirsharai Upazila Parishad
- Local community, local elites, local government representatives, schoolteacher, students, women
- Scientific Agencies (Government): Bangladesh Meteorological Department (BMD),
- Labor forces (farmer, fishermen, business group, entrepreneurs, day labor)
- Non-government organization

237. This section describes the different methods of consultation, issues discussed with the stakeholders, outcome of the exercise. The consultant used the methods for consultations, public participation and information disclosure include stakeholder's consultation meetings; Key Informant Interviews (KIIs), Focus Group Discussions (FGDs); individual contact etc. Total from December 2023 to February 2024 for the preparation of the ESIA and disseminating relevant information of the sub-project, a numerous KII, FGD and public consultation was conducted.

6.2. OBJECTIVES

238. Consultation is a process through which stakeholders can participate in project planning and implementation. Public consultation and disclosure are crucial to the success of any development project. Through the consultation process, affected communities can raise their voices about the project, its impacts, and compensation policy and participate in project design and impact mitigation planning. The suggestion is to review the impact of the sub-project. Many kinds of problems arise while implementing a project. These problems can be tackled if the affected communities are properly informed and consulted about the project. Consultation ensures community participation and allows affected communities to make appropriate choices and choices. Public or community participation through the consultation process will establish transparency in project planning and implementation. Consultation is a two-way process where implementing agencies, policy makers, beneficiaries and affected individuals discuss and share their concerns in a project process.

[54] BEZA (2020) Stakeholder Engagement Plan for Private Investment and Digital Entrepreneurship Project (PRIDE) PART 1 - Bangladesh Economic Zones Authority, January 2020
https://documents1.worldbank.org/curated/en/468621582247161451/pdf/Stakeholder-Engagement-Plan-SEP-Bangladesh-Private-Investment-Digital-Entrepreneurship-Project-P170688.pdf

239. World Bank (WB) Environmental and Social Framework 2018[55] (ESS-10) is a high priority as public consultation and participation to enhance community voice and ensure inclusion of community views in social design and implementation.

6.3. APPROACH AND METHODOLOGY FOR STAKEHOLDER MAPPING AND ANALYSIS

240. **Identification of Stakeholders:** During the preparation of the ESIA study, all stakeholders are initially synthesized into two categories which are identified as:

- **Project-affected parties**: those who will be or are likely to be affected by the development in zone 12 and 13 and part of Precinct F of NSEZ are fully occupied by BEZA, but some squatters and people from the outside are grazing their cattle and fishing at Sandwip Channel.
- **Other interested parties**: those who may be interested in the project and who may positively or negatively influence the views of the affected parties or affect the sustainability of the implementation process or project outcomes.

241. Project stakeholders such as local people, landowners, house owners, civil society organizations, locally active NGOs, government officials, farmers, transport owners, women and vulnerable groups, fishermen etc. will be affected directly or indirectly during project construction due to labor flow and project construction activities.

242. A combination of mixed methods of information disclosure and consultation process was adopted at this stage of ESIA preparation. The method selected for consultation was basically designed keeping in mind the profile of the stakeholders, type of information desired, and level of engagement required. In each consultation session the consultant introduced themselves, introduced the project and the purpose of engagement with the respective stakeholder. The primary methods followed in the consultation process are:

- Key Informant Interview (KII)
- Focus group discussion (FGD)
- Stakeholder Consultation Meeting (SCM)

6.3.1.KEY INFORMANT INTERVIEWS

243. A total 12 KIIs with the BEZA and NSEZ staff, KGDCL, Upazila Parishad, Chairman, local elites, workers, labor, fishermen, religious leader, social institutions committee head /representatives of Mosque, Madrasah, Schools, College, and civil society, etc. along the project area were conducted. KIIs have been done for secondary stakeholders such as public administrators, local government representatives (Municipal Mayor, Councilor and UP Chairmen, Members), Local champions, influential personalities and other people who have stakes in the project. Two phone calls to KII were conducted with Mr. Enamul Haque PD of BEPZA and Mr. Tariqul Islam Sub-Assistant Engineer (SAE). Regarding the land development within the part of Precinct F (IMD Zone and Housing Facilities) of NSEZ and drainage issues of the canal, KIIs were conducted with DoF, DoE, BWDB, and BIWTA officials. **Details in Appendix 9, Vol II.**

Table 6-1: Names, Designation, Locations, and Date of the KIIs at the Sub-project Site

SL. No.	Name	Designation	Location	Date
1	Md. Rashadul Islam	Imam	Ichakhali Central Mosque Ichakhali Union Mirsharai, Chattogram	9.12.2023
2	Abdur Rab	School Teacher	Char Sarat Model High School, Mirsharai, Chattogram	9.12.2023
3	Protap Chandra Roy	Upazila Agriculture Officer	Mirsharai, Chattogram	11.12.2023
4	Md. Motasim Bella (Hafiz)	Farm Manager	Fish Seed Multiplication Farm, Mirsharai, Chattogram	11.12.2023
5	Md. Yunus Mia	UP Member,	Ward No-9, Maghadia Union, Mirsharai, Chattogram	11.12.2023
6	Md. Ferdous Wahid	Assistant Engineer (Civil) & Focal Person	National Special Economic Zone (NSEZ), Mirsharai, Chattogram	12.12.2023
7	Md. Shahadat Hossain	Manager	CODEC Abu Turab Branch Abu Turab Bazar, Moghadia Union, Mirsharai, Chattogram	12.12.2023

[55] The World Bank (2018) Environmental and Social Framework

SL. No.	Name	Designation	Location	Date
8	.Alomgir Hossen	Labor	Nippon Point	04.03.2024
.9	.Zohirul Islam	Labor	Nippon Point	04.03.21024
10	Md. Ibrahim Miah	Executive Engineer	NSEZ Development Project, BEZA	02.04.2024
.11	.Md. Nazrul Islam	Deputy Project Director	NSEZ Development Project, BEZA	02.04.2024
12	Md. Shahadat Hossain	Jr. Urban Planner (Consultant)	Bangladesh Economic Zones Authority (BEZA)	03.04.2024

244. The opinions were sought from the stakeholders, and their opinions are as follows

- Due to the economic zone, especially the residents of Moghadiya Union and Ichakhali Union were affected by the land acquisition by BEZA, had to move to another place after receiving the compensation.
- There will be some positive impact on society, for example, increased employment, development of the communication system, development of the business overall quality of life will be improved.
- The dredging activities will be in the part of Precinct F (IMD Zone and Housing Facilities) of NSEZ will be installed within the Economic Zone, so there is no problem for the local people. However, due to the dredging activity, some of the trees and vegetation, drains, and irrigation channels may be affected. Besides, many cows and buffaloes used to graze in the economic zone, which will not be possible anymore.
- BEPZA has blocked the Daborkhali Khal for their project infrastructure development. Daborkhali Khal is a government-recorded Khal and is open for all walks of people for different purposes like fishing, crab collection, and also aquatic resources collection by community people who are living in the surrounding area.
- Must monitor the activities to mitigate the social impacts due to labor influx.
- Proper mitigation measures should be considered for the damage to the drainage system/irrigation channels due to the dredging activity and the dredging pipeline installation.
- There may be a 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.
- Providing compensation if any family is affected. Employment of local people should be considered on a priority basis.
- No Hilsa ground exists at Mayani Point within Shaerkhali canal.
- The health & safety of all those working on the project must be ensured. Waste generation should be prevented.
- Training and employment of local people should be arranged on a priority basis.
- Usually, BIWTA is not authorized to give permission, but if the competent authority requires any opinion regarding dredging-related information, in that case BIWTA will give its opinion. NOC may be required before starting the dredging.
- Landfilling through seawater salinity intrusion may happen to the groundwater through leaching. During the construction of a structure, it should be taken into consideration that landfilling sand may not contain salt.

6.3.2.FOCUS GROUP DISCUSSIONS

245. The sub-project has considered in-depth information, comments/concerns, and feedback from the FGDs during the preparation of the ESMP. Details of the public consultation, participants list and pictures are included in detail in **Appendix 9, Vol II.** Fifteen Focus Group Discussions (FGDs) were conducted to disseminate and disclose information on the dredging activities of the land development sub-project under the NSEZ Development Project and to know their opinions about the proposed sub-project from December 2023 to February 2024. The key objectives of these FGDs included informing the stakeholders, particularly the local communities about the proposed interventions and soliciting their views, concerns, and recommendations concerning the sub-project and its impact

246. The FGDs were conducted people with particular emphasis on different groups such as disadvantaged/vulnerable people including the daily Laborers group, Farmers group, Fishermen group, Businessmen group women at separate locations as shown in **Table 6-2**.

Table 6-2: List of Focus Group Discussions with Different Groups

Name of Group	Location	Date
Local Community	Shop of Mosharaf Member, Charsarat, Mirsharai	9.12.2023
Local Community	Member's office, Dabarkhali Point, Charsarat, Mirsharai	9.12.2023
Business Group	Ichakhali Sluice Gate Bazar, Charsarat, Mirsharai	10.12.2023
Local Community	Shop of Saiful Islam, Dabarkhali Point, Mirsharai	10.12.2023
Farmer Group	Shop of Bellal Hosen, sariatpara, Moghadia, Mirsharai	11,12.2023
Women Group	House of Mafij Saudagor, Bodiullahpara, Mirsharai	11.12.2023

Name of Group	Location	Date
Fishermen Group	House of Shishuram Das, Sarkerpara, Abuturab Bazar, Mirsharai	12.12.2023
Women Group	Besides Eunus Member's house, Sariatpara, Mirsharai	13.01.2024
Students (School Boys) Group	Badiullahpara Primary School Field, Mirsharai	13.01.2024
Labor Group	House of Soleman near Noyapara Jame Mosque, Mirsharai	23.01.2024
Local Community	House of Shukur Ali near CP point, Mirsharai	24.01.2024
Fishermen Group	Misir Ahmed's house near Ahmed Member's house, Badiullahpara, Mirsharai	25.01.2024
Students (School Girls) Group	Charsarat Model High School, Mirsharai	25.01.2024
Women Group	Ekramul Haque, Charsarat housing, Mirsharai	14.02.2024
Local Community	House of Tarek, Charsarat, Mirsharai	14.02.2024

247. Some issue-specific opinions and recommendations received from the FGD sessions are briefly presented below.

- The community will benefit from the economic zone, such as employment opportunities will increase, business areas will increase, the communication system will be better, etc.
- A lot of job opportunities will be created here, and many people from outside will come to this area to work in the sub-project area, so our business will be better
- Communication and development will be improved because of the economic zone, as a result, the businesses will expand, and women will be empowered
- They have no objection to the dredging from Sandwip Channel to the sub-project. Because there is no agricultural land, fish culture, or roads between the Economic Zone and the Sandwip Channel
- Fishermen do not know where the Hilsa breeding ground is located in the Sandwip channel alongside the NSEZ study area.
- The issue of filling up the canal by BEPZA is going to pose threats to the local farms as the water will have no way to flow and may flood the land.
- The safety and security of female labor are to be ensured at the construction yard during the construction phase.
- When people are asked about gender-based violence, they reply that there are very few incidents of violence. It is to be noted that the main reason for such a type of violence is its non-harmonious relationship with in-laws, dowry, drug addiction, illicit relationships, eve teasing, etc. Usually, attempts are made to resolve the problem at the family level, and if it is beyond their control, they go to law enforcement agencies for justice. However, they requested to take strong initiative to stop the violence against local women during construction work. It was informed to them that a Grievance Redress Mechanism (GRM) has been developed in the RAP of the project to prevent such incidents and ensure good governance
- They ask to engage the poor and vulnerable people in the construction work
- Livelihood restoration issues for the poor and poorer need to be considered
- Ensure Skill development training for the poor, rehabilitation, loan facility on easy terms, etc.
- Many people will come from outside to work in the sub-project area, and we may have conflicts with them. And people who come from outside can be involved in various types of crime, such as theft, robbery, intoxication, etc. Therefore, the proper precautionary measures should be taken by the NSEZ
- Employment of local people should be arranged on a priority basis
- The community people are also looking for employment in the BEZA project work to enhance their livelihood quality during the construction phase.
- There will be a positive impact on society, increased employment, development of communication systems, development of business, and overall, the quality of life will be improved.

6.3.3.STAKEHOLDER CONSULTATIONS

248. Two public consultation meetings were conducted at Moghadia Union Parishad in the Hall room and in the Charsarat Model High School in Ichakhali Union Parishad on 16/01/ 2024 and 12/02/2024, respectively. Both Union Parishad chairmen presided over public consultation meetings with the presentation of Dr. Tajul Islam as part of the environmental and social consultant focusing on sub-project activities, and anticipated impacts due to dredging activities of the IMD Zone, including Zone 5 and 18 under the NSEZ Development Project. Among prominent participants, UP members, teachers, political personalities, and people from various professions in the area were in the consultation meeting.

249. In the first meeting, 53 participants, and in the second meeting participants were 28. Only 10 women

participants attended the two meetings. The reason for the low participation of women in the meeting may be due to their daily schedule of house chores such as cooking, cleaning, mopping etc. Social and cultural taboos and the location of the meeting could also be a reason for absenteeism. Some female participants attended the meeting and after a while, they went back to their urgent work**.** The stakeholder consultation attendance list and photographs are shown in **Appendix 9, Vol II.**

250. A discussion at an open forum was arranged where the stakeholders expressed their opinions and views. They also provided remedial suggestions on adverse environmental and social issues. The outcomes of the Stakeholders' Consultation Meetings are as follows **(Table 6-3).**

Table 6-3: Summary of the Public Consultations

Date-12/02/24	Participants	Demand and Suggestions	Responses /incorporated in the ESMP
Moghadia Union Parishad	Participants-Total 53 Male-46 Female-7	Due to the economic zone, especially the local people of Moghadia Union are affected. The size of the land has been reduced due to the acquisition of land for this Economic Zone. Landfilling of the sub-project will also damage the grazing lands, so wants job opportunities in this sub-project activities.	Upazila Agriculture Extension Officer said after land acquisition, if a portion of land is left then vegetables can be grown there.
		As a result of dredging, the fish will not be available in the dredging location during the dredging period and fish will moved away. Those who fish in the Sandwip Channel are poor and helpless, so they should be compensated and try to create alternate livelihoods.	BEZA authority will try to create alternate livelihoods within the project activities according to their abilities and expertise. Especially labor can recruit from them.
		Those who lived on government land have become homeless and their source of income has become very low. They have to compensate properly and provide them with alternate livelihood.	The Social Expert said, BEZA has made a list of victims and BEZA will give priority to the family in this list if he has any support (e.g., house, job). He also said that everyone should try alternative livelihoods.
		Housing facilities must be provided for those who are losing their homes. The homeless in this area should be rehabilitated properly.	BEZA has made a list of victims and BEZA will give priority to the family if require any support (e.g., house, job).
		The homeless in this area should be rehabilitated. Priority should be given to the local people in case employment is based on their qualifications. Priority should be given and encouraged to the local woman for employment.	These issues are prioritized by the BEZA authorities.
Date-12/02/24		**Demand and Suggestions**	**Responses /incorporated in the ESMP**
Charsarat Model High School	Participants Total: 28 Male: 25 Female: 3 (Appendix 9, Vol II)	The participants raised their concerns about environmental and social issues such as pollution from construction activities. Such as air pollution, noise pollution, groundwater and surface water pollution. Dense dust/sand generation will be in the entire location, as well as drainage congestion and flooding	Proper mitigation measures will be considered during dredging activities. Mitigation measures for controlling the dust generation, noise pollution and surface water pollution from the dredging activities are incorporated in the ESMP.
		The land filling of the canal Daborkhali -has become a major concern for the locals, as due to the lack of a canal, the water may drown the local farmlands. Drainage congestion will occur at the site	The consultant has shared with the Client this particular issue of the landfill of the Daborkhali canal being done by the BEPZA and assured that this concern will be shared with the appropriate authority. After consultation with BEPZA, it came to know that this filled-up canal will be excavated soon for restoration.
		Participants raised points on Labor Health and Safety (LHS), and community health and safety.	Occupational Health and Safety Management Plan and Labour Management Plan will be

Date-12/02/24	Participants	Demand and Suggestions	Responses /incorporated in the ESMP
			implemented for the mitigation of these issues.
		Other issues include local-level involvement and employment opportunities, and safety issues.	Local labor would be a priority during dredging activities.

6.3.4.ENVIRONMENTAL AND SOCIAL IMPACTS ISSUES DISCUSSED

A. Environmental Impact Assessment and Mitigation Measures.

251. The following issues and their mitigation measures were discussed in the KII, FGD, and Stakeholder meetings.

Table 6-4: Environmental and Social Concerns, and Suggested Mitigation Measures

Issues Discussed	Suggested Mitigation Measures
Environmental and Social Issues	
Noise Pollution	The sound level should be within the acceptable/tolerable limit during the dredging activities and land reclamation construction period
Dust pollution	Dust generated from the movement of vehicles and the dredging location during windy conditions will be minimized.
Occupational Health and Safety (OHS)	Occupational health and safety (OHS) measures include providing PPE, first aid boxes, sanitization, and sanitation to the workers
WASH and Drinking Water at labor camp	Supply of potable water and separate latrine facilities for male and female workers will be ensured at the labor shed
GBV and SEA/SH and Gender equity	Gender-based violence (GBV) and sexual exploitation, abuse, and harassment will be strictly controlled through the appropriate measures. Gender equity to be ensured
Drainage	Smooth drainage of stormwater and proper drainage facilities will be provided along the side of the road within Precinct F (IMD Zone, Zones 5 and 18)
Biodiversity	Proper steps to be taken to save the terrestrial flora and fauna and to uphold biodiversity in the locality, particularly
Hilsa fish breeding ground	No Hilsa breeding ground exists within the Sandwip Channel study area. But it would be well to restrict the dredging operation during fish breeding sessions.
Land acquisition and resettlement Impacts	No land acquisition is required in this stage; all the land is owned by the BEZA.

B. Social and Resettlement Impacts, Risks, and Mitigation Measures:

252. Due to this sub-project implementation, there will be no economic displacement and physical displacement, since there is no acquisition of land, private built-up settlement, market, shops, etc. required. . All the land is owned by the BEZA, so no resettlement issues in this land preparation sub-project. Only a handful of potential female participants were also invited to attend the stakeholder consultation meeting. A few matters and issues related to Gender-Based Violence (GBV) and gender equity were discussed with the participants, and the provision of the Grievance Mechanism.

253. **Grievance Mechanism:** Considering the overall need for the sub-project period, BEZA will establish a Grievance Redress Mechanism (GRM) to address complaints and grievances throughout the lifecycle of the sub-project following the PRIDE Stakeholder Engagement Plan. The purpose of the GRM is to record and address any issues that may arise during the life cycle of the project period effectively and efficiently. To receive complaints, grievances, and remedies over the issues concerned, a grievance redress mechanism (GRM) shall be established, likely adhering to the World Bank's Environmental and Social Standards, particularly, ESS-10 focuses on information disclosure and stakeholder engagement, which aligns with the need for a GRM. The establishment of a GRM is crucial in ensuring accountability and addressing concerns raised by workers and stakeholders. The PMU is likely responsible for sub-project implementation and collaboration between project management and grievance redress activities. The GRM is intended to address issues and complaints in an efficient, timely, and cost-effective manner. The mechanism will, however, not bar an aggrieved person from going to the courts of law. A separate mechanism will be available for labor-related issues under contractors and subcontractors. Project-affected people in the PRIDE project and any other stakeholders may submit comments or complaints at any time by using the project's Grievance Redress Mechanism (GRM).

254. The GRM is designed to address concerns and complaints promptly and transparently with no impact (cost, discrimination) on any reports made by project-affected people (PAPs) and the complainants. The GRM works within

existing social and resettlement management frameworks, providing an additional opportunity to resolve the grievances at the local level, the PIU level, and the NSEZ level. Necessary signposts/billboards would be placed at the central places/places where people gather to share detailed information about the GRCs at every level (community level, project level, BEZA Level during the implementation and operation, industry level, NSEZ level, and BEZA level).

255. **GRM-NSEZ contact information:** Information on the sub-project and future stakeholder engagement programs will be available on the website- NSEZ-BEZA and will be posted on information boards in the sub-project office, villages, Union Parishad office, and Upazila Office. Information can also be obtained from NSEZ-BEZA offices in Mirsharai and Dhaka.

6.4. COMMUNICATION STRATEGY AND PLAN FOR CAPACITY BUILDING OF THE LOCAL COMMUNITY

256. The NSEZ would implement a communication strategic plan to enhance the capacity building of the local community to qualify for employment opportunities within the NSEZ (National Special Economic Zone) development. By focusing on skill development, training, and community engagement, the project aims to empower residents, ensuring they can actively participate in employment opportunities generated from the sub-project and benefit from the economic growth generated by the NSEZ. Involving the local community for capacity building regarding job creation in the NSEZ areas. The key objective of this plan is to

- Identify and provide training programs that align with the employment needs of the NSEZ.
- Collaborate with local technical educational institutions to enhance curriculum offerings that prepare students for careers in sectors relevant to the NSEZ.
- Foster a sense of ownership and involvement among community members in the NSEZ development process.

257. **Needs Assessment:** BEZA should conduct a thorough needs assessment to identify the specific skills and qualifications required by employers within the NSEZ. This will involve:

- Surveys and interviews with local businesses and potential employers.
- Focus groups with community members to understand their aspirations and current skill levels.

258. **Training Programs:** Based on the needs assessment, develop targeted training programs that may include:

- Vocational training in trades relevant to the NSEZ.
- Workshops on soft skills such as communication, teamwork, and problem-solving.
- Digital literacy programs to prepare community members for technology-driven jobs.

259. **Partnerships with Technical Educational Institutions:** Establish partnerships with local technical schools/colleges, and vocational training centers to:

- Update curricula to include courses that align with the skills needed in the NSEZ.
- Create internship and apprenticeship opportunities for students within the NSEZ.

260. **Community Awareness Campaigns:** Conduct awareness campaigns to inform the community about-

- The opportunities available within the NSEZ.
- The importance of skill development and education in securing employment.

261. **Monitoring and Evaluation:** Implement a monitoring and evaluation framework to assess the effectiveness of the training programs and community engagement initiatives. This will include:

- Regular feedback from participants.
- Tracking employment outcomes for community members who complete training programs.

262. **Recruitment of a Third Party by BEZA:** The procurement process is underway to appoint a firm for the implementation of the Social and Skill Development Program of the NSEZ. The appointed firm will have a lot of responsibilities, and one of the major responsibilities is consulting with stakeholders regarding the relevance of the sub-project, the findings of the ESIA, and the feasibility study. They will conduct rigorous stakeholder consultations in the project area relating to adverse impacts due to dredging and land development activities, such as

- Landfilling of the sub-project, whether it will damage the grazing land or not
- Impact on fishing, leading to fish migration to other areas
- Impacts on Hilsa Fish
- Potential reduction of irrigation water for local farmlands and
- Drainage congestion likely occurs at the site, etc.

263. It is recommended that the selected firm should ensure all relevant information about the mitigation measures

to minimize the adverse impacts reported in the ESIA study should be properly communicated to the local communities through consultations such as KII, FGD and the stakeholder consultation process. The summary of the environmental and social concerns raised during ESIA consultations, feedback from the stakeholders and suggested mitigation / design measures is presented in **Table 6-4**. In addition, the appointed social and environmental councilors of the NSEZ must monitor these issues through consultations with stakeholders and regular observations with cross-checking.

264. A Stakeholder Engagement Plan (SEP) should be followed according to the Stakeholder Engagement Plan (SEP) of the PRIDE[56] This plan provides a framework for identifying, communicating with, and involving stakeholders throughout the project lifecycle. It recognizes that open communication, transparency, and capacity building are crucial for building trust, mitigating potential conflicts, and ensuring the project aligns with community needs and priorities.

Table 6-5 : Stakeholder Engagement Plan

Sl. No.	Types of consultation	Participant types	Duration/schedule	Remarks
1	FGDs (Focus Group Discussions)	Local people, workers, and contractors' staff	Quarterly	Meeting minutes should be recorded.
2	KIIs (Key Informant Interviews)	PIU of NSEZ, BEZA officials, local DOE officials, local Fire Service and Civil Defence officials, local forest department officials, local UP members/Chairman and other relevant personnel as required.	Semi-annually	Meeting minutes should be recorded.
3	KIIs	Local people, sub-project affected community who are facing problems regarding fishing, Hilsa Fish, drainage congestion, etc.	Weekly	Meeting findings/raised issues should be recorded.
4	Public Consultation Meetings	PIU of NSEZ, BEZA, contractor's people, local community, local UP members/ chairman, Local administration, local NGOs, Local DOE, Forest Department and Fire Service and Civil Defence officials and others as required.	Yearly	Meeting minutes should be recorded.
5	Face to Face interviews (F2F)	PIU of NSEZ, BEZA, contractor's people, local UP members/ chairman, Local administration etc.	Yearly	Meeting minutes should be recorded.

6.5. INFORMATION DISCLOSURE

265. Primary information on the project was disclosed verbally (without any formalities) in the initial public consultation process during the studies on safeguards. It is essential to continue this consultation process to ensure that the community remains supportive and fully informed of progress, particularly before and during the construction period. Furthermore, the community will be given information on the grievance redress mechanism, and regular meetings with the community will be held in the future. Once the project has been awarded to the contractor and the dredging activity program has been defined, further community meetings must be held to provide details of the construction program and to give information on the grievance redress committee. Thus, the consultation process will remain an integral part of project management and implementation.

266. **Disclosure of ESIA**: The approved ESIA will be disclosed on the BEZA and World Bank external websites. Many of the community may not have access to the internet, therefore, face meetings and hard copies of the ESIA report and its summarized form in English and Bangla language must be made available to the local communities or other interested stakeholders. Both summarized reports will briefly present (i) the Project impacts; (ii) mitigation measures and entitlement matrix; (iii) grievance redress mechanisms, and (iv) the institutional framework for project implementation.

[56] Stakeholder Engagement Plan for Private Investment and Digital Entrepreneurship Project (PRIDE) PART 1 - BEZA, January 2020 https://documents1.worldbank.org/curated/en/468621582247161451/pdf/Stakeholder-Engagement-Plan-SEP-Bangladesh-Private-Investment-Digital-Entrepreneurship-Project-P170688.pdf

7. ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

7.1. INTRODUCTION

267. This chapter of the report classifies and forecasts the potential environmental and social impacts due to the various planned activities in the project area of influence for the land development of Part of Precinct F (IMD zone and Housing Facilities) of NSEZ. The impacts have been evaluated with respect to the nature of impact (i.e., direct or indirect), spatial nature (i.e., local or widespread), temporal nature (i.e., long-term or short-term), and likelihood of occurrence. Finally, the significance of impacts has been categorized into a qualitative scale defined by the nature of work for each category. The following sections describe all the potential impacts during the construction or dredging landfilling phase of the sub-project on physio-chemical (water resources, land resources, agricultural resources, fisheries resources, ecosystem resources), biodiversity and ecology; and socio-economic environment in and around the project area. During the construction phase, the impacts may be observed as temporary or short-term.

268. The construction phase will involve site clearance, labeling & filling activities for the development of land of Part of Precinct F (IMD Zone and Housing Facilities) Zone at NSEZ. The PIU of NSEZ, BEZA plans to level & fill the activities of the land of Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ in order for the land to be flood resilient. Related to land development impacts would be mitigated by the Contractor, PIU of the NSEZ.

7.2. IDENTIFICATION OF IMPACTS

269. The project's planned and unplanned activities have been evaluated for their potential impacts to interact with social and environmental resources. The interaction of a scoping matrix offers a methodical process to identify the potential environmental and social impacts (positive or negative) associated with the sub-project activities. The impacts were assessed during the land development works. The matrix outlined in the Scoping results of anticipated environmental and social risks of the project activities based on the World Bank's ESS (1-10).

7.3. IMPACT ASSESSMENT METHODOLOGY

270. Environmental and social risks were evaluated through scoping and contextual analysis of sub-project activities based on location and geography.

- The significance of impacts has been determined by combining the perceived frequency of occurrence of the source of the impact, the duration, severity, and spatial extent of the impact, and the sensitivity of the area being impacted.
- The Valued Components (Environmental and Social) for the identification of impacts have been assessed for the construction phase based on the ***ESSs of the WB.***
- Stakeholder consultations were held with local people, project-affected people (PAPs), local NGOs, and various government officials, and participants' views, recommendations, and suggestions were recorded to better understand their concerns and expectations.
- Examining local, & international rules and regulations, and World Bank Environmental and Social Standards (ESS-1 to 10) in relation to project activities.
- Scoping of anticipated E&S risks of the project activities was carried out based on expert's judgement, which is as shown in **Table 7.3**, and **Table 7-2**. The significance of the impacts was assessed from the scores of 0-8 is low, 8 $^{(+)}$-30 for moderate, 30$^{(+)}$-56 for substantial risks, and 56$^{(+)}$-100 is considered as High risk
- Quantifying of environmental and social risk matrices and potential effects as shown in **Table 7-3.**
- Developing and implementing mitigation strategies to mitigate potential impacts; and establishing management plans and systems to monitor, manage, and continuously improve environmental and social performance.
- Evaluating the need for project workers and contractor representatives to improve capacity in order to properly manage and respond to environmental and social challenges.
- Suggestion for assessing and revising risk assessment and management plans on a frequent basis in response to changing situations, new information, and lessons learned during the land development, and
- Encourage a continuous improvement culture in environmental and social performance.

271. This assessment of effects and identification of residual impacts takes account of any incorporated mitigation measures adopted due to any potential impact of sub-project activities will be largely dependent on the extent and duration of change, the number of people or size of resources affected, and their sensitivity to change. Potential impacts can be both negative and positive (beneficial), and the methodology defined below will be applied to define

both beneficial and adverse potential impacts.

272. Criteria for determining significance are generally specific for each environmental and social aspect, but generally, the magnitude of each potential impact is defined along with the sensitivity of the receptor. Generic criteria for defining the magnitude and sensitivity used for the sub-project are summarized below;

Impact Magnitude

273. The assessment of magnitude shall be undertaken in two steps: Firstly, the key issues associated with the sub-project are categorized as beneficial or adverse. Secondly, potential impacts shall be categorized as High, Substantial, Moderate, and Low based on consideration of the parameters such as:

- Duration of the potential impact.
- Spatial extent of the potential impact.
- Reversibility.
- Likelihood; and
- Legal standards and established professional criteria

Sensitivity of Receptor

274. The sensitivity of a receptor shall be determined based on a review of the population (including proximity/numbers/vulnerability) and the presence of features on the site or the surrounding area. Criteria for determining receptor sensitivity of the program's potential impacts are outlined table below.

Table 7-1: Sensitivité of Réception

Sensitivity Determination	Definition
High	Vulnerable receptors with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Substantial	Vulnerable receptors with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Moderate	Vulnerable receptors with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptors with a good capacity to absorb proposed changes or/and good opportunities for mitigation

7.3.1.ASSIGNING SIGNIFICANCE (ESS1: HIGH RISK, SUBSTANTIAL RISK, MODERATE RISK, AND LOW RISK)

275. Following the assessment of the magnitude of impacts, the quality and sensitivity of the receiving environment receptor shall be determined, and the significance of each potential impact is established using the potential impact significance matrix by the ESS1 standard, viz. **High, Substantial, Moderate, and Low.**

7.4. OVERALL ENVIRONMENTAL AND SOCIAL IMPACTS AND RISKS

276. Numerous strategies are developed to mitigate the potential risks relating to the proposed sub-project activities focusing on the environmental and social management plan and monitoring plan. The significance of impact is derived from the likelihood and intensity of impacts. The magnitudes of different parameters of impacts (duration, reversibility, extent, likelihood) have been determined by the WB's potential risk categories (Low, Moderate, Substantial, and High). ***Low impact activities*** are those that cause minimal and short-lived disturbances to the environment. The effects are typically localized and do not significantly alter the local environmental and social risks due to their short duration (0 to 1 year) and it can naturally recover to its original state within a year without significant intervention. ***Moderately risky activities*** have a more pronounced impact compared to low impact activities and effects may extend beyond the immediate area and can cause noticeable changes in local environmental and social components. While the impacts are reversible, the recovery process requires a longer timeframe, typically one to four years. ***Substantial Risks Activities*** posing substantial risks result in significant and potentially long-lasting impacts which can affect large areas and cause considerable alterations to ecosystem structure, function, and biodiversity. The recovery process is protracted, taking between 5 to 10 years, and may require extensive restoration efforts. ***High Impacts Project Activities*** cause severe and irreversible damage to the environmental and social components, the effects are permanent, leading to long-term or irreversible changes in environmental and social structure, function, and biodiversity. Recovery to the original baseline conditions is not possible, and the environment may be permanently altered (Details in **Table 7-2**).

277. In addition, the values for likelihood and intensity are set on a 0-10 scale and the distribution. The significance of impacts on different activities during the construction works is presented in **Table 7-3.** Identified environmental and social impacts have been categorized into two dimensions: i) Positive impact and ii) Negative

impact. The consequences/severity of impacts are merely Low, Moderate, Substantial, and High. The Significance of impact for individual VC was calculated based on expert's judgement corresponding the sub-project activities, details in **Table 7-2.**

Table 7-2: Parameters for Determining the Magnitude of Impacts

Parameter	Low	Moderate	Substantial	High
Duration	Temporary with no detectable potential impact (<1 year)	Within the sub-project lifespan (1-4 years)	Medium Term Lifespan of the Program (5 to 10 years)	Long-term (more than 10 years)
Reversibility	The potential harm is likely to be minor and easily rectified within a year.	The damage can be repaired, the original state can be restored, or the negative impacts can be significantly reduced by 4 years.	It considers various types of risks, from environmental damage to societal disruption, and analyzes the extent to which the consequences of these risks can be mitigated within a period of 5 to 10 years.	The potential impact is effectively permanent, requiring considerable intervention to return to baseline conditions which seem to be irreversible.
Spread/Spatial Extend (Considering AOI of 5 km areas)	The impact is not expected to occur, but if it is possible within the sub-project areas (0 to 1 km).	The impact is expected to occur within the sub-project areas (>1 to 3 km).	The impact is expected to occur beyond the sub-project boundary (>3 to 5 km).	Widespread. The impact causes severe and irreversible damage or disruption for more than 5 km areas.
Likelihood	0-2=Unlikely to occur	$2^{(+)}$-5=Occasional	$5^{(+)}$-7=Possible (Negative/Positive)	$7^{(+)}$-10=Certain
Intensity	1-4= Low	$4^{(+)}$-6= Moderate	$6^{(+)}$-8= Substantial	$8^{(+)}$-10= High
Significance of Impact	0-8= Low	$8^{(+)}$-30= Moderate	$30^{(+)}$-56= Substantial	$56^{(+)}$-100= High

Table 7-3: Significance for Impacts on Different Activities During the Land Development

Project Activities	Impacts	Duration	Reversible/ Irreversible	Spread	Likelihood of Occurrence (0-10)	Intensity of Impact (0-10)	Significance Value (1-100)	Significance
Delivery Pipe Installation	Noise Level	Short term	Reversible	Moderate	3	-6	-18	Moderate
	Community Health and Safety	Short term	Reversible	Moderate	2	-5	-10	Moderate
	Social Conflict	Short term	Reversible	Moderate	2	-5	-10	Moderate
	Terrestrial Ecology	Short term	Reversible	Low	2	-4	-8	Low
	Occupational Health and Safety	Short term	Reversible	Moderate	5	-7	-35	Substantial
Dredging	Movement of Water Vessels and Transport	Short term	Reversible	Low	3	-5	-15	Moderate
	Climate Change Vulnerability	Short term	Reversible	Moderate	3	-8	-24	Moderate
	Air Quality	Short term	Reversible	Moderate	5	-8	-40	Substantial
	Noise Level	Short term	Reversible	Moderate	4	-6	-24	Moderate
	Surface Water Quality	Short term	Reversible	Moderate	5	-6	-30	Moderate
	Aquatic Ecology	Short term	Reversible	Moderate	4	-7	-28	Moderate
	Marine ecology	Short term	Reversible	Moderate	4	-6	-24	Moderate
	Occupational Health and Safety	Short term	Reversible	High	5	-6	-30	Moderate
	Community Health and Safety	Short term	Reversible	Moderate	4	-6	-24	Moderate
Landfilling	Change of land use and land cover	Long term	Irreversible	Moderate	8	-9	-72	**High**
	Air Quality	Short term	Reversible	Moderate	5	-7	-35	Substantial
	Noise Level	Short term	Reversible	Moderate	4	-5	-20	Moderate
	Surface Water Quality	Short term	Reversible	Moderate	6	-8	-48	Substantial
	Ground Water Quality	Short term	Reversible	Moderate	4	-6	-24	Moderate
	Soil Erosion and Impact on Soil Quality	Short term	Reversible	Moderate	7	-8	-56	Substantial
	Water Logging and Drainage	Short term	Reversible	Moderate	7	-8	-56	Substantial
	Waste Generation	Short term	Reversible	Low	4	-6	-24	Moderate
	Aquatic Ecology	Short term	Reversible	Moderate	4	-6	-24	Moderate
	Terrestrial Ecology	Short term	Reversible	Low	2	-5	-10	Moderate
	Labor Influx and Working Conditions	Short term	Reversible	Moderate	6	-8	-48	Substantial
	Occupational Health and Safety	Short term	Reversible	Moderate	6	-9	-54	Substantial
	Employment Generation	Short term	Reversible	High	7	+8	56	**High (+) ve**
	GBV/ SEA/SH	Short term	Reversible	Low	2	-2	-4	Low
	Social Conflict	Short term	Reversible	Low	2	-4	-8	Low
	Community Health and Safety	Short term	Reversible	Moderate	4	-4	-16	Moderate

7.5. IMPACTS AND MITIGATION

7.5.1.DELIVERY PIPE INSTALLATION

278. Due to delivery pipe installation, local noise level, occupational health and safety, community health and safety, social conflict, and terrestrial and aquatic ecology are to be affected. The significance of the impact is low to moderate, short-term and reversible. The details are given below:

7.5.1.1. NOISE LEVEL (ESS-3: RESOURCE EFFICIENCY AND POLLUTION PREVENTION AND MANAGEMENT)

279. During delivery pipe installation, the local noise level will be increased by the movement of vehicles, equipment, and it will affect the local community and workers. Noise pollution from pipe installation can lead to some stress, displacement, and even hearing damage for the community, workers, and others.

280. **Mitigation Measures**: To reduce the noise level, it is necessary to plan the pipe route to minimize proximity to sensitive receptors. Consider alternative routes that avoid areas with high concentrations of vegetation coverage or residential areas. Choose equipment with lower noise emissions whenever possible. Consider using electric-powered equipment instead of diesel-powered equipment where feasible and avoid unnecessary idling of equipment and use mufflers on engines and other mitigation measures as appropriate. Provide comprehensive training to all personnel involved in the pipe installation process on noise mitigation measures and best practices. Supply earplugs to the workers during the installation of delivery pipes etc.

7.5.1.2. TERRESTRIAL AND AQUATIC ECOLOGY (ESS-6: BIODIVERSITY CONSERVATION AND SUSTAINABLE MANAGEMENT OF LIVING NATURAL RESOURCES)

281. On land, pipeline installation often requires clearing vegetation, grading the land, and constructing access roads. This can fragment habitats, disrupt wildlife corridors, and lead to soil erosion. Sensitive areas, such as wetlands or forests, are particularly vulnerable. However, aquatic ecology will face disturbance during pipe installation over the seawater surface. Aquatic ecology will face disturbance during pipe installation over the sea water surface. It could interfere with the as usual movement of aquatic species, mainly fish. Fish can be affected by habitat loss, water quality degradation, and noise pollution. Sediment resuspension can clog their gills, while contaminants can poison them. Noise pollution can disrupt their behavior and even cause physical damage. Marine mammals are particularly sensitive to noise pollution, which can interfere with their communication, navigation, and foraging. They can also be displaced from important habitats, such as breeding grounds or feeding areas

282. **Mitigation Measures:** To minimize the ecological impacts, delivery pipelines should be chosen in considering the less vegetative areas and preserve native vegetation whenever feasible. Restore disturbed areas as quickly as possible using native vegetation species. Implement noise reduction measures, such as using quieter equipment or installing noise barriers, to minimize noise pollution. Installation work should be limited to only daytime; night-time work should be prohibited to the site. Regular maintenance of pipelines should be confirmed to avoid leakage during dredging period etc., and other appropriate mitigation measures should be applied based on ground conditions.

7.5.1.3. OCCUPATIONAL HEALTH AND SAFETY (ESS-2: LABOR AND WORKING CONDITIONS)

283. **During pipe installation:** workers need extensive labor to move the equipment and pipes to the site. It will extend the risks of health and safety conditions, and workers may receive serious health hazards such as incidents, accidents, and sorts of injuries. The major hazards are musculoskeletal disorders (MSDs), slips, trips, and falls, struck by hazards, pinch points and crushing hazards, noise exposures, electrical hazards, and hazardous materials etc.

284. **Mitigation Measures:** To minimize these anticipated health hazards, it is necessary to utilize cranes, forklifts, pipe layers, and other mechanical lifting devices to minimize manual handling. Implement team lifting techniques for tasks that require manual handling, ensuring proper communication and coordination. Maintain a clean and organized work area, removing debris, tools, and other obstructions. Ensure that walkways and work surfaces are level and free from hazards. Ensure that all equipment is properly maintained and operated by trained personnel. Implement lockout/tagout procedures to prevent the unexpected startup of equipment during maintenance or repair and ensure slow and controlled movements of pipes and equipment during installation. Provide workers with appropriate hearing protection, such as earplugs or earmuffs. Implement engineering controls to reduce noise levels, such as using quieter equipment or installing noise barriers. Ensure that all electrical equipment is properly grounded. Inspect and maintain electrical insulation to prevent shocks. To control hazardous waste, it is suggested to provide

workers with access to Material Safety Data Sheets (MSDS) for all hazardous materials. Provide workers with appropriate Personal Protective Equipment (PPE), such as gloves, respirators, and eye protection. The occupational hazards with mitigation measure can be described as follows;

285. **Physical Hazards**: Lifting and manually handling heavy pipes can lead to musculoskeletal disorders (MSDs), including back injuries, sprains, and strains. The weight, size, and awkwardness of pipes, combined with repetitive movements, increase the risk.

286. **Mitigation Measures:** Utilize cranes, forklifts, pipe layers, and other mechanical lifting devices to minimize manual handling. Implement team lifting techniques for tasks that require manual handling, ensuring proper communication and coordination. Train workers on proper lifting techniques, emphasizing bending at the knees, keeping the back straight, and holding the load close to the body. Conduct ergonomic assessments of tasks involving manual handling to identify and address potential risk factors. Rotate workers between tasks to reduce repetitive strain and fatigue.

287. **Slips, Trips, and Falls*:*** Work areas around pipe installation sites can be uneven, cluttered, and slippery, increasing the risk of slips, trips, and falls. Weather conditions, such as rain or ice, can exacerbate these hazards.

288. **Mitigation Measures:** Maintain a clean and organized work area, removing debris, tools, and other obstructions. Ensure that walkways and work surfaces are level and free from hazards. Repair or replace damaged surfaces promptly. Require workers to wear slip-resistant footwear. Post warning signs in areas with potential slip, trip, and fall hazards and provide adequate lighting in work areas, especially during nighttime or low-light conditions.

289. **Struck-by Hazards:** Workers can be struck by moving equipment, falling objects, or swinging pipes during installation.

290. **Mitigation Measures:** Ensure that all equipment is properly maintained and operated by trained personnel. Implement a traffic management plan to separate workers from moving equipment. Establish exclusion zones around lifting operations and other hazardous activities. Secure pipes and other materials to prevent them from falling or shifting, and use clear communication signals and procedures to alert workers to potential hazards.

291. **Pinch Points and Crushing Hazards:** Workers can be caught in pinch points or crushed between pipes, equipment, or other objects during installation.

292. **Mitigation Measures:** Install guards of machinery and equipment to prevent access to pinch points. Develop and implement safe work procedures for tasks involving potential pinch points. Train workers to recognize and avoid pinch point hazards. Implement lockout/tagout procedures to prevent the unexpected startup of equipment during maintenance or repair and ensure slow and controlled movements of pipes and equipment during installation.

293. **Noise Exposures*:*** Operating heavy machinery and equipment during pipe installation can generate high noise levels, leading to hearing loss.

294. **Mitigation Measures:** Conduct noise monitoring to assess worker exposure levels. Provide workers with appropriate hearing protection, such as earplugs or earmuffs. Implement engineering controls to reduce noise levels, such as using quieter equipment or installing noise barriers. Implement administrative controls to reduce noise exposure, such as limiting worker exposure time or rotating workers between tasks.

295. **Electrical Hazards**: Contact with electrical equipment or power lines can lead to electrocution.

296. **Mitigation Measures:** Ensure that all electrical equipment is properly grounded. Inspect and maintain electrical insulation to prevent shocks. Implement lockout/tagout procedures to de-energize electrical equipment before maintenance or repair and maintain a safe distance from overhead power lines, and ensure that all electrical work is performed by qualified personnel.

297. **Hazardous Materials:** Exposure to hazardous materials, such as fuels, lubricants, and chemicals, can lead to skin irritation, respiratory problems, or other health effects. Hazardous materials such as pigment, usually used during the installation of pipes, and lubricants such as Mobil, Grease, etc., are used for periodic maintenance of the pipeline.

298. **Mitigation Measures:** Implement a hazard communication program to inform workers about the hazards of chemicals they may be exposed to. Provide workers with access to Material Safety Data Sheets (MSDS) for all hazardous materials. Provide workers with appropriate Personal Protective Equipment (PPE), such as gloves, respirators, and eye protection. Develop and implement spill control procedures to contain and clean up spills of hazardous materials, etc.

7.5.1.4. COMMUNITY HEALTH AND SAFETY (ESS-4: COMMUNITY HEALTH AND SAFETY)

299. **Community health and safety**: This will be at risk due to the installation of pipelines along road networks, village areas and other busy areas. It will mainly create disturbance to the community and other health hazards etc.

300. **Mitigation Measures**: To mitigate this problem, it is suggested to provide alternative routes and access points. Establish a proper communication channel with the community about potential disruptions. Minimize the duration of disruptions, avoid damaging property during pipeline installation, and address concerns and complaints promptly and respectfully. Provide opportunities for community involvement in the project, etc.

301. **Disruption of Access:** Pipeline installation can disrupt access to roads, businesses, and other busy areas. Reduced access can cause inconvenience, economic losses, and social disruption.

302. **Mitigation Measures:** Provide alternative routes and access points. Communicate with the community about potential disruptions. Minimize the duration of disruptions.

303. **Property Damage**: Pipeline installation can cause damage to private property, such as fences, landscaping, and utilities, which can lead to financial losses and disputes with property owners.

304. **Mitigation Measures**: Conduct pre-installation surveys to document existing property conditions. Take precautions to avoid damaging property during pipeline installation. Repair any damage promptly and fairly.

305. **Psychological Impacts**: The noise, dust, and disruption associated with pipeline installation can cause stress and anxiety for residents, which can lead to mental health problems and reduced quality of life.

306. **Mitigation Measures:** Communicate with the community about the project schedule and potential impacts. Address concerns and complaints promptly and respectfully. Provide opportunities for community involvement in the project.

7.5.1.5. SOCIAL CONFLICT (ESS-4)

307. Local disputes will occur during the installation of the pipeline along the roads, village sides, busy areas, and other recreational areas. It will occur if the pipeline installation damages any private property, such as fencing, crops, and others. However, proper communication with the local community and appropriate consultation can reduce the anticipated risks. The anticipated risk is of lower significance; it may merely occur and be mitigable or manageable.

308. **Mitigation Measures:** It will require pre-installation surveys to record all the private property lists and even avoid the disturbance areas. Necessary consultations, meetings and communications are required with the local people and local communities to inform about the project activities. If any private damage occurs, proper compensation should be provided to the affected people.

7.5.2. DREDGING ACTIVITIES

309. The Dredging Process involves mainly three systems, all of which have some negative impacts.

310. **Pre-treatment:** The pre-treatment consists of treating the ground surface before the excavation process. This is mainly required for dredging rock and similar hard materials to fragment/loosen the same either mechanically

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

312. **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 the disposal

313. Use of Dredger has environmental social impacts also. Mechanical dredgers and Hydraulic dredgers are common, various types of dredgers being used worldwide. 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.

314. Similarly, wind waves and swells are the main meteorological and oceanographic conditions which affect the working of the dredger. The high wind may make anchoring of the dredger and loading on to the barge operation difficult. The dredgers, which are located using spuds, are susceptible to waves, which may lead to 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 the bottom. Dredging technologies and different types of dredgers have been described in detail in Appendix 4, Vol II. For the Land Development of Part of Precinct F (IMD Zone and Housing Facilities) of NSEZ. Dredging operation involves a number of sites located in part of Precinct F of the NSEZ, and most locations of dredging will be inside the coastline. Therefore, a cutter suction type dredger would be the feasible option from both a technical and a financial point of view.

Figure 7-1: Cutter Suction Dredger

315. The cutter suction dredger consists of a centrifugal pump and a suction tube that has a 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 a transportation pipeline by design could be 2-3 km. However, by adding a booster pump to the pipeline, the dredge-spoil can be transported/dumped to further. A cutter suction dredger (32 inch) with a capacity of 5000 cubic meters 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 approximately 9,00,000 cubic meters of soil each year (this amount of output of working 8 hours a day). This Cutter Dredger would not significantly increase the turbidity of the surface water during the dredging operation at the dredging location

316. Dimensions and instructions for the cutter suction dredger and production capacity is given below

Table 7-4 : Cutter Suction Dredger Specifications

Sl. No.	Dredger specification	Dimension	Capacity of a Cutter Suction Dredger
1	Dredger Type	32" (8 lac cum/year)[57]	• 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
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	5 m min to 27.5m max	

317. 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 is 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.

318. An aalternative analysis on the different capacities production of fill materials findings indicated that one

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

small CSD with a capacity of 500 m³ per hour and one medium CSD with a capacity of 1,000 m³ per hour can be engaged to dredge and fill the target 15.85 MCm volume, following a safe sequence with shallow cutting depth to avoid erosion of the Sandwip Channel.

319. However, the potential impacts during dredging work, there are several impacts are anticipated or expected on the natural and social environment. Among them, the identified impacts are mainly creating disruptions of movement of water vessels, road traffic, and transport including the climate change vulnerability (GHG emissions), pollution of air quality, noise level, surface water quality, aquatic ecology, occupational health and safety, and community health and safety concern, etc.

7.5.2.1. AIR QUALITY (ESS-3)

320. Dredging, the process of excavating and removing sediment from underwater environments, can release pollutants into the air, affecting both human health and the environment. Exhaust emissions will occur from dredging such as Dredges, tugboats, barges, and other support vessels typically rely on diesel engines, which emit particulate matter (PM), nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO), and volatile organic compounds (VOCs). The quantity of these emissions depends on the size and age of the equipment, the type of fuel used, and the operational load.

321. **Mitigation Measures**: To lessen the impact, it is suggested to use newer, more efficient dredging equipment with lower emissions can significantly reduce air pollution. Measuring the concentration of pollutants in the air. Adjusting dredging operations to minimize air pollution. Conducting regular inspections to ensure compliance with environmental regulations. Scheduling dredging activities during periods of favorable weather conditions (e.g., low wind speeds) can help to minimize the dispersion of air pollutants.

7.5.2.2. NOISE LEVEL (ESS-3)

322. Dredging operations involve a variety of equipment and activities that generate noise. The primary sources of noise include Dredgers, support vessels such as tugboats, barges, and other support vessels that contribute to noise levels through engine operation, propeller cavitation, and other onboard machinery. Underwater noise can travel long distances, depending on the frequency, water depth, salinity, temperature, and seabed characteristics. Low-frequency noise tends to propagate further than high-frequency noise. Airborne noise is generated by machinery, engines, and other equipment operating above the water surface. The intensity of airborne noise decreases with distance from the source. The potential impacts on noise levels will affect the aquatic environment such as fish relying on sound for various purposes, including communication, navigation, and predator avoidance. The workers will be affected due to working with high noise generating conditions and dredging operations can disturb nearby communities etc.

323. **Mitigation Measures**: To reduce this impact, it is necessary to select dredging equipment that generates less noise and can significantly reduce noise levels. Using dredging techniques that minimize noise generation, such as slow dredging speeds and optimized cutter head designs. Monitoring noise levels and marine life behavior during dredging operations to ensure that mitigation measures are effective. Reducing the speed of support vessels to minimize noise generation. PPE (earplugs) should be supplied to the workers during the work in the dredging operation period

7.5.2.3. SEDIMENTATION AND EROSION

324. Dredging activities may create channel /river embankment erosion in most cases, due to over-excavation of fill materials and improper operation of the dredgers, which need to be controlled. In addition, consideration of the sedimentation process of the channel with the trend of accretion and erosion processes are also a major factor.

325. **Mitigation Measures**: To mitigate bank erosion, it is necessary to introduce high-tech dredging methods that minimize sediment resuspension, such as hydraulic dredging with a cutter suction dredger. The Contractor should do dredging sequentially with two dredgers at one interval location, rather than side-by-side locations. As a result, the immediate or short-term impact of this sequence of excavation of filling material would be insignificant.

326. Erosion/ Accretion process in the study area based on the morphological study of this ESIA indicated that the coastal morphology of the Sandwip Channel is accretion-prone alongside the NSEZ. This morphological study included an assessment of the stability of the Sandwip Channel using time series satellite image analysis and field observations and secondary bathymetric data, as shown in **Figure 5-7** and **Figure 5-8.** Another study of the Coastal Morphology Model (CMM) using the 2D version of Deflt3D numerical model indicates that the right bank of the Sandwip Channel at Mirsharai is accretion-prone, as shown in **Figure 5-9.** Furthermore, the embankment protection has already been carried out by the construction of the Super Dyke alongside the channel beside the NSEZ premises. Therefore, from the above evidence, it can be expected that the long-term impacts of the dredging activities would be insignificant.

327. In addition, The NSEZ may be conducted a detailed separate study through Erosion Plume Modelling by bathymetric survey to anticipate precisely the immediate and long-term changes in the sedimentation and erosion trend along the Sandwip Channel and nearby Charland due to the dredging impacts.

7.5.2.4. SURFACE WATER QUALITY (ESS-3)

328. Dredging operations inevitably disturb the sediment at the bottom of water bodies. This disturbance can trigger a cascade of effects that negatively impact surface water quality. Dredging directly introduces sediment into the water column, leading to increased turbidity and concentrations of suspended solids (TSS). This is perhaps the most immediate and visible impact. The consequences of increased turbidity are multifaceted such as reduced light penetration.

329. Dredging can disrupt the natural cycling of nutrients in aquatic ecosystems. The release of nutrients from sediments can lead to algal blooms, which can deplete oxygen levels when the algae die and decompose. This can create hypoxic or anoxic conditions that are harmful to aquatic life. Dredging can directly reduce dissolved oxygen (DO) levels in the water column. The resuspension of organic matter from sediments increases the biological oxygen demand (BOD), as microorganisms consume oxygen to decompose the organic material. Additionally, the release of reduced chemical species, such as sulfides and ammonia, can also consume oxygen etc.

330. **Mitigation Measures**: To mitigate the impact on surface water, it is necessary to introduce dredging methods that minimize sediment resuspension, such as hydraulic dredging with cutter suction heads or environmental buckets. Deploy silt curtains or turbidity barriers to contain suspended sediment and prevent it from spreading to surrounding areas. Schedule dredging activities to avoid sensitive periods for aquatic life, such as spawning seasons or periods of high flow. Implement a comprehensive water quality monitoring program to track turbidity, suspended solids, dissolved oxygen, and contaminant levels during and after dredging and other mitigation measures as appropriate should be implemented based on ground conditions etc.

7.5.2.5. AQUATIC ECOLOGY (ESS-6)

331. One of the most immediate and widespread impacts of dredging is the resuspension of sediments into the water column. This process increases turbidity, which is a measure of the cloudiness or haziness of the water. Elevated turbidity can have several negative effects. Increased turbidity reduces the amount of sunlight that penetrates the water, which can inhibit photosynthesis by aquatic plants and phytoplankton. This can disrupt the base of the food web and affect the overall productivity of the ecosystem. Suspended sediments can settle on the bottom, smothering benthic organisms such as shellfish, worms, and crustaceans.

332. This can lead to mortality and reduced biodiversity. Suspended sediments can clog the gills of fish and other aquatic animals, impairing their ability to breathe and potentially leading to suffocation. Dredging can completely remove benthic communities, including sensitive habitats such as seagrass beds, and shellfish beds. Dredging can change the flow patterns of water, which can affect sediment transport, nutrient distribution, and the dispersal of larvae. Dredging can produce high underwater noise that can interfere with the ability of animals to communicate with each other, which can affect mating, social interactions, and predator avoidance. Dredging can release nutrients, such as nitrogen and phosphorus, from sediments. These nutrients can stimulate algal blooms, which can further deplete oxygen levels when the algae die and decompose. Dredging can redistribute contaminated sediments to new areas, spreading pollution to previously unaffected areas and so on.

333. **Mitigation Measures**: To lessen the impact, it is necessary to select dredging sites that minimize impacts on sensitive habitats and avoid dredging during critical periods for aquatic organisms, such as spawning seasons. Employing dredging techniques that minimize sediment resuspension and disturbance, such as hydraulic dredging or cutter suction dredging. Monitoring water quality, sediment quality, and biological communities before, during, and after dredging to assess the effectiveness of mitigation measures and adapt management strategies as needed.

334. **Hilsa Breeding Ground,** which is around 5 km away from the nearest dredging point of L-9 which is more than 5 km away from the Hilsa Breeding ground. So, it is assumed that the Hilsa breeding zone will remain unaffected by the dredging activities, because the breeding zone is located on the upstream side of L-09. However, Mayani Hilsa Spawning Ground is located at Myani point at Mirsharai which is now silted due to the development activities, and the site is 5.32 kilometers away from the suitable dredging site L-05 (**Figure 7-2**). So, it is anticipated that downstream dredging activities will not affect the upstream Hilsa spawning zone. The findings are significant for the conservation of Hilsa fish, which is vital for both ecological balance and local fisheries; So, the Hilsa breeding site at the confluence of the Feni River and the Bay of Bengal remains unaffected by the dredging activities, ensuring the continued viability of this important ecological resource.

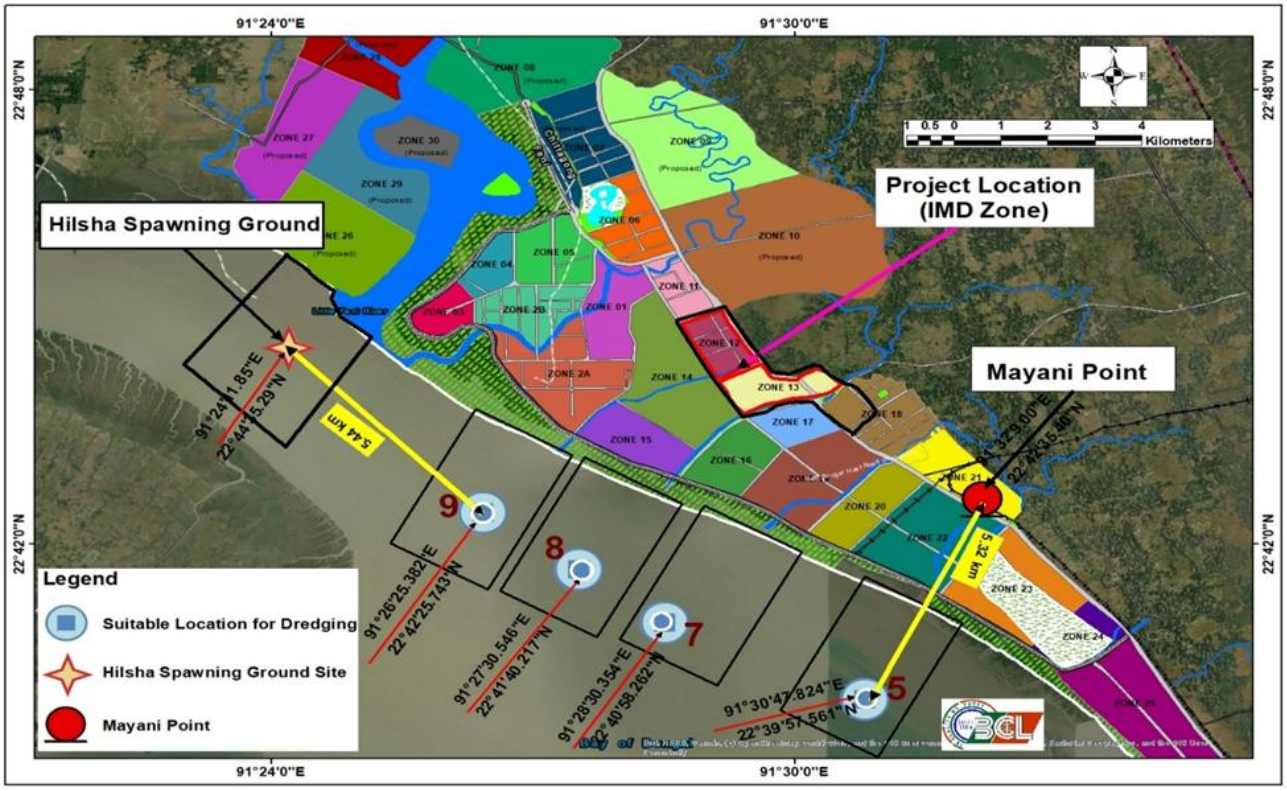


Figure 7-2 : Distance of the Nearest Dredging Locations from Hilsa Breeding Grounds at Sandwip Channel- Feni River Confluence, and Mayani point

335. However, it is important to note that there are no designated Hilsa Sanctuaries within the study area, which further supports the assertion that the breeding site is not under immediate threat from the proposed dredging operations; During the breeding season, it is crucial to minimize human interference in the habitats of Hilsa fish. However, to gear the extra precautions of the conservation measures, the government enforces a ban on Hilsa fishing in both the river and the Bay of Bengal for a period of 22 days, from October 22 to November 12, coinciding with the Hilsa spawning period. This regulatory measure ensures that dredging operations at L-5, and other suitable locations will be suspended during this critical time, thereby safeguarding the uninterrupted spawning of Hilsa and contributing to the overall health of Hilsa populations.

7.5.2.6. ENERGY REQUIREMENTS (ESS-3)

336. The estimated approximate amount of energy requirement during the construction (dredging phase) is approximately 10369 kW/day or 3,04,153 kW/month of electricity would be required. The following measures should be considered to control the operational impact of dredging.

337. **Mitigation measures:** To meet the demand of energy requirements, it is suggested that administrative and site offices will require different kinds of machinery, generators, air conditioning machines, computers, and laptops. Labor camps should have all kinds of home appliances. The contractor along with the help of BEZA and local suppliers, needs to ensure electricity and energy to operate these facilities. Dredgers will be equipped with diversified heavy-duty machinery such as cutter pump, ladder pump, inboard pumps, and jet pumps.

7.5.2.7. UTILITY AND MACHINERY (ESS-3)

338. Fuel and electricity are necessary for the Dredging activities. The approximate utility demand for the pipeline construction is presented in the below

Table 7-5: Consumption of Utility During Construction

Sl. No.	Name of utilities	Details	Utility sources
1	Water	Approximate 2-4 MLD of water will be needed for hydro test and domestic purpose	Deep tube well
2	Electricity	10,369 kw/day (approximately)	National Grid/ NSEZ/DG
3.	Fuel: Gas	for cooking and welding, cylinder gas will be used	Supplier
4.	Fuel: Diesel	for 20 no. heavy vehicles, 5 no. diesel generator	Supplier
5.	Fuel: Octane	for 10 no. light vehicles	Supplier

Sl. No.	Name of utilities	Details	Utility sources

Source: BEZA

339. Besides, a wide array of dredging-related activities to be performed requires diversified machinery and equipment materials for dredging would need to be transported via pipelines. To set up the piping network, a large number of vehicles would be required to carry pipes. This network needs to be configured carefully to prevent fluid contamination or spillage into fields and the current Bamonsundar Channel, Ichakhali Channel or Shaherkhali Khal and existing roads. In addition, obtaining energy would necessitate the use of diesel generator(s). Underground water will be delivered by water pumps and air blowers will be needed to provide large quantities of dredging materials. Equipment for compaction and levelling will also be required. Excavators, dump trucks, tractors, and other equipment would be required to store topsoil.

340. **Mitigation measures**: It is recommended that the contractor should utilize every possible way to reduce GHG emissions; Utilize solar systems and rainwater harvesting in the camps; Control the burning of fossil fuels; Use clean energy for cooking; Overhauling machinery and vehicles on a routine maintenance schedule; The contractor should manage waste properly and should not burn solid waste; Control of GHG emissions by energy use efficiency, process modification, and selection of fuels; Control GHG emissions by updating processes that may result in fewer emissions.

7.5.2.8. CLIMATE CHANGE VULNERABILITY (ESS-3)

341. Climate change is causing significant and widespread impacts on coastal environments, including sea-level rise, increased storm intensity, and altered precipitation patterns. These changes threaten coastal ecosystems and the communities that depend on them. Dredging, the process of removing sediment from underwater environments for landfilling and other activities. However, poorly planned and executed dredging can exacerbate the vulnerability of coastal areas to climate change impacts.

342. Dredging can erode the shorelines and increase the frequency and severity of coastal flooding. Dredging generates sediment plumes that can smother sensitive habitats, reduce water clarity, and interfere with the feeding and respiration of marine organisms. Dredging can alter bathymetry and increase the depth of channels, allowing storm surges to penetrate further inland and increasing the risk of flooding. Dredging can damage or destroy natural defenses against climate change, such as mangroves, salt marshes, and coral reefs, which provide coastal protection from storm surges and erosion. Dredging can emit CO, Nox, SOx, VOC into the air that could pollute the local air quality etc.

343. **Mitigation Measures:** To mitigate this problem, it is necessary to employ dredging techniques that minimize sediment disturbance and reduce the release of contaminants. Reduce the area and duration of dredging activities to minimize habitat destruction and sediment plumes. Restore or create coastal habitats, such as mangroves, salt marshes, to enhance coastal protection and ecosystem resilience. Implement monitoring programs to track the impacts of dredging and adapt management practices as needed. Integrate climate change adaptation strategies into dredging operations to ensure that they are resilient to future climate impacts and engage local communities in the planning and decision-making processes related to dredging activities etc.

7.5.2.9. OCCUPATIONAL HEALTH AND SAFETY (ESS-2)

344. The significant occupational health and safety (OHS) risks associated with dredging activities can lead to serious injuries, illnesses, and even fatalities if not properly managed. Drowning is a primary concern in dredging operations due to the proximity to water and the potential for accidental falls caused by slippery surfaces, lack of fall protection, vessel instability, and unexpected weather conditions can all contribute to drowning incidents.

345. Dredging involves heavy machinery and equipment, increasing the risk of being struck by moving objects, such as Swinging cables, falling objects, moving machinery and collisions between vessels can all result in struck-by injuries. Unguarded machinery, entanglement in cables or ropes, and being caught between vessels or equipment during maintenance or operation are common causes. Slippery decks, cluttered walkways, inadequate lighting, and unstable footing can all contribute to slips, trips, and falls on dredging sites due to uneven surfaces, wet conditions, and obstructions. Engines, pumps, and other machinery produce significant noise pollution which can lead to hearing loss.

346. Operating vibrating equipment such as jackhammers and certain types of dredging machinery can lead to hand-arm vibration syndrome (HAVS) and other musculoskeletal disorders. Dredging operations rely on fuels and lubricants, which can pose chemical hazards such as skin contact, inhalation of vapors, and spills can lead to dermatitis, respiratory irritation, and environmental contamination. Hydraulic fluids used in dredging equipment can be hazardous if not handled properly. Exposure to contaminated water can lead to waterborne

diseases. Repetitive tasks and working in awkward postures can lead to musculoskeletal disorders, and exposure to extreme weather conditions can pose health risks etc.

347. **Mitigation Measures:** To protect workers' health and safety, it is necessary to take preventive measures such as implementing strict fall protection measures (e.g., safety harnesses, guardrails), providing adequate training on water safety and rescue techniques, ensuring vessel stability, and monitoring weather conditions are crucial. Life jackets must be always worn near or on the water. Regular drills for man-overboard situations are also essential. Installing machine guards, implementing lockout/tagout procedures during maintenance, providing training on safe operating procedures, and ensuring adequate clearance around equipment are essential. Workers should be aware of potential pinch points and entanglement hazards. Maintaining clean and dry work areas, providing adequate lighting, using non-slip surfaces, and implementing good housekeeping practices are crucial. Workers should wear appropriate footwear and be trained to identify and avoid slip, trip, and fall hazards. Implementing noise control measures (e.g., using mufflers, isolating equipment), providing hearing protection (e.g., earplugs, earmuffs) are necessary. Workers should be trained in the proper use and maintenance of hearing protection. Using proper handling techniques, wearing appropriate PPE, and implementing spill control measures are crucial. Workers should be trained on the hazards of hydraulic fluids and the proper procedures for handling them.

7.5.2.10.COMMUNITY HEALTH AND SAFETY (ESS-4)

348. Dredging operations can generate significant noise, which can be disruptive and harmful to nearby communities mainly fishermen. Dredging can disrupt marine ecosystems, affecting fish populations, benthic communities, and other aquatic life which may affect to the fishermen to catch fish during the dredging period. Fishermen can restrict to catch fishes from the seas adjacent to the dredging operation areas that will affect their livelihood opportunity. Dredging can increase turbidity in the water that will affect the communities' people who are depended on surface water sources for their livelihood and living conditions.

349. **Mitigation Measures:** To reduce this anticipated impact, clear communications channels should be established with the community to inform people about the dredging activities and schedule. A regular consultation should be undertaken with the community people and awareness campaign should be forwarded at community level. Implementing navigation safety measures, such as marking dredging areas with buoys and providing warnings to boaters, can prevent accidents. Developing emergency response plans to address potential accidents, such as accidental releases of dredged material, can minimize the impacts of such events. Restricting dredging operations to daytime hours can minimize noise disturbance during nighttime hours and other appropriate measures should be taken as per needs.

7.5.2.11.MOVEMENT OF WATER VESSELS AND TRANSPORT (ESS-4)

350. The potential environmental and socioeconomic impacts are associated with the movement and transport of water vessels during dredging activities. Dredging, the process of excavating and removing sediment from the bottom of water bodies, often relies heavily on vessels for material transport, equipment deployment, and overall operational support. Vessel traffic can interfere with fishing activities, reducing catch rates and increasing operational costs for fishermen. Dredging operations may require temporary restrictions on navigation, affecting commercial shipping and other vessel traffic.

351. **Mitigation Measures:** To minimize the potential impacts of water vessel movement and transport during dredging activities, a range of mitigation measures can be implemented. Careful route planning can minimize vessel traffic in sensitive areas and reduce the risk of collisions or groundings. Reducing vessel speeds can decrease sediment resuspension, noise pollution, and the risk of accidents. Monitoring water quality, habitat conditions, and vessel traffic can help identify and address potential impacts. Adaptive management strategies can be used to adjust dredging operations in response to monitoring results. Engaging with local communities, fishermen, and other stakeholders can help identify and address concerns related to vessel traffic and dredging activities.

7.5.3. LANDFILLING ACTIVITIES

7.5.3.1. CHANGE OF LAND USE (ESS-1: ASSESSMENT AND MANAGEMENT OF RISKS AND IMPACTS)

352. Presently, there is no significant infrastructure in the sub-project area, and nearby other Zones. Major land use types in the surrounding area include mostly barren char land, some agricultural land with small wetland and mangrove plantation. Mobilization of equipment and dredging pipe installation will cause changes in land use. Local land use will be permanently changed due to landfills in the sub-project areas. The areas currently low-lying areas and the status of low-lying areas will be changed, and elevation height will be increased due to landfilling activities. Local other depressed parts will be affected by releasing dredge materials to the surrounding areas, and the natural

ecosystem will be affected.

353. **Mitigation Measures:** Though the areas of wetland with mangrove plants and agricultural lands are minimum, to mitigate this problem it is necessary to maintain a minimum buffer zone around wetlands, mangrove areas, and agricultural lands, construct from the outer edge of the ecosystem boundary, where applicable. Implement necessary erosion control measures, such as silt fences, dams and sediment traps to prevent sediment runoff into water bodies. Construction of dams for drainage congestion and control the flooding will serve as buffer zone in some areas. Schedule construction activities should be limited only in the daytime and avoid breeding season to minimize disruption to wildlife. Develop and implement restoration plans for disturbed areas to promote recovery of ecosystems post-construction etc.

7.5.3.2. CLIMATE CHANGE VULNERABILITY (ESS-1 AND ESS-3)

354. Climate change vulnerability is selected as an important VC, because of the vulnerability to climate change impacts, such as extreme weather events: rainfall/precipitation, temperature changes, flash flood/flooding, coastal surge, GHG Emission (due to the dredging activity, utility, and use of machinery, etc.) and Carbon footprint related to the land reclamation and dredging operations as per requirements of ESS3 and minimize climate-related risks (ESS1).

355. Mitigation Measures: Ensure a proper drainage system is activated during the landfilling to avoid flooding or waterlogging in the sub-project areas. Ensure good engines are used in the dredgers and vehicles to reduce exhaust emissions during dredging activities. During heavy rain, dredging activities should be prohibited, etc. Adverse weather conditions further exacerbate these risks, requiring constant vigilance and skilled navigation. Adverse natural hazards like cyclones, coastal surges, etc., occurrence, an Emergency Response and Disaster Management plan shall be implemented, as documented in Appendix 7, Vol. II.

7.5.3.3. AIR QUALITY (ESS-3)

356. Due to landfilling activities by dredge materials, it is anticipated that fugitive dust will form caused by site development works, civil construction, handling, loading, and unloading, stocking dredge material, and earthworks such as leveling, grading, excavation, compaction, and movement of vehicles, machinery, and generators (point and area sources) and exhaust gas emissions of SO2, NOx, CO2, CO, PM 2.5, and PM10 will occur from vehicles, such as the movement of trucks and other vehicles, during construction work that will deteriorate the local air quality.

357. **Mitigation Measures:** To minimize this problem, it is necessary to provide face masks to the workers, laborers, and staff to protect workers' health and safety. Regular air quality monitoring should be carried out as per the national standard of NPCR 2022. Ensure good quality engines are used at the site and covering loose sand with a hard cover (e.g., polythene) is essential to protect from fugitive dust etc.

7.5.3.4. NOISE LEVEL (ESS-3)

358. Local noise level will be declined due to operation of construction machinery and construction, landfill activities. Operation of landfilling, and movement of vehicles, machinery, and generators (point and area sources) etc., can also deteriorate the local noise level

359. Mitigation Measures: To reduce this impact, it is suggested to maintain construction-related noise-generating vehicles, equipment, machinery, and generators on a regular interval. Restrict the speed limit of construction vehicles to a maximum of 30 km/hr. Workers should be provided with earplugs and encouraged to use them. Ensure good and low-noise-producing engines, limit construction-related activities to 6 am to 6 pm and conduct noise level and vibration level monitoring a regular interval.

7.5.3.5. SURFACE WATER QUALITY (ESS-3)

360. It is anticipated that contamination of surface water by the run-off from the landfilling site, which might carry a higher quantity of sediments and oil that would impact aquatic life in and around the sub-project areas. Liquid wastes release from labor camps can also contaminate the local surface water sources. Henceforth the location of the dredger would be around 6.0 km to 8.5 km away from offshore. The placement area of dredged material will be bound by embankment, and hence, no significant impact on surface water quality of the nearby rivers and canals is expected. The dredger to be used is a cutter suction dredger, which would lift the dredged material by a suction pipe. The material would be transported to the filling location by a closed pipeline. Hence, the increase of turbidity of seawater at the point of the dredging operation would be significant if leakage of pipeline is detected.

361. **Mitigation Measures**: To lessen this impact, it is suggested to prevent piling up of excavated soil, raw material, and construction debris at the site by proper management and disposal, minimize run-off by using sprays for curing; maintaining the appropriate flow of water sprinklers at the site; construction of storm water drains along

with sedimentation tanks with sandbags as partitions as barriers for direct flow of runoff to the river; construction of an adequate number of toilets and a proper sanitation system to prevent open defecation along the river banks/water supply lines; construction of soak pits/septic tanks to dispose-off the domestic wastewater generated from labor camps to prevent the disposal of sewage in surface water bodies; proper collection, management, and disposal of construction and municipal waste from site to prevent mixing of the waste in run-off and entering the water bodies; no debris/construction material should enter the aquaculture ponds and other water bodies in the area, and surface water should be collected and examined in the renowned laboratory.

7.5.3.6. GROUNDWATER QUALITY (ESS-3)

362. During landfilling activities by dredging materials, dredged materials can contain a variety of contaminants that can leach into groundwater. The specific contaminants present depend on the source of the dredged material and the historical activities in the surrounding area. Common contaminants include heavy metal, nutrients, salts etc. The proximity of the landfill to sensitive receptors, such as drinking water wells and surface water bodies, determines the potential for exposure. Leachate from the worker camps can also release water sources to the surface that could penetrate the groundwater sources and contaminate the drinking water quality also.

363. **Mitigation Measures:** It is suggested to mitigate the following measures to protect ground water sources, such as groundwater is saline in the shallow aquifer of the project area. Use of groundwater was discouraged for the activity of the original project. Rainwater will be adopted in the construction works by harvesting rainwater and hence no significant impact is anticipated on the groundwater quality due to the activity of the original project. No sewage or wastewater will be allowed to accumulate in any unlined structure and timely disposal of the construction/chemical/hazardous waste to prevent the leaching of any pollutant to the ground helped in preserving groundwater.

7.5.3.7. SOIL EROSION AND SOIL QUALITY (ESS-3)

364. The most anticipated impacts to soil erosion and soil quality caused by landfilling activities by dredge materials are mainly development of the structures and construction of the bund, widening of the access road, and proposed additional landfilling might disturb the soil profile of the area; Topsoil might be affected by contaminated construction materials, used oil, spillage of oil; and waste generation may occur during landfilling activities and from labor camps will contaminate the soil quality also. Soil erosion will occur from the embankment side and the spread of vehicle fuel & lubricant and stockpiles into the nearby water body through runoff

365. **Mitigation Measures:** To reduce the anticipated impact, it is necessary to ensure waste disposal from construction camps and yards, hazardous waste, and chemicals, following the Waste Management Plan (indicative WMP is documented in Appendix 3, Vol-II). Establish a local drainage line with an appropriate spoil/silt collector; rehabilitate road drainage structures to reduce soil erosion, and other appropriate mitigation measures should be undertaken based on ground conditions.

7.5.3.8. WATER LOGGING AND DRAINAGE (ESS-3)

366. **Water logging:** This anticipated impact will be triggered out due to lack of proper drainage for rainwater/liquid waste or wastewater, owing to the landfilling activities, harming the environment in terms of water and soil contamination and mosquito growth. Improper or unplanned dredging will cause overflooding and waterlogging in the surrounding areas (road network, sedimentation in the canal) which may impact on the movement of the local community.

367. **Mitigation Measures**: To manage this problem, it is required to establish a drainage line with an appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing drainage lines already there; ensure the internal roads/hard surfaces in the construction yards/construction camps has the enough capacity to accommodate high runoff during downpours, and ensure there is no stagnant water in the area; construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning; provide appropriate silt traps to avoid drainage congestion; protect natural slopes of drainage channels to ensure adequate stormwater drains; regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem..

368. **Transportation of dredge materials:** Dredged materials would not be possible to transport through the local barge. Cutter Suction Dredgers (CSD) discharge their dredged materials with higher pressure. Local barges are not capable of bearing such pressure. So, it is better to consider another option like temporal dykes. The dykes will be filled with dredged material through discharge pipes and then those could be transported through trucks or dumb trucks. A truck (5 tons) 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.

369. **Mitigation Measures:** To manage this problem, it is required to establish a drainage line with an appropriate

silt collector and silt screen for rainwater or wastewater connecting to the existing drainage lines already there; ensure the internal roads/hard surfaces in the construction yards/construction camps has the enough capacity to accommodate high runoff during downpours, and ensure there is no stagnant water in the area; construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning; provide appropriate silt traps to avoid drainage congestion; protect natural slopes of drainage channels to ensure adequate stormwater drains; regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem..

370. 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 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 a local drainage line with an 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 transport. Build new drainage lines as appropriate and required wastewater from construction yards connecting to the available recipient water bodies. Ensure wastewater quality conforms to the relevant standards provided by DoE, before it being discharged into the recipient's 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.

371. The contractor should follow the Drainage Management Plan (indicative DMP) and Dredging Management /Land Development Plan documented in Appendix 4, Appendices, Vol-II.

7.5.3.9. TERRESTRIAL ECOLOGY (ESS-6)

372. The impacts on terrestrial ecology will occur due to cleaning of land filing areas which may affect the vegetation and biodiversity of existing animal amphibians, reptiles, birds, and mammals; Movement and operation dredging dredging-related vehicles, equipment, and machinery will generate vibration and noise, which may affect avian species, particularly migratory birds and animals; After the completion of the onsite intervention, effects on biodiversity and the ecosystem will be negligible. About 843 Trees may be affected in Zone 12 and Zone 13.

373. **Mitigation Measures**: To mitigate this problem, it is necessary to avoid falling any trees as much as possible, and reducing the anticipated impacts, strict monitoring is required during landfilling activities which shall be carried out in a planned way. Any kind of killing, trapping, and hunting of aquatic birds and other animals should be prohibited at the site and it'll be a punishable offense; Contractor shall implement environmental enhancement measures and a Greenery Plan to compensate for the cut-down trees and vegetation **(Appendix 7, Vol II)**; and Strict monitoring is required at the sites etc. Replantation of 2530 trees on the roadside side to be carried out after land preparation as three times the felled trees.

7.5.3.10. AQUATIC ECOLOGY (ESS-6)

374. The aquatic ecology will be affected due to, filling, storage of raw material, storage of debris, and establishment of site for machinery and equipment activities might lead to contamination by rainfall run-off due to mixing with excavated material, debris, raw materials like paints, fuel, rusting of iron, etc.; The site being in close vicinity to channel, khal, river, and sea, however, dredged materials, wastewater and rainfall-runoff from the site will directly enter the river & sea that might impact the quality of the river & seawater and aquatic life.

375. **Mitigation Measures**: To mitigate this anticipated impact, it is required to manage surface run-off to minimize impact on water quality & aquatic life supported by the water bodies; No solid or liquid waste shall be discharged in canals, the Sandwip channel, or any other water body. Septic tanks/soak pits should be provided at the construction site & labor camp to keep sewage of labor camps and prevent its disposal in water bodies; Toilets should be provided at construction sites & labor camps to prevent contamination of water due to open defecation in nearby areas. A temporary stormwater drainage system should be developed at site to channel the storm water away from the excavation/filling area, debris storage area, and raw material storage area. All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of surface runoff and onsite water testing with testing kits (e.g., turbidity, pH, BOD, etc.) should be conducted regularly; If any negative impacts, or dead bodies of fish or other sea creatures found, it should be reported immediately.

7.5.3.11.OCCUPATIONAL HEALTH AND SAFETY (ESS-2)

376. The land development of Part of Precinct F (IMD Zone and Housing Facilities) will involve a range of activities that might possibly be unsafe to workers and the local community if measures or precautions are not taken. The construction activities include site preparation, mobilization of equipment and dredging pipe installation, setting up camps, and building structures. Hazards associated with the fall of construction material (toxic or flammable liquids; flammable solids; oils and other hydrocarbons; paint; metal waste; etc., from diverse construction work) or tools, as well as the collapse of constructed structures can result in injury to the head, eyes, and extremities. Potential for slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction material, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, which results in injuries and time loss during construction. Transportation and movement of vehicles are associated with road accidents and related hazards, which can lead to injuries and fatalities; Improper housekeeping, inappropriate use of PPEs, and absence of an emergency response plan at the working site would likely impact the health and safety of the associate's worker.

377. **Mitigation Measures:** To reduce the occupational health and safety risks, it is suggested that workers should be provided with on-the-job training on OHS issues; To ensure appropriate PPE (Hard boots, life vest, safety goggles, hand gloves, etc.) is available at the site and used by workers; Sanitary toilets should be made at the sites; a separate female toilet is required if female workers are involved at the sites; The drinking water supply should be accessible to each worker at the site (a portable drinking water supply is acceptable); A toolbox meeting (TBM)/ and Toolbox Talking (TBT) should be carried out on OHS issues before starting to work at the site; Ensure implementation of Occupational Health and Safety Management Plan (indicative OHSP is documented in Appendix 5, Vol-II; Contractor will ensure implementation of the Environmental and Social Code of Practice as documented in Appendices 10, Vol-II.

7.5.3.12.CHILD LABOUR (ESS-2 AND ESS-4)

378. **Child labor**: The child labor involvement may occur at the landfilling site due to lower wages and forced to work for a long time. It may impact on the educational opportunity of school-going children in the path of the project., and impact of the sub-project on the increase in child labor.

379. **Mitigation Measures:** To mitigate this problem, it is suggested that contract and PIU, PRIDE, or BEZA shall include provisions for the prohibition of child labor; and Contractor, PIU of PRIDE project, and BEZA shall regularly monitor project sites to guide contractors and third-party monitoring/ related firms to discourage child labor. It is strictly prohibited to recruit child labor following the Labor Rules 2015 (amended in 2022) and World Bank Environmental and Social Framework.

7.5.3.13.LABOR INFLUX AND WORKING CONDITIONS (ESS-2)

380. It is estimated that around 30-35 workers will be required at the landfilling and dredging sites. This kind of job is heavily loaded; normally local people are not familiar with working in this type of job. Contractors can usually higher workers from other districts who are experienced in this type of job. That's why labor influx will occur however the number of workers will not be large quantities. However, the labor influx will carry forward some health hazards to the new areas particularly for transmitted diseases like HIV/AIDS, COVID-19 and others etc., which may affect the local people health and safety also. Other risks are associated with labor influx such as migrated workers may be involved in interaction with the local community due to the forced migration of local people; migrated workers may conflict with local people due to price hikes; Influx of labor may affect the project area adversely in terms of additional burden on public infrastructure, such as health services, utilities (i.e., water and electricity), housing, and social dynamics.

381. **Mitigation Measures:** It requires residential support for the workers and other staff members during dredging-related work, including landfilling, and it requires ensuring an adequate number of amenities or facilities, such as play areas, lavatory sets, bathing blocks, kitchens, canteens, prayer rooms, and amusement rooms. The camps must include emergency exits, fire safety and fire protection systems, and firefighting supplies. Additionally, a waste management system needs to be implemented. Toilet sets must be installed with an airtight and watertight septic tank (with the entire inside wall of the RCC chamber or brickwork plastered) and ensure the Labor Management Plan (LMP) is fully complied with the management of labor influx (following the LMP of the PRIDE Beza[58]).

[58] Labor Management Procedure (LMP), Private Investment and Digital Entrepreneurship (PRIDE) Project, Bangladesh Economic Zones Authority (BEZA), February 2020 .
https://documents1.worldbank.org/curated/en/141611582829764921/pdf/Revised-Labor-Management-Procedures-Bangladesh-Private-Investment-amp-Digital-Entrepreneurship-Project-P170688.pdf

7.5.3.14.EMPLOYMENT GENERATION (ESS-2)

382. **Employment opportunities**: The employment opportunities will be ensured by direct employment for unskilled labor, indirect employment to the local community, and employment of women workers. Direct employmentincludes site clearance, excavation, loading and offloading of materials and deliveries, masonry, and construction works. Further, the construction labor force will require food and other items, which are expected to be supplied by the local eateries, retail shops, and the local community. The local community members can take advantage of these opportunities. Employment generation benefits improve the quality of life of the laborers and enhance their productivity and living standards. Through employment generation, both direct and indirect, land development of Part of Precinct F (IMD Zone and Housing Facilities) in NSEZ will have a tremendous impact on human development and poverty reduction in the project area. Different types of construction work will create an important avenue for young women to become part of the formal economy at better wages compared to agriculture and domestic services. Employment opportunities due to the land development of Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ will increase employability and position in the household. In addition, the NSEZ is expected to assist women in changing their occupational patterns and accessing better job opportunities and wages.

7.5.3.15.COMMUNITY HEALTH AND SAFETY (ESS-4)

383. The community health and safety will be at risk due to dust blowing, increased noise level from different project activities; use of hazardous materials and generation of hazardous wastes from the landfilling site, labor camps, increased construction vehicle movement will also put endanger of community safety and water borne disease is very common due to releasing of liquid waste or effluent from the landfilling sites and faecal elements from the labor camps that will jeopardize the community health and safety also. However, due to labor influx, it is possible to increase sexually transmitted diseases like HIV/AIDs and other issues will also affect the community health and safety issues such conflict with the migrated laborers etc.

384. **Mitigation Measures**: These anticipated impacts can be mitigated to ensure dust suppressing vehicle sprays water, conduct free, prior, and informed community consultation; provide traffic management personnel to control traffic. Disseminate leaflets, awareness signage, and posters regarding HIV/AIDS; conduct awareness training on social conflict, transmitted diseases such as HIV/AIDS and conduct toolbox talks daily basis and cover these issues etc.

7.5.3.16.WASTE GENERATION AND SPILLAGE (ESS-4)

385. Different kinds of waste such hazardous and non-hazardous waste will be generated during land filling activities. The non-hazardous waste, including excavated material, construction material, solid waste, and wastewater, etc. will be generated due to project activities; Hazardous waste may include used oil, empty drums, or replaced parts of the construction machinery, used batteries, chemicals for concreting like admixture, etc.; Potentially several risks to human health and the environment that maybe associated with the handling, storage, and disposal of waste; Environmental pollution with organic and non-organic waste generated from project activities may occur due to uncontrolled disposal and inadequate management of waste; Discharge of untreated wastewater can result in pollution in soil and water bodies, and have adverse effects on human health, flora and fauna, and surface and groundwater; Accidental release and/or inappropriate disposal of oil from the dredging equipment/ vehicles and disposal of dredging liquid waste.

386. **Mitigation Measures:** To reduce this impact, it is necessary to establish a waste management system at the project area; Train workers, staff to manage waste properly; Provide waste collection bins (hazardous, organic, and solid) at labor camps, administrative buildings, and construction sites; Maintain waste inventory, and conduct an MOU with the waste collector as per the waste management plan and Implement a site-specific Waste Management Plan by the contractor etc.

7.5.3.17.GENDER BASED VIOLENCE (GBV), SEA/SH (ESS-2 AND ESS-4)

387. GBV, SEA/SH will occur mainly wage discrimination between men & women; lacks of women-friendly sitting arrangements and drinking water facilities; Eve teasing and sexual abuse; Women, particularly of weaker sections, may be discouraged from speaking and demanding equitable benefits in the name of Prodan/ dignity of women.

388. **Mitigation Measures**: To mitigate this problem, it is necessary to ensure that the project has been screened for GBV risks, and it has been rated as “substantial”; The GBV Action Plan that will be prepared by BEZA will include appropriate mitigation measures. Conduct training on GBV/SEA/SH by the social and gender councilor,

following the World Bank's relevant good practices[59]. Social Counselors of the NSEZ will monitor regularly on these issues.

7.5.3.18.SOCIAL CONFLICT (ESS-4)

389. Influx of workers to the community may cause impacts to community health and safety, especially an increase in the prevalence of diseases and social conflict; Migrant labor will impact the local environment and will create extra pressure on locally available resources like housing, water, transportation, etc. Community is food and water-borne diseases, faucal elements contamination into water, possibility of an increase in sexually transmitted diseases such as HIV/aids because of the influx of workers; Migrantlabor can involve local politics, and labor can abuse the female worker as well as the neighboring society etc.

390. **Mitigation Measures:** To mitigate these anticipated risks, the contractor should execute free, prior, and informed consultation with the local people; Distribute leaflets, awareness signage, and posters regarding HIV/AIDS; Conduct awareness training on social conflict, transmitted diseases such as HIVAIDS; Conduct toolbox talks daily basis and cover these issues and Gender-based violence should be strictly monitored at the site etc.

7.5.3.19. MOVEMENT OF ROAD TRAFFIC AND SAFETY (ESS-4)

391. Due to movement of road traffic, the safety of local people will be endangered due to increased construction vehicles movement etc.; Traffic jams may occur in busy areas; Dredging pipelines may obstruct traffic movement and local roads; Dust blowing, increasing noise level from different project activities; Increase the number of accidents; Increase noise near schools, hospitals; Accident of a water vessel if dredging pipelines are not properly marked or accurately surveyed due to water conditions and depth; Tidal shifts can suddenly change the water depth, posing a risk to the dredger's stability or causing it to run aground.

392. **Mitigation Measures:** To manage this problem, it is necessary to ensure that the compactors, bulldozers and other equipment will be mobilized via road and waterways networks during the daytime; Ensure traffic lights for assisting vehicles, particularly during the evening. Allocate traffic management personnel with proper PPE, flags, signal lights, etc. Ensure the speed of vehicles (maximum limit 25 km/hr.); Provide training to the drivers, operators, and signalmen; Control any danger from the dredger pipeline accident of water vessels by the proper installation of the dredger pipeline with marking; Ensure the Traffic Management Plan is implemented properly by the contractor (as an indicative TMP is documented in **Appendix 8, Vol-II**.)

7.6. CUMULATIVE IMPACT ASSESSMENT

393. The Cumulative Impact Assessment (CIA) process for the development of Precinct F (IMD Zone and Housing Facilities) under the PRIDE Project in the National Special Economic Zone (NSEZ) follows the International Finance Corporation (IFC) guidelines[60], focusing on a six-step process[61] that evaluates both current and future conditions concerning various valued components (VCs), including physical features, habitats, and wildlife populations, ecosystem services, social conditions, and cultural aspects due to and potential impacts of land preparation activities, specifically landfilling, across a substantial area of 1560 acres.

394. The CIA has been prepared considering the existing, ongoing, and future development activities within 5-7 km influence area of the sub-project during the proposed project duration. Whereas, the CIA of Regional Strategic Environmental Assessment (RESA) report has considered the entire study area of NSEZ. Since land filling would take place in the proposed sub-sones in a phased manner, the CIA will help the project proponent to avoid or mitigate any significant cumulative impact by zoning/sequencing of the development activities. The CIA would enable the authority to evaluate the thresholds of landfilling or any concurrent development that the ecosystem can sustain before any irreversible damage takes place in the sub-project area. Thus, making this CIA a key tool for the justification of this ESIA study.

395. The existing sub-project development in the economic zone will contribute to environmental impacts on Valued Components (VCs) like land use, air quality, water quality, water resource, mangrove habitat, aquatic ecology, community health and safety, socioeconomics, etc. In the CIA process, the VC screening process was applied, using

[59] The World Bank (2018): Good Practice Note Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works.
[60] The Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (IFC, 2013).
[61] Scoping-Phase-I for valued components (VCs), Phase II: environmental drivers, the establishment of Baseline condition, Assessment of current conditions of the site, Prediction of future conditions, Management of cumulative impacts etc.

a logical analytical framework, to determine which of the sub-project identified VCs can be reasonably expected to be affected by some combination of other sub-projects and/or external stressors and the multi-projects. The key VCs selected for this CIA are land use, air quality, surface and groundwater resource, m, drainage, terrestrial, aquatic, and marine ecologies, livelihood (land-based agriculture & fisherman), and social well-being.

396. Cumulative impact is the combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in the case of standalone projects. In this case, the cumulative impact is the combination of multiple impacts from existing projects that are not part of PRIDE project such as bridge project (length 550 meters) which is being implemented by the Local Government Engineering Department (LGED) and construction of Super Dyke along Sonagazi sites of the NSEZ etc. It is expected that these anticipated projects will be initiated within the next two to three years, supported by other funding agencies (not yet finalized). However, based on available information from secondary sources, there are some industrial construction activities such steel industry, electronics, glassware industries, footwear, pharmaceuticals, paints industry, etc., have started in the NSEZ areas that will also contribute to the CIA[62].

Figure 7-3 : Industrial Infrastructure Construction Activities in the NSEZ Areas

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

Summary of VCs of Landfilling Activities

398. To assess the contribution of the landfilling of the part of Precinct F (IMD Zone and Housing Facilities) 1560-acre land areas, key cumulative impact issues are summarized from existing VC as follows:

Physical Environment

1. Land Use: Land use patterns will be permanently changed due to sand filling in the depression part of IMD Zones and their adjacent areas. However, this land use changes will not be impacted by other construction activities which are not part of PRIDE project.
2. Air Quality: Air quality such as PM $_{2.5}$, PM_{10}, NOx, SOx, CO etc., will be deteriorated in the IMD Zone and its adjacent study areas due to release of air pollutants from various emission sources such as ongoing construction of various industries, and construction of a 550m long bridge over the Feni River, however, future construction of super dyke will also elevate the deterioration of local air quality in this area.
3. Noise Quality: The estimated baseline noise level will be further declined due to the other construction activities/operations in the NSEZ areas such as construction of various industries, and construction of a 550m long bridge over the Feni River and future construction of super dyke on the Sonagazi site of NSEZ
4. Surface water Quality: Surface water quality may deteriorate due to dredging wastewater discharge into canals and ponds in the study area. Dredging can allow saltwater and heavy metal from the Sandwip Channel. However, the surface water contamination will be further elevated by the other project activities such as construction of a 550 meters long bridge over the Feni River and construction of Super Dyke including other construction of industries in the NSEZ areas. These activities will release wastewater, solid and liquid waste, effluents into the nearest canals and khals if proper mitigation measures are not undertaken during construction/operation period.
5. Groundwater Quality: Groundwater quality may be deteriorated due to leachate the heavy metals from the dredging material into the ground that will be further elevated by releasing of pollutants from the other

[62] Regional Strategic Environmental Assessment of NSEZ, BEZA, Vol. II. 2025

construction activities such as liquid waste and construction waste etc. The seawater sediment will not be impacted by the other construction activities, so, CIA will be of lower significance in this case.

6. Water logging and drainage congestion: Local water bodies will be impacted by releasing excessive sediments from the landfilling sites if proper drainage is not ensured during the landfilling activities. However, this situation will be further worsened by surface runoff from the other construction activities particularly at the time of heavy rains.
7. Climate Change Vulnerability: Necessary to evaluate the vulnerability to climate change impacts, such as sea-level rise, extreme weather events, and temperature changes. GHG emissions and Carbon footprint related to the land reclamation and dredging operations. The GHG emission such as NOx, SOx, CO will be further elevated by releasing air pollutants from the other construction activities for using of vehicles, equipment, and construction materials etc.

Marine ecology, aquatic life, terrestrial flora and fauna

1. The Sandwip channels and Feni River are considered an important breeding ground for commercially important fish species and potential habitat for dolphins. River dredging may impact the onsite reservoirs, kill fry and eggs, and alter the breeding habitat of mentioned aquatic animals temporarily. Dredging activities may temporarily disturb the movement of fish along the Chennel. Due to the lotic water (water current existing) dredging site will be normal after the dredging activities are completed. Excavation, transportation and disposal of soft-bottom material may lead to various adverse impacts on the marine environment[63].
2. The population of aquatic organisms changes in aquatic fauna may consequently alter in food chain and food web at the primary trophic level due to an increase of sedimentation. Increased sedimentation may decrease primary production and create negative cascades by depleting food availability to zooplankton, insects, freshwater mollusks, and fish.
3. Reduction in the number of species or change in structure can be improved or re-vegetated through eco-restoration of habitats. Destructed vegetation cover and habitat can be re-established through afforestation and a habitat improvement program. Success and the implementation of the habitat restoration program depend on the proper use of suitable techniques and methods to establish green coverage best suited as a wildlife habitat. Nursery and plantation techniques vary considerably among the different species and existing conditions; irrespective of the areas under the core zone or buffer zone, considering the inundation level and condition of soil, species would be selected. Such habitat restoration programs are recommended at a block that is inside the impacted area. So that biodiversity may increase and /or new natural ecosystem may develop again.

Social Aspect

1. Disturbance of agricultural land and produce due to the dredging pipeline alignment passing over the agricultural lands.
2. Disruption of the smooth movement of vehicles and pedestrians by local access/roads due to the dredged material transport pipeline
3. Occupational Health Safety and Community Health Safety: accidents of workers and project personnel may occur, as well as to the local community.
4. Labor Influx will create negative impacts due to the employment of workers/ workforce from different places. Conflict between local workers and far-off workers, and the local community. Unhygienic conditions resulting from the day-to-day activities of workers during the construction stage may spread various diseases and other adverse impacts.

7.6.1.KEY VC OF CIA FOR THE LANDFILLING ACTIVITIES

399. Based on the foregoing assessment of key issues, the following VCs) were considered in the CIA:

1. Air quality
2. Water quality
3. Sediment quality
4. Marine ecology, aquatic life, terrestrial flora and fauna
5. Labor Influx/ Employment during the construction phase

[63] Environmental impacts of dredging on seagrasses: A review, Marine Pollution Bulletin, Volume 52, Issue 12, December 2006, Pages 1553-1572

Table 7-6 : VCs Selected for the CIA of Land Development Sub-project Activities

VC	Rationale	Current Status
Air Quality	Dredging involves the removal of sediments and debris from the bottom of water bodies, which can release dust and particulate matter into the air. However, the other construction activities can lead to a substantial increase in airborne pollutants. The simultaneous operation of multiple construction projects can lead to a compounded effect on air quality. The combined emissions from dredging and other construction activities such as construction of various industries, bridge and super dyke can result in significantly higher levels of pollutants.	Ambient air quality at all the points is found within the allowable Bangladesh standards. In the land development zones, PM2.5, PM10, SO2, NO2, CO, and O3 values are also within the Bangladesh standard.
Water Quality	The proposed sub-project activities are likely to have significant implications for local water quality. The discharge of dredging water into nearby canals and ponds poses a direct threat to aquatic ecosystems and the overall health of water bodies in the region. This contamination is not an isolated issue; it is expected to be compounded by other construction activities such as construction of varies industries, bridge and super dyke etc. that may further pollutants into the environment. In addition to the direct effects of the sub-project activities, the cumulative impact of other development works in the area cannot be overlooked. bridge construction, factory setups, and Super Dyke construction can all contribute to increased pollution loads in local water bodies. The interaction between these various sources of contamination can create a compounded effect, leading to more severe water quality issues.	Tested all parameters of DO, TDS, TSS, EC, Turbidity, pH, Salinity, COD, BOD, Hg, Pb, Cd, Oil and Grease, FC, TC of surface water samples. were within the standards of the ECR, 2023, except that TDS in two water samples was slightly above the standards Groundwater tested parameters were TDS, EC, Turbidity, pH, Salinity, Total Hardness as CaCO3, Fe, As, Mn, Odor, FC, and TC. Results showed that only DS and Turbidity in one sample exceeded the national ECR 2023 standard. Fe concentration in all samples slightly exceeds the standard set by the ECR 2023. The groundwater samples were collected from 650-700 feet.
Sediment Quality	Dredging operations inevitably disturb and resuspend sediments, leading to a decline in sediment quality both in marine and riverine environments. This disturbance can release contaminants previously bound within the sediment matrix, increasing their bioavailability and potentially impacting aquatic ecosystems. A significant concern arises from the dewatering of dredged materials. This process, while necessary for volume reduction and subsequent disposal or beneficial reuse, can release contaminated water back into nearby surface water sources. The effluent from dewatering operations may contain elevated levels of	The analysis revealed that the textural composition of the sediment samples, characterized by the relative proportions of Sand, Silt, and Clay, aligns with the acceptable ranges outlined in the Australian standards. Similarly, the concentrations of the analyzed heavy metals (Zn, Cu, Hg, Pb, and Cd) were all below the threshold levels specified in both the Australian standards[64] and the Dutch Intervention Values[65]. This indicates that, based on these parameters and compared to these international standards, the sediment quality is within acceptable limits. The absence of specific sediment quality standards in Bangladesh necessitates the adoption of international benchmarks for environmental assessments. While the Australian standards and

[64]Reference: https://www.ppsthane.com/blog/soil-sediment-sampling
[64] Recommended toxicant default guideline values for sediment quality, Australian Government Initiative. https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants
[65] Guidance Document for Sediment Assessment, Date 4 November 2010, e Dutch Water Act. Ministry of Infrastructure and the Environment - DG Water. December 2009
[65] DGV means Default guideline values.

VC	Rationale	Current Status
	suspended solids, nutrients, heavy metals, and organic pollutants, further degrading the sediment quality of the receiving water bodies. The problem can be compounded by other construction activities occurring in the vicinity, especially those not supported by the World Bank (WB). For instance, bridge construction often involves pile driving, cofferdam installation, and other activities that can generate sediment plumes and release pollutants. These activities, if not managed properly, can exacerbate the negative impacts of dredging on sediment quality and overall ecosystem health. The cumulative effect of dredging and non-WB supported construction can lead to a significant and potentially long-lasting decline in sediment quality, requiring careful monitoring and mitigation strategies.	Dutch Intervention Values provide a valuable framework for evaluating sediment quality, tailored to the local environmental context and potential sources of pollution, it would be beneficial for more accurate and relevant assessments in the future. This would allow for a more nuanced understanding of sediment quality and its potential impact on the local ecosystem and human health.
Marine ecology, aquatic life, terrestrial flora and fauna	The population of aquatic organisms' changes in aquatic fauna may consequently alter in food chain and food web at the primary trophic level due to an increase of sedimentation. Increased sedimentation may decrease primary production and create negative cascades by depleting food availability to zooplankton, insects, freshwater mollusks, and fish. A total of 123 species of important terrestrial plants under 116 genera of the family 61 have been recorded in the project area. Among them, 44% are trees, 41% are herbs, and the rest are shrubs. Out of 123 species of terrestrial plants, mostly used as medicinal and which is 56 in number and used as timber 27, fruit-bearing 28, ornamental 08, and fuel 04. 23 species of aquatic plants have also been identified. A total of 10 species of amphibians, 70 species of birds and 10 species of mammals were recorded in the study area.	The baseline conditions suggested 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 conditions created by high Suspended Particulate Matter (SPM) resulting from other activities. **Benthos:** A total of 19 taxa (families) of soft-bottom macrobenthos were recorded of which 14 families were identified over the six sampling sites. The mean abundance (individual/m2) was 707.8±210.2. St 9 had the lowest density of macrobenthos, followed by St14. The other sites demonstrated similar density but were >1.5 times higher in abundance than that of L-09 and 14. In addition, the District Fisheries Officer (DFO) in Feni district has confirmed that one Hilsa breeding site is predicted at the confluence of the Sandwip channel and the Feni river (also called as Muhuri River), which is 5 km away from the nearest potential dredging locations (L-09), and the Mayani point is another Hilsa Spawning Ground (91°32.15′E and 22°42.59′N), located in the Shaerkhali canal inside Mirsharai plain land, notified in the Gazette in 2014 by the DoF But the current condition of this spawning ground in the Shaerkhali canal is silted up, and the local people have reported that there is no evidence of this Hilsa spawning ground. The study areas are characterized by a common assemblage of terrestrial plants, animals, and Aves species. Detailed surveys confirmed the absence of any species listed as threatened or endangered under relevant conservation legislation. Given the commonality of the observed species and

VC	Rationale	Current Status
		the specific nature of the proposed dredging activities for landfilling, the assessment predicts no potential impacts on the terrestrial ecology of the study areas. Dredging activities are not expected to significantly disrupt habitats or negatively affect the populations of the observed species.
Social		
Labor Influx/Employment	Included due to the impact the sub-project will have on jobs in the area and the potential for labor influx. On a more positive note, the employment variable is expected to have a high positive impact as a result of the new job opportunities created by the development of the economic zone. This influx of employment can significantly benefit the local economy and contribute to the area's overall development.	Local laborers are not receiving job opportunities in the EZ preparatory activities. Influx of laborers for preparatory activities.

Table 7-7 : Potential Cumulative Impacts of Landfilling Activities on Each VC

VCs	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact
Air Quality	PM2.5, PM10, SO2, NO2, CO, O3	Particulate emissions may exceed standards for a short period at the construction site and along access roads.	Impacts are expected to be localized, and of moderate duration in the construction phase, and further elevated by other construction of bridge, super dyke and various industry in NSEZ areas. The impact will be of lower significance.
Water Quality	Surface water parameters - Temperature, TSS, EC, Turbidity, pH, Salinity, COD, BOD, Hg, Pb, Zn, Cr, TC	Surface water quality may be affected by potential leaks of fuel or oil from the Dredger and other machinery for dredging activities. From sanitary waste if proper toilet facilities are not installed for workers.	Impacts are expected to be localized and further increased by other construction of bridge, super dyke and various industry in NSEZ areas. The impact will be of lower significance.
Sediment Quality	Sediment parameters- relative proportions of Sand, Silt, and Clay, the heavy metal concentrations (Zn, Cu, Hg, Pb, and Cd)	A significant concern arises from the dewatering of dredged materials. This process, while necessary for volume reduction and subsequent disposal or beneficial reuse, can release contaminated water back into nearby surface water sources. The effluent from dewatering operations may contain elevated levels of suspended solids, nutrients, heavy metals, and organic pollutants, further degrading the sediment quality of the receiving water bodies.	Impacts are expected to be localized and further increased by other construction of bridge, super dyke and other industrial operations. The impacts will be of medium significance.
Marine ecology, aquatic life, terrestrial flora and fauna	Terrestrial flora and fauna species, aquatic ecosystem covering aquatic floral and faunal species both marine and freshwater and particularly concerned for Hilsa breeding zones at the confluence of the	The population of aquatic organisms' changes in aquatic fauna may consequently alter in food chain and food web at the primary trophic level due to an increase of sedimentation. Increased sedimentation may decrease primary production and create negative cascades by depleting food availability to zooplankton,	Destructed vegetation cover and habitat can be re-established through afforestation and a habitat improvement program Nursery and plantation techniques vary considerably among the different species and existing conditions;

VCs	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact
	Sandwip channel and the Feni River (also called as Muhuri River) and Shaerkhali canal which is already silted up.	insects, freshwater mollusks, and fish.	irrespective of the areas under the core zone or buffer zone, considering the inundation level and condition of soil, species would be selected. Such habitat restoration programs are recommended at a block that is inside the impacted area.
Employment	Workforce numbers	Land development of part of Precinct F (IMD Zone and Housing Facilities) will result in additional but limited job creation for the area. The project should ensure that local people are given employment opportunities. Labor influx to the area is not expected at the construction stage.	Localized and no adverse cumulative impacts are anticipated. Even, the employment generation will be increased due to other construction activities that are not part of the PRIDE project. The impacts will be substantial due to getting access to the employment opportunities by the local people.

7.6.2.ASSESSMENT OF CUMULATIVE IMPACTS

The assessment of cumulative impacts of various completed and ongoing activities in and around the proposed additional area on each selected VC is discussed above The following assumptions of additional landfilling activities were made for the CIA:

- This will form part of the full CIA as part of the ESIA for the land development sub-project. The CIA only considers the impacts of the IMD Zone, 18 Zone, and Zone 5 land development activities or being carried out in and around the area.
- Proposed landfilling by dredged seabed material and other completed, ongoing, and proposed works such as Super dyke, power Plant, access road construction, and gas line network has been added, .
- The proposed CIA area considered cumulative impacts on the four selected VCs. It does not include consideration of the cumulative impacts of future proposed projects and impacts during the operation phase.
- The temporal boundary of the assessment is only during the construction phase.
- The spatial boundary of the CIA is the landfilling
- Impacts were assigned in three categories: low, moderate, and high (as shown in legend)

Table 7-8 : Cumulative Impact Assessment of Sub-Project and Other Activities on Valued Components

Activity	Valued Component					Overall Cumulative Impact
	Air Quality	Water Quality	Sediment Quality	Marine ecology, aquatic life, terrestrial flora and fauna	Employment	
Project Activity						
Dredging of bottom sediments						
Transport of dredged material by pipeline to shore						
Drying of dredged material						
Grading and leveling of dredged material						
Compaction of surface						
Other Activities						
Construction of an administration building						
Setting up labor camps						
Revegetation and establishment of green buffers						
Categorization of Impact						
	Low (L)		Impacts are localized, of short duration and are expected to have an insignificant effect on the valued component			

Activity			Valued Component					Overall Cumulative Impact
			Air Quality	Water Quality	Sediment Quality	Marine ecology, aquatic life, terrestrial flora and fauna	Employment	
	Medium (M)		Impacts are more widespread, of moderate duration and are expected to have a limited to moderate effect on the valued component					
	High (H)		Impacts are widespread, of longer duration and are expected to have an adverse effect on the valued component					

Table 7-9 : Summary of the expected Potential Cumulative Impact of Landfilling Activities on each VC

VCs	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact
Air Quality	PM2.5, PM10, SO2, NO2, CO, O3	Particulate emissions may exceed standards for a short period at the construction site and along access roads.	Impacts are expected to be localized, and of moderate duration in the construction phase, and no adverse cumulative impacts are anticipated if proper mitigation measures are adopted as per ESMP.
Water Quality	Surface water parameters - Temperature, TSS, EC, Turbidity, pH, Salinity, COD, BOD, Hg, Pb, Cd, Zn, Cr, TC)	Surface water quality may be affected from potential leaks of fuel or oil from machinery for construction. Potential for contamination from sanitary waste if proper toilet facilities are not installed for workers.	Impacts are expected to be localized and no adverse cumulative impacts are anticipated.
	Groundwater parameters to be selected – pH, Cl, TDS, TSS, EC, oil/grease, coliform, metals (arsenic)	Fuel, oils, and chemicals may seep into groundwater from leaks or the inadequate disposal of waste.	Impacts are expected to be localized and no adverse cumulative impacts are anticipated.
Sediment Quality	Concentrations of Zinc, Copper, Mercury, Lead, Cadmium need to be assessed	Run off from the site may introduce contaminants into adjacent drainages	Localized impacts on marine water quality are expected. Fill quality of dredged material meets international standards. No adverse cumulative impacts expected.
Marine ecology, aquatic life, terrestrial flora and fauna	Terrestrial flora and fauna species, aquatic ecosystem covering aquatic floral and faunal species both marine and freshwater and particularly concerned for Hilsa breeding zones at the confluence of the Sandwip channel and the Feni River (also called as Muhuri River) and Shaerkhali canal	Sediment runs off from the dredging sites and landfill sites may contaminate the aquatic ecosystems which will be of medium significance and terrestrial flora and fauna will be affected as of lower significance.	The assessment concludes that no adverse cumulative impacts are expected. However, the report emphasizes the critical importance of strict monitoring throughout the dredging operation period, contingent upon the perfect implementation of all proposed mitigation measures. The assessment highlights the following key points: • **Localized Impacts:** Dredging activities are expected to cause localized disturbances to marine and freshwater quality. These disturbances may include increased turbidity, temporary habitat disruption, and potential release of sediment-bound pollutants.

VCs	Indicator	Potential for Cumulative Impact	Contribution to Cumulative Impact
	which is already silted up		• **Fill Quality:** The dredged material meets international standards for fill quality, minimizing the risk of long-term contamination from the disposal or reuse of the material. • **Cumulative Impacts:** The assessment concludes that no significant adverse cumulative impacts are anticipated from the dredging operation, considering other existing or planned activities in the area. • **Monitoring and Mitigation:** The report stresses the necessity of rigorous monitoring during the dredging operation. The effectiveness of the mitigation measures is paramount to ensuring minimal environmental impact. Perfect implementation of these measures is a prerequisite for the positive conclusion regarding cumulative impacts.
Employment	Workforce numbers	Land development of part of Precinct F (IMD Zone and Housing Facilities) will result in additional but limited job creation for the area. The project should ensure that local people are given employment opportunities. Labor influx to the area is not expected at the construction stage.	Localized and no adverse cumulative impacts are anticipated Ensure engaging local people, Ensure appropriate OHS measures for the workers, implement GRM and GRC at all levels, Arrange emergency response facility, first aid box, and health check for all the staff

400. In conclusion, the measures/ management plans developed for each VC in this ESIA are integral to mitigating negative impacts associated with land development. The outlined responsibilities for BEZA and other organizations ensure a coordinated approach to monitoring and mitigation.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1. OBJECTIVES

401. The Environmental and Social Management Plan (ESMP) outlines the strategies and measures to manage and mitigate the potential environmental and social impacts. The objectives of the ESMP are typically designed to ensure responsible and sustainable practices throughout the project lifecycle. The specific objectives are as follows:

- Ensure that the project adheres to all relevant national, International, and World Bank environmental and social regulations and standards.
- Identify and assess potential environmental and social impacts of the sub-project.
- Develop strategies to mitigate and manage adverse impacts to an acceptable level.
- Enhancing stakeholder engagement, including local communities, indigenous groups, and other relevant parties;
- Establish mechanisms for communication, consultation, and feedback to address concerns and incorporate local knowledge.
- Implement measures to protect and conserve biodiversity, ecosystems, and natural resources affected by the subproject.
- Promote resource efficiency and sustainable use of natural resources.
- Develop effective waste management plans to minimize environmental pollution.
- Address social issues such as displacement, resettlement, and labor conditions.
- Build the capacity of local communities, project staff, and relevant stakeholders to understand and manage environmental and social issues.
- Develop and implement plans for responding to emergencies, accidents, or unforeseen events that may have environmental or social implications.
- Establish a robust monitoring and reporting system to track the implementation of the ESMP and assess its effectiveness.
- Regularly communicate the project's environmental and social performance to stakeholders and the Project Authority.
- Encourage continuous improvement by reviewing and updating the ESMP as necessary to ensure best practices. etc.

8.2. POSSIBLE MITIGATION MEASURES AND RESPONSIBLE PARTIES

402. The details on possible mitigation measures and responsible parties are presented in the Environmental and Social Management Plan of this study as shown in **Table 8-1**. It is noted that contractors' responsibility for planning and execution of various mitigation measures, and the monitoring and supervision will be done by DSC and PIU.

Table 8-1: Environnemental and Social Management Plan

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
Construction Phase (Pipe installation, Dredging, and Landfilling activities)					
Pipe Installation	Noise level	• To reduce the noise level, it is necessary to plan the pipe route to minimize proximity to sensitive receptors. • Selecting low noise generating equipment • Maintain construction-related noise-generating vehicles, equipment, machinery, and generators on a regular interval • Restrict the speed limit of construction vehicles to a maximum of 30 km/hr. • Workers should be provided with earplugs and encouraged their use and ensure good and low-noise-producing engines • Limit construction-related activities from 6 am to 6 pm • Conduct noise level and vibration level monitoring at regular interval	Contractor's responsibility for planning and execution of various mitigation measures.	DSC & PIU	Contract cost
	Local Ecosystems Loss of habitat for wading birds (resident and migratory) Loss of habitat for amphibians and reptiles	• To minimize the ecological impacts, delivery pipelines should be chosen in consideration of the areas with less vegetation • Implement noise reduction measures, such as using quieter equipment or installing noise barriers, • Work should be limited to only daytime from 6 am to 6 pm • Clearing natural vegetation will be avoided as far as possible. • The construction staff will not indulge in any animal shooting, trapping, catching, or killing activities. • Areas reserved for future development at the site shall be made green by growing grasses and shrubs, and herbs • Noise barriers will be installed where needed • Vehicular traffic through the habitats will be avoided as far as possible. • Contractors shall use lower-wattage flat lens fixtures that direct light down and reduce glare, and shall avoid the use of flood lights • Contractors will also raise awareness about the protection of birds and other wildlife species among the workforce to reduce impacts such as disturbance	Contractor	DSC & PIU	Contract cost
	Occupational Health and Safety	• To minimize risk, it is necessary to utilize cranes, forklifts, pipe layers, and other mechanical lifting devices to minimize manual handling. • Ensure that all equipment is properly maintained and operated by trained personnel • Implement lockout/tagout procedures to prevent unexpected events. • Necessary PPE should be accessible for the workers, such as earplugs or earmuffs, hand gloves, respirators, and eye protection • The contractors should follow the Occupational Health and Safety plan during	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
		construction work as shown in **Appendix 5, Vol. II)** . • The contractor should implement the Emergency Response and Disaster Management Plan (as shown in **Appendix 6, Vol. II.** at the site for workers to combat natural disasters like cyclones, surges, thunder, etc. and immediately save lives			
	Community Health and Safety	• Occurrence of accidents due to improper installation of dredging pipes. To mitigate this problem, it is suggested to avoid pipe routes alongside villages and busy areas with alternative routes and access points for local people, • Ensure the Traffic Management Plan is implemented properly by the contractor to control traffic accidents / disruption of local transports safe movement as documented in **Appendix 8, Vol-II,** • Work should be conducted only in the daytime from 06 am to 06 pm • Avoid damaging property of local people as much as possible • Address any kind of complaints promptly and respectfully.	Contractor	DSC & PIU	Contract cost
Dredging	Air Quality	• Provide face masks for the workers, laborers and staff • Conduct air quality monitoring as per the national standard • Ensure good quality engines are used at the site • Adjusting dredging operations to minimize air pollution • Conduct regular inspection to meet the compliance requirements and • Other appropriate mitigation measures should be adopted based on the local conditions.	Contractor	DSC & PIU	Contract cost
	Noise level	• Use low noise generating equipment and dredging techniques such as slow dredging speeds and optimized cutter head designs • Regularly monitoring noise levels at the working areas etc. • Ensuring appropriate PPE is accessible to all. • Workers should be provided with earplugs and be encourage to use these • Limit the dredging-related activities from 6 am to 6 pm • Conduct noise level and vibration level monitoring at regular interval etc.	Contractor	DSC & PIU	Contract cost
	Surface Water Quality	• To mitigate impact, selecting dredging methods that minimize sediment resuspension, such as hydraulic dredging with cutter suction heads, is the best solution • Avoiding dredging during the spawning or breeding seasons of aquatic animals • Periodically conduct the seawater quality with an accredited laboratory and • Regular monitoring of water quality is essential	Contractor	DSC & PIU	Contract cost
	Aquatic ecology	• To lessen the impact, it is necessary to select dredging sites that minimize impacts on sensitive habitats and avoid dredging during spawning or breeding	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
	Disturbance to the aquatic riverbed species, benthos, Hilsa fish.	periods of Hilsa fish. • Employing hydraulic dredgers or cutter suction dredgers to prevent excessive turbidity • Select dredging equipment (e.g., Cutter Suction Dredger) that is known to have a low risk of sediment dispersal. The suction action inside the Cutter Suction Dredger means that most of the sediment removed by the cutter is captured. As high dredging efficiency and low turbidity at the cutter head are closely linked, it is uncommon for turbidity generated by the cutter head to cause environmental concern. • Limit the noisy dredging to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife) or during nighttime hours. Where unavoidable, the levels of engines or other noise-producing sources are ramped, so that the noise slowly increases. This will encourage marine and terrestrial fauna to move away from the source area prior to significant noise emissions. • To reduce the impact on the riverbed benthos and loss of aquatic communities, especially benthic biota. • Restrict dredging only to the area where suitable • Minimize habitat loss by applying careful control of the cutter head, restricting digging to specified boundaries • Reduce disturbance to aquatic mammals and permanent impairment • The dredging area should be checked every day prior to the commencement of dredging work. • All dredging activities should be carefully done to avoid disturbances to aquatic mammals. • Conduct onsite water testing by testing kits (e.g., turbidity, pH, BOD, etc.) • If there are any negative impacts, or dead bodies of fish or other sea creatures, it should be reported immediately • Control disturbance of fish and damage to aquatic vegetation • Ensure measures to prevent Bagda larvae collection and killing of other species by traditional fishers. • Enhance culture and capture fishery in a planned manner. • Ensures that dredging operations are suspended during this critical time of Hilsa breeding from October to November, coinciding with the Hilsa spawning period. • No dredging activities will be allowed to be undertaken during the government declared ban on Hilsa fishing for a period of 22 days, from October 22 to November 12, coinciding with the Hilsa spawning period. This regulatory measure ensures that dredging operations at L-09 will not be allowed during			

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
		this critical time, thereby safeguarding the uninterrupted spawning of Hilsa. Also, the other three locations that this enforces can be applied • To minimize disruption to fish migration, mainly Hilsa and other fish, control noise from dredging under water, limit the noisy dredging to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife) or during nighttime hours. Where unavoidable, the levels of engines or other noise-producing sources are ramped, so that the noise slowly increases. This will encourage marine and terrestrial fauna to move away from the source area prior to significant noise emissions. • To control disturbance to aquatic mammals and permanent impairment, the dredging area should be checked every day prior to the commencement of dredging work, and to avoid disturbances to aquatic mammals.			
	Climate change vulnerability	• Selecting dredging techniques is important to minimize sediment disturbance and reduce the release of contaminants, following the Dredging Management/Land Development Plan as documented in **Appendix 4, Vol. II.** • Integrate climate change adaptation strategies into dredging operations to ensure climate climate-resilient dredging operation etc. • Monitoring the exhaust gas emission from the dredgers and other equipment regularly • The contractor should implement the Emergency Response and Disaster Management Plan at site	Contractor	DSC & PIU	Contract cost
	Occupational Health and Safety	• To protect workers' health and safety, it is necessary to take preventive measures such as strict fall protection measures (e.g., safety harnesses, guardrails), vessel stability, life jackets, lockout/tagout procedures, clean and dry working areas, adequate lighting, using non-slip surface and good housekeeping and monitoring weather conditions are crucial. • The contractors should follow the Occupational Health and Safety plan during construction work (shown in **Appendix 5, Vol. II.**) • The contractor should implement the Emergency Response and Disaster Management Plan (as shown in **Appendix 6, Vol. II.** at the site for dredging activities during the natural disasters like cyclones, surges, thunder, etc., and immediately save lives	Contractor	DSC & PIU	Contract cost
	Community Health and Safety	• To minimize this impact, clear communication with the community people should be ensured and local people should be informed about the dredging schedule. • Implementing safety measures, such as marking dredging areas with buoys and providing warnings to boaters, can prevent accidents etc.	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
	Movement of Water Vessels	• It is advised to select the carefully route planning can minimize vessel traffic in sensitive areas and reduce the risk of collisions or groundings. • Reducing vessel speeds can decrease sediment resuspension, noise pollution, and the risk of accidents, and • Implementing safety measures, such as marking dredging areas with buoys and providing warnings to boaters, vessels etc., can prevent accidents, etc.	Contractor	DSC & PIU	Contract cost
Landfilling	Air Quality	• Provide face masks for the workers, laborers and staff at all time • Conduct air quality monitoring as per the national standard • Ensure good quality engines are used at the site • Adjusting infilling operations to minimize air pollution • Conduct regular inspection to meet the compliance requirements • Other mitigation measures, as appropriate, should be adopted based on the local conditions.	Contractor	DSC & PIU	Contract cost
	Noise level	• Using low noise generating equipment for levelling, grading etc. • Regularly monitoring noise levels at the working areas etc. • Ensuring appropriate PPE is accessible by all etc. • Workers should be provided with earplugs and encourage their use • Limit the dredging -related activities to 6 am to 6 pm • Conduct noise level and vibration level monitoring at regular intervals etc.	Contractor	DSC & PIU	Contract cost
	Surface Water Quality	• To prevent the piling up of excavated soil, raw material, and construction debris at the site by proper management and disposal • Minimize run-off by using sprays for curing • Maintaining an appropriate flow of water sprinklers at the site • Construction of stormwater drains along with sedimentation tanks with sandbags as partitions and barriers for direct flow of runoff to canals. • Construction of an adequate number of toilets and a proper sanitation system to prevent open defecation along the riverbanks/water supply lines • Construction of soak pits/septic tanks to dispose of the domestic wastewater generated from labor camps to prevent disposal of sewage in surface water bodies • Proper collection, management, and disposal of construction and municipal waste from the site to prevent mixing of the waste in run-off and entering the water bodies • No debris/construction material should enter the aquaculture ponds and other water bodies in the area • Surface water should be collected and examined in the laboratory	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
	Groundwater Quality	• No sewage or wastewater will be allowed to accumulate in any unlined structure and timely disposal of the construction/chemical/hazardous waste so as to prevent leaching of any pollutant to the ground helped in preserving groundwater. • Pumping groundwater should be from deep aquifers of more than 300 m to supply water free from contamination (e.g., arsenic). Safe and sustainable discharges are to be ascertained before the selection of pumps. • Tube wells will be installed with due regard for the surface environment, protection of groundwater from surface contaminants, and protection of aquifer cross-contamination. • All tube wells, test holes, and monitoring wells that are no longer in use or needed shall be properly decommissioned. • Install monitoring wells in both upstream and downstream areas near construction yards and construction camps to regularly monitor the water quality and water levels. • Protect groundwater supplies of adjacent lands.	Contractor	DSC & PIU	Contract cost
	Soil Erosion and Impact on soil quality	• Establish a local drainage line with an appropriate spoil/silt collector • Rehabilitate road drainage structures to reduce soil erosion • Implementing erosion control measures such as silt fences and sediment traps to prevent sediment runoff into water bodies, and • Providing cross dams as appropriate etc.	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
	Waterlogging and drainage	• Establish a drainage line with an appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing drainage lines already there • Rehabilitate road drainage structures immediately if damaged by contractors' road transport. • Build new drainage lines as appropriate and required wastewater from construction yards connecting to the available recipient water bodies. • Ensure wastewater quality conforms to the relevant standards provided by DoE, before it is 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 downpours and that there is no stagnant water in the area at the end of the downpours. • 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 problems. • Reduce infiltration of contaminated drainage through stormwater management design. • Provide cross dams as a barrier that stops or restricts the flow of surface water or underground steams etc., • The contractors should follow the Drainage Management Plan (indicative DMP) and the Dredging Management/Land Development Plan are documented in **Appendix 3, and Appendix 4, Vol. II,** respectively	Contractor	DSC & PIU	Contract cost
	Waste Generation	• Establish a waste management system at the project area • Train workers and staff to manage waste properly • Provide waste collection bins (hazardous, organic, and solid) at labor camps, administrative buildings, and construction sites • Maintain waste inventory, and conduct an MOU with the waste collector as per the waste management plan • The contractors should follow the Waste Management Plan (indicative WMP is documented in **Appendix 2, Vol. II.**)	Contractor	DSC & PIU	Contract cost
	Energy Consumption**:**	**Energy Consumption:**	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
		• Utilize maximum energy-efficient technologies, • Install energy-saving lighting, machines, and VFDS • Calculate/track GHG emissions • Set up a target to minimize GHG emissions • Ensure oil (diesel, octane) is stored in a safe place with secondary containment • Contractors should utilize every possible way to reduce GHG emissions • Utilize solar system, rainwater harvesting in the camps • Control the burning of fossil fuels • Use clean energy for cooking • Overhauling machinery, vehicles on routine maintenance • Contractors should manage waste properly and should not burn solid waste • Control of GHG emissions by energy use efficiency, process modification, and selection of fuels • Control GHG emissions by updating processes that may result in fewer emissions			
	Utility and machinery:	• Ensure that safe and updated machinery is used in the sub-project • Hauling and calibrating machinery on a regular interval • All machinery is stored in a safe place • Maintain a lockout and tagout while working with the electrical connection • Maintain proper switching, wiring, and cables to reduce short circuits. • Power supply generators and substations should be enclosed with security barriers • Provide enough awareness signage	Contractor	DSC & PIU	Contract cost
	Terrestrial Ecology	• Construction sites will be selected with approval from the Environmental Consultants. Areas with important vegetation must be avoided as far as possible • Clearing natural vegetation will be avoided as far as possible. • To reduce the anticipated impacts, strict monitoring is required during landfilling activities. • Landfilling should be carried out in a planned way to create less impact on the existing bank vegetation and animals, causing temporary harm to herbs and shrubs in the project area. Faunal groups, including amphibians, reptiles, birds, and mammals, may experience temporary disturbance. • Any kind of killing, trapping, and hunting of aquatic birds and other animals should be prohibited at the site, and it will be a punishable offense.	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
		• Workers should be sensitized in this regard, and strict monitoring is required at the sites, etc. • To control the disturbance of both diurnal and nocturnal terrestrial wildlife, noise barriers will be installed where needed, and vehicular traffic through the habitats will be avoided as far as possible. • Contractors shall use lower-wattage flat lens fixtures that direct light down and reduce glare, and shall avoid the use of flood lights • Contractors will also raise awareness about the protection of birds and other wildlife species among the workforce to reduce impacts such as disturbance and poaching • Maintain a minimum buffer zone around wetlands and mangrove areas around agricultural lands at the outer edge of the ecosystem boundary where applicable • Areas reserved for future development at the site shall be covered with greenery by growing grasses, shrubs, and herbs • Replantation of the felled tree, about 2529 number following the Enhancement Measures and Green Plan as documented in **Appendix 7, Vol-II**			
	Aquatic Ecology	• It is required to minimize contamination of rainfall run-off to minimize impact on water quality & aquatic life supported by the water bodies. • No solid or liquid waste shall be discharged in khal, sea, and any other water body • Septic tanks/soak pits should be provided at the construction site & labor camp to treat sewage to be generated from labor camps and prevent its disposal in the water body • Toilets should be provided at construction sites & labor camps to prevent contamination of water due to open defecation in nearby areas. • Vehicle washing/equipment cleaning should not be allowed near water bodies • Wastewater from the washing area should be collected and should be used for curing purposes or wheel washing purposes and should not be allowed to enter the water bodies • Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration • A temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area • All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
		• Contractors should follow the gob restriction on fishing during Hilsa fish spawning period and stop the dredging activities for safety purposes, if necessary			
	Occupational Health and Safety	• Workers should be provided with on-the-job training on OHS issues. • Ensure appropriate PPE (Hard boots, life vest, safety goggles, hand gloves etc.) and should be available at the site and used by workers. • Sanitary toilets should be made at the sites; a separate female toilet is required if female workers are involved at the sites. • Drinking water supply should be accessible to each worker at the site (portable drinking water supply is acceptable). • A toolbox meeting (TBM) should be carried out on OHS issues before starting to work at the site • Ensure implementation of Occupational Health and Safety Management Plan (indicative OHSP is documented in **Appendix 5**, **Vol-II**) • Ensure implementation of Emergency Response and Disaster Management Plan as shown in **Appendix-1, Vol-II** during any emergency situation at site	Contractor	DSC & PIU	Contract cost
	Child labor	• Contractor and PIU, PRIDE or BEZA shall include provisions for the prohibition of child labor • The contractor, PIU of the PRIDE project, and BEZA shall regularly monitor sub-project sites to guide contractors and third-party monitoring/ related firm to discourage child labor	Contractor	DSC & PIU	Contract cost
	Labor Influx and Working Conditions	• Provide skill enhancement training to locals • Contract with different agencies to undertake civil works • Accommodation for the skilled and unskilled laborers will be provided at the workforce camps • Ensure the Labor Management Plan (LMP) needs to be executed by the Contractor (following the LMP of the PRIDE project, BEZA)	Contractor	DSC & PIU	Contract cost
	Community Health and Safety and GBV/SA/SH	• Ensure the dust-suppressing vehicle sprays water • Conduct free, prior, and informed community consultation • Provide traffic management personnel to control traffic • Disseminate leaflets, awareness signage, and posters regarding HIV/AIDS and awareness training on, these transmitted diseases and social conflict • Conduct toolbox talks daily basis and cover these issues • Maintain GBV GRM at PIU and Contractor level, aware of workers about GVB/SA/SH	Contractor	DSC & PIU	Contract cost
	Employment generation	• The sub-project would require skilled manpower. • The contractor will hire a sufficient number of skilled manpower.	Contractor	DSC & PIU	Contract cost

Sub-project Activities	Anticipated Impacts/Risks	Suggested Mitigation Measures	Responsible Parties		Associated Cost
			Implementing Agency	Monitoring & Supervision	
		• PIU/BEZA will monitor the overall performance of the contractor independently, complying with the provisions of the ESMP for satisfactory environmental management of the proposed sub-project, including compliance with the DoE conditions and social compliances. • Local community members will get preference for employment (daily basis or contractual) at the site. • Capacity building and training on EHS, OHS, WASH, housekeeping, and other relevant topics			
	GBV/ SEA/SH	• The project has been screened for GBV risks and it has been rated as "substantial". • The GBV Action Plan that will be prepared by BEZA will include appropriate mitigation measures • Conduct training on GBV/SEA/SH by the social and gender councilor	Contractor	DSC & PIU	Contract cost
	Social Conflict	• Contractors should execute free, prior, and informed consultation with the local people • Distribute leaflets, awareness signage, and posters regarding HIV/AIDS • conduct awareness training on social conflict, transmitted diseases such as HIV/AIDS • Conduct toolbox talks daily basis and cover these issues • Gender-based violence should be strictly monitored at the site etc. • Leaning land filing areas may affect vegetation and agricultural patterns. • People engaged in vegetation, agriculture or farming can be employed in the land-development activity. • Contractors should support local people to move alternative ways. • Consultation with the local community about the alternative options (for economic development as well as transportation);	Contractor	DSC & PIU	
	Traffic movement and disruption	• The dredgers and other equipment are mobilized via road and waterways networks during daytime, • Ensure traffic lights for assisting vehicles particularly during the evening • Allocate traffic management personnel with proper PPE, flags, signal lights etc. • Ensure the speed of vehicles (maximum limit 25 km/hr.) • Provide training to the drivers, operators, and signal men • Ensure the Traffic Management Plan is implemented properly by the contractor (as indicated by the TMP is documented in **Appendix 8, Vol-II)**	Contractor	DSC & PIU	Contract cost

Note: Monitoring locations to be landfill areas, delivery pipe route, and dredging locations.

8.3. MONITORING INDICATORS FOR ESMP EVALUATION

403. Monitoring and evaluating the implementation of the Environmental and Social Management Plan (ESMP) is critically important to ensure that the intended environmental and social objectives are achieved. Performance indicators of VCs will provide measurable criteria to assess the effectiveness of the plan. The probable performance indicators ((monitoring parameters) for ESMP implementation are given in **Table 8-2**.

8.4. ENVIRONMENTAL AND SOCIAL MONITORING PLAN

404. The main objective of an environmental and social monitoring plan is to decrease negative effects, increase the effectiveness of ESMP, improve the natural and social environments at project sites, examine the requirements of an environmental and social management plan for improvement, and evaluate the distinction between baseline circumstances and changes in the degree of environmental repercussions caused by project operations.

405. The monitoring will include physical measurements of specified parameters such as air, water (surface and seawater), noise, soil quality, and so on, in compliance with ECR 2023 and the World Bank's ESS standards (ESS-1-10). Furthermore, visual observations will be conducted in areas such as biodiversity assessment and monitoring, adoption of best practices, workplace and community health and safety, stakeholder involvement, and so on.

406. The study area's biodiversity encompasses life forms, including marine animals, terrestrial wildlife, plants, and microorganisms. Marine life can be categorized into plankton, nekton, and benthos. While limited benthic organisms and plankton were observed at the 12 dredging sites, the dredging process itself can still have a few impacts, which can be minimized through a proper monitoring process. So the information on the ESMoP is given in **Table 8-2.**

Table 8-2: Environmental and Social Monitoring Plan of the Sub-project

#SL.	Monitoring Component	Monitoring Parameter	Monitoring standard	Monitoring Method	Monitoring frequency and Location	Monitoring Agency		Monitoring Locations
						Execution by	Supervision	
A.	**Physical Environmental Issues**							
01	Ambient Air Quality	Each following parameter: PM10, PM2.5, NO2, SO2, CO at all locations Dust suppression	Air Pollution (Control) Rules 2022, ESS-3, ESS-4, ESS-2	▶Sampling and Lab test	Quarterly at 3 locations (1 dredger operation site, 1 dredging landfilling side, and 1 roadside)	Contractors	PIU-PRIDE, DSC	Dredging Location Landfill sites, and Vehicle movement route
02	Ambient Noise Quality and Vibration Level	Noise level in Leq Vibration Level (mm/s) at all locations	Noise Pollution (Control) Rules 2006, ESS-3 ESS-4, ESS-2	▶Sampling and Lab test ▶Sampling in Day and Nighttime	Monthly at 4 locations, (1 Dredger operation, 1 landfilling, and 2 roadside)	Contractors	PIU-PRIDE, DSC	Dredging Location Landfill sites, and Vehicle movement route
03	Surface water Quality	Each following parameter:- Temperature, TSS, EC, Turbidity, pH, Salinity, COD, (BOD), Hg, Cd, Zn, Cr, Total Coliform (TC) etc,at all locations	ECR 2023 ESS-3	▶Sampling and Lab test	Quarterly at 2 Locations (1 nearby dredging activities in Sandwip channel, 1from canal near the landfilling side)	Contractors	PIU-PRIDE, DSC	Nearest waterbody/ canals around the landfill site Sandwip Channel (L-5, L-7, L-8, L-9)
04	Ground Water Quality and drinking water	Each following parameter:- Temperature, TDS, EC, Turbidity, pH, Salinity, Total Hardness as CaCO3, Fe, As, Mn, FC, TC, Odor etc.at all locations.	ECR 2023 ESS-3	▶Sampling and Lab test	Quarterly at 5 locations (2 from inside the landfilling area, 1 from the BEZA office, 2 from the labor camps	Contractors	PIU-PRIDE, DSC	Sample one (1) from the inside the land filling area, sample one (1) from BEZA office, sample three (3) from the labor camps = 5
05	Sediment Quality	Each following parameter:- Zinc (Zn), Copper (Cu), Mercury (Hg), Lead (Pb), Cadmium (Cd) etc.at all locations.	ECR 2023 ESS-1	▶Sampling and Lab test	Two times (1 start of dredging and 1 after the dredging operation from Sandwip Channel)	Contractors	PIU-PRIDE, DSC	Sandwip Channel (L-5, L-7, L-8, L-9)

#SL.	Monitoring Component	Monitoring Parameter	Monitoring standard	Monitoring Method	Monitoring frequency and Location	Monitoring Agency		Monitoring Locations
						Execution by	Supervision	
06	Soil Erosion	Bank of the Sandwip Channel at the dredging sites	ESS-3	►Physical observations	Daily/	Contractors	PIU-PRIDE, DSC	Along the delivery pipeline, shoreline, coast, and landfill site.
07	Land Use changes	Soil erosion, clearing vegetation and record of oil, Mobil, or grease changes from engine etc.	ESS-1	►Site observation	Daily	Contractors	PIU-PRIDE, DSC	Along the delivery pipeline, shoreline, coast, and landfill site.
08	Solid & Hazardous Waste Management	Food waste, HHs waste, Liquid waste, and medical wastes etc.	Solid waste management Rules 2021 ESS-2, ESS-4	►Visual inspection ►Record keeping of waste ►Training	Quarterly	Contractors	PIU-PRIDE, DSC	Labor camps, dredging locations, Landfill sites etc.
09	Movement of traffic	Traffic counting, movement, maintenance records, and accident records	ESS4	►Visual inspection ►Record keeping ►Maintenance record	Quarterly	Contractors	PIU-PRIDE, DSC	Camps and sites
10	GHG Emission Tracking	GHG Tracking tools, emission calculation, fuel consumption	ESS1 ESS 3	►Record keeping on fuel consumption (oil, diesel, octane, petrol consumption)	Quarterly	Contractors	PIU-PRIDE, DSC	Camps and sites
B	**Ecological Aspect**							
11	Biodiversity: Terrestrial and Aquatic Flora, Fauna etc.	Nos of trees felled, Nos of accidental deaths, disturbances, rescues and rehabilitation of local wild species. Monitoring of death/ disturbance of aquatic flora and faunal species	Biodiversity (Conservation) Act 2017 ESS-6	►Interviews with workers, local people, and site managers and ►Visual inspection ►Ecological Survey	Two time (Before and after dredging operation)	Contractors & Environmental consultant	PIU-PRIDE, DSC	Along the delivery pipeline, shoreline, coast, and landfill site.
12	Habitat (Wildlife)	Sensitive habitats in Project influence area Within 10km Program impact area, within 2 km around the activity sites.	Biodiversity (Conservation) Act 2017 ESS-6	►Awareness raising of workers, employees and general public, Include information on wildlife protection ►A public education program: Number of sightings of key wild species	Before and throughout the construction phase	Contractors & Environmental consultant	PIU-PRIDE, DSC	Along the delivery pipeline, shoreline, coast, and landfill site.

#SL.	Monitoring Component	Monitoring Parameter	Monitoring standard	Monitoring Method	Monitoring frequency and Location	Monitoring Agency		Monitoring Locations
						Execution by	Supervision	
				►Daily monitoring ►of indicator wildlife species and other species quantitatively ►A public education program should be implemented to avoid the poaching of wildlife ►Keeping away ►Keeping away from sensitive habitats such as water channels & *khals*				
13	Habitat (Aquatic Flora and Fauna including Benthos)	Evidence of initiation of monitoring plan	Biodiversity (Conservation) Act 2017 ESS-6	►Visual inspection Ecological Survey ►Inspection of channel morphology and monitoring of benthic biota.	Quarterly at 4 locations for 2 years	Contractors & Environmental consultant	PIU-PRIDE, DSC	Along the delivery pipeline, shoreline, coast, and landfill site.
14	Aquatic Fauna	Number of reports of sightings of key species Evidence of initiation of the monitoring plan	Biodiversity (Conservation) Act 2017	►Visual inspection Ecological Survey ►Inspection of aquatic habitats, channel morphology, and quantitative monitoring of faunal species (fish and dolphins, if observed).	Quarterly at 4 locations for 3 years	Contractors & Environmental consultant	PIU-PRIDE, DSC	Sandwip Channel
	Fisheries	Disturbance of Hilsa fish and damage to the breeding ground, and also other fish in the canals	ESS-6	►Ensure restriction of dredging during the Hilsa spawning period, particularly October- November at the peak spawning period. ►Ensure measures to prevent Bagda larva collection ►Enhance culture and capture fishery in a planned manner.	Consultations with the local community	Contractor for Dredging	PIU-PRIDE, DSC	Sandwip Channel and canals
15	Impacts on aquatic habitat and migratory birds	•Presence of Study report, Implementation of recommended impact •Avoidance and mitigation measures	Within 2-3 km of construction sites	►Visual inspection Ecological Survey ►A detailed study on aquatic habitat and migratory birds will be carried out with appropriate impact avoidance and mitigation	Before construction is commenced and midway through dredging activities, and after completion of dredging	Contractors & Environmental consultant	PIU-PRIDE, DSC	Sandwip Channel

#SL.	Monitoring Component	Monitoring Parameter	Monitoring standard	Monitoring Method	Monitoring frequency and Location	Monitoring Agency		Monitoring Locations
						Execution by	Supervision	
C	**Social Issues**							
16	Occupational Health and Safety	PPE, access to safe drinking water, and sanitary toilets, good housekeeping, first-aid medical facility etc.	Project's Occupational health and safety plan ESS-2	▶Records of accident/ incident. ▶Physical observations ▶Records of toolbox meeting etc.	Daily	Contractors	PIU-PRIDE, DSC	Dredging sites, Landfill sites, and delivery pipeline etc.
17	Daily Labor Influx	PPE, attendance, accidents and injuries Grievance	LMP ESS2	▶Records of attendance, injury, attendance	Daily	Contractor	PIU-PRIDE, DSC	Dredging sites, Landfill sites, and delivery pipeline etc.
18	Community Health and Safety	Information dissemination, hard barricade installation, deployment of flag man, danger sign posting, traffic management plan etc.	Project's Occupational health and safety plan ESS-4	▶Physical observations. ▶Consultation schedule and records. ▶GRM records etc.	Daily	Contractors	PIU-PRIDE, DSC	Dredging sites, roadsides, Landfill sites, and delivery pipeline etc.
19	Women Worker, disadvantageous and vulnerable people	GBV (gender-based violence)	Project document (gender action plan) ESS-1	▶Physical observations. ▶Records of wages ▶Consultation schedule and records. ▶GRM records etc.	Daily	Contractors	PIU-PRIDE, DSC	Dredging locations and landfill sites.
20	Infectious Diseases	Medical Testing of workers	Project's Occupational health and safety plan ESS-2, ESS-4	▶Records of accident/ incident. ▶Physical observation ▶Records of toolbox meeting etc.	Daily	Contractors	PIU-PRIDE, DSC	Dredging sites, Landfill sites, and delivery pipeline etc.
21	Grievance Redress Mechanism (GRM	Record of grievances and settlement of the issues.	ESS-5	▶Nos of grievances recording and remedial actions.	Monthly	Contractors	PIU-PRIDE, DSC	Entire sub-project study area
22	Capacity Building	No training, meeting, Toolbox meeting, workshop, and informal discussion.	ESS-1	▶Number of training sessions conducted, and participants reached. ▶Improvement in the understanding and awareness of environmental and	Quarterly	Contractors	PIU-PRIDE, DSC	Entire sub-project study area

#SL.	Monitoring Component	Monitoring Parameter	Monitoring standard	Monitoring Method	Monitoring frequency and Location	Monitoring Agency		Monitoring Locations
						Execution by	Supervision	
				social issues among project staff and local communities.				
23	Emergency Preparedness and Response	Emergency history and records	ESS-2	►Effectiveness of emergency response plans assessed through drills and simulations. ►Time taken to respond to and resolve emergencies or accidents.	Quarterly	Contractors	PIU-PRIDE, DSC	Entire sub-project study area
24	Compliance with Regulations	Site Clearance/ Environmental Clearance from the DOE and BWDB, WB Clearance or approval of ESIA and recommendations Quarterly/Semi-annual Environmental &Social Safeguards Monitoring Report.	ESS-1	►Evaluation of implementation status for ESMP in line with National Laws and WB Environmental and Social Standards.	Annually	Contractors	PIU-PRIDE, DSC	Entire sub-project study area
25	Incident and Non-Compliance Reports	Periodically checking the Accident/ Incident Record Form	ESS-2	►Number and nature of incidents or instances of non-compliance with environmental and social requirements.	Monthly	Contractors	PIU-PRIDE, DSC	Entire sub-project study area
26	Stakeholder Engagement	Checking of stakeholder engagement records (e.g., meeting, workshop, FGD, IDI, KII, PCM etc.) Survey results etc.	ESS-10	►Level of satisfaction among stakeholders through surveys or feedback mechanisms. ►Number and quality of consultations should be held with local communities, indigenous groups, and other stakeholders.	Monthly	Contractors	PIU, PRIDE	Entire sub-project study area

8.5. INSTITUTIONAL SETTING AND IMPLEMENTATION ARRANGEMENTS

407. In the institutional arrangement procedure, the Project Director (PD) will be directly involved in this sub-project. Under the Project Implementation Unit (PIU) or Project Management Unit (PMU), there will be relevant officials and individual consultants / Environmental and Social Cell to support the PD. For preparing the BID document, the ES specification inclusion in the contract document, and the float BID Document, as well as supervision and monitoring of the sub-project activities, the PIU would require skilled manpower. Since the Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ would be developed by the contractor, the PIU of the NSEZ will hire experienced contractors to construct delivery dredging pipelines, dredging, and landfilling activities of the sub-project

408. The Environmental and Social Management Plan will be implemented under the direct supervision of the PIU of the NSEZ. The PIU will be in charge of overall coordination between various international and government agencies, such as the World Bank, BEZA, DOE, and other organizations, to implement ESMP. The organizational flowchart for the implementation of the ESMP is shown in **Figure 8-1.**

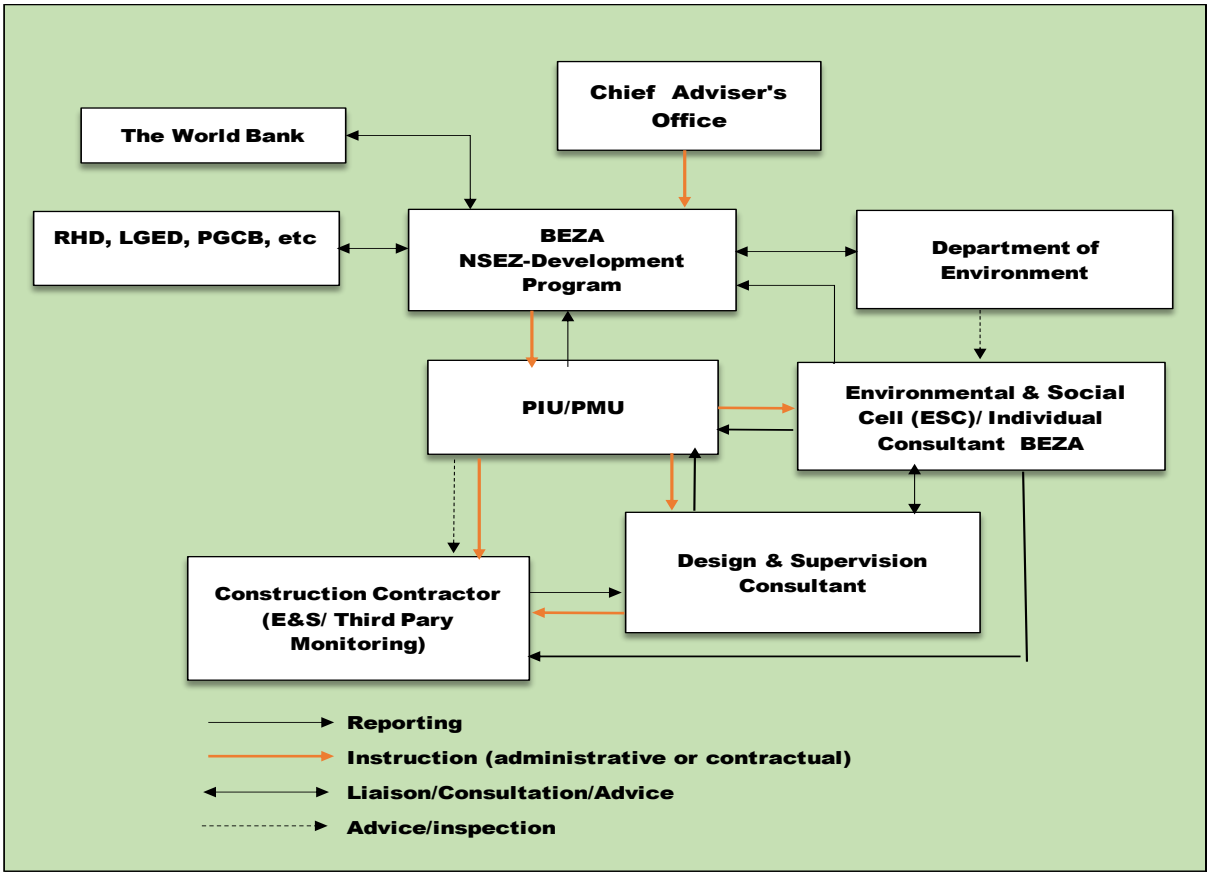


Figure 8-1: Organizational Flow chart of the ESMP Implementation

8.5.1.ROLES AND RESPONSIBILITIES FOR ESMP IMPLEMENTATION

409. The description of the key specific responsibilities of various agencies and parties for implementing environmental and social safeguards is provided below;

1. Project Implementing Unit

410. The Project Implementing Unit (PIU) of NSEZ will be responsible for ensuring that all components of the ESMP comply with the local and World Bank ESF (Environmental and Social Framework) during the implementation of the project. Under the EA, the PIU will manage individual contract Packages under the sub-project. The PIU is headed by a Project Director, responsible for ensuring the implementation of the social and environmental safeguards for the sub-project in consistent with WB-ESF and GoB's environmental rules and regulations. The organizational setup of the PIU is presented in **Table 8-3.** The PD and DPDs, and APDs would be supported by an Environmental and Social, and Occupational Health and Safety specialists.

Table 8-3 : Personnel under the PIU of the NSEZ -BEZA

Name of Post	No. of Post	Mode of Recruitment	Pay Grade
Project Director (PD)	1	Deputation	3
Deputy Project Director (DPD)	3	Deputation	4
Executive Engineer (Xen)	2	Deputation	5
Assistant Project Director (APD)	3	Deputation/BEZA	
Social Specialist	1	Deputation	5
Environmental Specialist	1	Deputation	6
Monitoring and Evaluation Consultant	12	Deputation	6
Social Counselor	4	Contractual agreement	
Environmental Counselor	2	Contractual agreement	

Note: The PIU set up is prepared based on the scope of the sub-project.

411. The PIU will submit the monthly, quarterly, semiannually, and annually on the environment and social monitoring reports (prepared by DSC and contractors) to the World Bank for review and disclosure on the World Bank's websites. However, the details of the scope of PIU for monitoring the environmental and social progress at the site are specified below.

- Ensure that the ESMP and relevant environmental clauses are included in the contractor's bidding documents
- The PIU head office officers and the field offices will conduct the field visit regularly (at least bi-monthly), and ensure that the project meets the compliance requirements by the contractor and DSC.
- The Safeguard specialist(s) of PIU will ensure that the C-ESMP is made part of the contract documents.
- Review all sub-plans identified in the CESMP to be prepared by the Contractor to include camp layout, waste/debris management plan, traffic management plan etc., as per requirements of the contract document.
- Review monthly/quarterly/annual environmental monitoring reports prepared by the Contractor's
- Conduct monthly or bi-monthly site and follow-up inspections to ensure the veracity of the submitted monitoring reports and enforce the ESMP and ESMoP;
- Ensure that DSC, while carrying out work at the site, follows the environmental and social standards, guidelines, and manual of BEZA-PRIDE
- Conduct spot checks on-site to monitor the contractor’s compliance with the ESMP
- If there are any non-compliance issues or unanticipated environmental impacts, ensure that necessary corrective actions are taken and the ESIA and/or ESMP are updated as necessary
- Ensure that all grievances and complaints received are addressed promptly and properly documented
- Carry out all other activities on environmental and social safeguards on behalf of the PIU as needed.

2.Design and Supervision Consultant

412. The NSEZ shall utilize the consultancy services of the DSC for the overall management and supervision of the sub-project work on behalf of the EA. In addition to supervising the construction work of the contractor, their role will be to check on conformity with the relevant clauses in construction contracts and national legislation. Since the project area is close to the habitat of the marine ecosystem and other important aquatic faunal species, there will be an additional provision of an ecological expert in the DSC team. The educational qualification, experience and responsibilities of the DSC’s Environment and Ecological Experts is presented in **Table 8-4**.

3.Contractor/ Sub-contractors

413. The Contractor/sub-contractor is legally mandated to implement the ESMP and EMoP and obtain all environment-related permits and clearances required for construction. Hence, the selected contractor must have a testimonial to be compliant with the Environmental Management System and related Occupational Health and Safety (OHS). The contractors will recruit experienced Environmental and Social Management Officer (ESMO) and Occupational Health and Safety Officer (OHSO) for monitoring environmental, social, and occupational health and safety issues. The educational qualification, experience and responsibilities of the DSC’s ESMO and OHSO are presented in **Table 8-5**. The contractor will implement the environmental and social mitigation measures as per the ESMP as E&S compliance of the WB. Before commencement of civil works, the contractors should prepare a site-specific Construction Environmental and Social Management Plan (C-ESMP) based on the ESMP of the ESIA report, and the World Bank guidelines. The C-ESMP should include the labor management plan, waste management plan, traffic management plan, occupational health and safety plan, spill management plan, drainage management plan, tree plantation plan, and greenery plan, etc., as well as environmental and social code of practices **(**according to **Appendices, Volume-II).**

Table 8-4 : Educational Qualification, Experience and Responsibilities of DSC's Environment and Ecological Experts

Position	Educational Qualification	Experience	Responsibilities
Environmental and Health and Safety Expert	He/ she must have a master's degree in environmental science/environmental engineering or any other relevant field from a well-reputed university Having a NEBOSH Certificate in health and safety, with the knowledge and skills to manage and assess workplace risks effectively, is preferable	At least 5 years of working experience in donor-funded projects. ADB, JICA, WB, KfW etc.	Review ESIA to acquaint him/herself with the project and environmental safeguard requirements. Identify statutory/regulatory requirements (clearances/permits/NOC for the project and ensure all are secured or at least applied for. Assist the PIU with technical input where applicable Prepare and provide a checklist/format to the contractor for periodic pollution monitoring and OHS reporting in line with ESMP and ESMoP. Review the method of construction technology of the contractor, especially dredging to minimize noise and vibration from dredging pipeline installation, dredging and landfilling. Review and approve the C-ESMP submitted by the contractor and check whether it is in line with the ESMP of ESIA and present site conditions. Review the adequacy of existing onsite facilities (waste management, storm water drainage, oil spillage prevention, firefighting, emergency preparedness, and other OHS requirements) before the start of construction. Conduct workshops/training for contractors and PIU staff before and periodically Conduct regular site inspections to examine environmental and social compliance and suggest corrective actions. In times of emergencies, as stated above, where necessary, coordinate with the relevant government agencies, local community, assess the practicality of social conflict Prepare Semi and Annual Monitoring Plan Coordinate and work closely with the ESMO and of the contractor and the NSEZ.
Ecological Expert	He/ she must have a master's degree in environmental science/environmental engineering or any other relevant field from a well-reputed university	At least 5 years of working experience in donor-funded projects, ADB, JICA, WB, KfW etc. s	Review ESIA to acquaint him/herself with the project and the ecological component of environmental safeguard requirements. Review and approve the C-ESMP submitted by the contractor and check whether it is in line with the ESMP and ESMoP of ESIA and present site conditions. Review the proposed design and activities of the contractor that may have potentially significant adverse impacts on terrestrial flora and fauna aquatic biodiversity including marine ecosystem Modify, if required, the construction schedule to avoid any adverse impact on Hilsa fish breeding ground, and other wildlife migrations. Prepare forms/formats and a checklist for monitoring to be conducted by the contractor related to marine, other aquatic fauna and Hilsa fish. Regular continue to monitor of Hilsa spawning period and other aquatic fauna Ensure that monitoring is being conducted as per project requirements and ESMoP. Conduct an awareness program for biodiversity conservation among all stakeholders Prepare the quarterly, semi-annual annual and completion monitoring reports on monitoring /biodiversity-related activities. Coordinate and work closely with the contractor's ESMO and OHSO and the PIU.

Table 8-5 : Educational Qualification, Experience and Responsibilities of the Contractor's ESMO and OHSO

Position	Educational Qualification	Experience	Responsibilities
Environmental and Social Management Officer	He/ she must have a master's in environmental science /environmental engineering or any other relevant field from a well-reputed university	At least 7 years of working experience in donor-funded projects, like ADB, JICA, WB, KfW etc. Experience of Stakeholders Engagement Plan implementation.	• Review ESIA, ESMP and ESMoP to acquaint him/herself with the project and environmental safeguard requirements. • Identify statutory/regulatory requirements (clearances/permits/NOC for the sub-project and ensure all are secured or at least applied for. • Prepare the C-ESMP based on method of construction technology to minimize noise, surface water, groundwater pollution, etc. from dredging pipeline installation, dredging and landfill in compliance with the World Bank ESF, ESMP of ESIA and present site conditions. • Prepare a checklist/format for periodic pollution monitoring in line with ESMoP and accordingly monitoring to examine environmental and social compliance. Conduct workshops/training • Ensure the adequacy of existing onsite facilities (waste management, storm water drainage, oil spillage prevention, firefighting, emergency preparedness, etc. before the start of construction. • Regular continuation to monitor of Hilsa migration route and spawning period are not adversely impacted due to dredging activities • In times of emergencies, where necessary, coordinate with DSC, PIU and the relevant government agencies, local community, the practicality in case of social conflict • Coordinate and work closely with the EH&S Expert of DSC and PIU of the NSEZ. • Prepare monthly and quarterly reports on environmental monitoring /biodiversity-and social related issues. Coordinating and working closely with the expert of the DSC's ecologist to ensure dredging activities are not impacting to marine ecology, .
Occupational Health and Safety Officer (OHSO)	He/ she must have a master's in environmental science /B.SC in Environmental Engineering/ or in relevant field or equivalent. Professional certification in Health from a well-reputed university Having a NEBOSH Certificate in health and safety, with the knowledge and skills to manage and assess workplace risks effectively, is preferable.	At least 5 years of working experience in donor-funded projects like ADB, JICA, WB, KfW etc. Experience on OHS issues with exposure of dealing issues on infrastructure development; Experience on World Bank ESF., having good knowledge on international best practices on OHS (for example ILO OSH 2001- Guidelines on OHS and ILO Code of Practice Safety and Health in Construction 1991	• Develop Risk Assessment Procedure; Risk related to Land development works. • Prepare a checklist for OHS monitoring of the workers during pipeline installation, dredging and landfilling activities • Prepare SOP, Training manual, Operational Manual, monitoring, reviewing plans, and conduct on the job training/toolbox talk daily and internal auditing, • Ensure proper implementation of OHS measures during land development activities through monitoring the day-to-day activities to ensure occupational health & safety of the workers. • Support PIU to establish and oversee grievances mechanism related to OHS issues and follow it up and ensure its satisfactory disposal. • Analyze the risks related to labor influx and construction works at site covering OHS and community health and safety. Assess the management of such risks at the project and sub-project levels in line with the sub project's WB-ESF, relevant ESSs. • Ensure OHS requirements for the sub-project of the project cycle as per the requirements of WB EHS guidelines, GOB regulations, COVID 19 protocol and GIIP. • Ensure following standard of OHS requirements for operation safety, excavation safety, welding and cutting safety and hand tools safety; noise, fire safety; material handling safety. • Develop a sound monitoring plan covering different sub-projects and visit the sites time to time to ensure OHS compliance. Investigate accidents and incidents to identify their causes and to determine how they might be prevented in the future • Maintain a database in a standard form, on the status of various OHS requirements implementation status • Prepare and submit monthly and Quarterly progress reports to the DSC and for sending to the WB

414. The overall responsibility includes as follows:

- ❖ Review ESIA, especially ESMP and EMoP, in detail and identify clearances required during the construction stage
- ❖ Ensure that the regulatory permissions secured for construction equipment, vehicles, and machinery are obtained timely manner and are valid at all times during the execution
- ❖ Prepare site-specific C-ESMP of the sub-project. The C-ESMP should include the labor management plan, waste management plan, traffic management plan, occupational health and safety plan, spill management plan, drainage management plan, tree planation plan and greenery plan etc. as well as environmental and social code of practices (Appendix**, Volume-II),** and to be implemented during construction stage in compliance of the ESMP of the project
- ❖ Prepare all sub-plans such as the traffic management plan, emergency response and disaster management plan, construction material and storage handling plan, waste management plan, occupational health and safety plan, camp layout plan, and any other plans specified in tender specifications and deemed necessary for environmental safeguard.
- ❖ Fill up the environmental and safety-related compliances as per daily/weekly, fortnightly, monthly, quarterly, semi-annual checklists in the ESMP
- ❖ Implement the ESMP and ensure the construction works comply with it and conditions of all environmental clearances and permits issued by respective statutory bodies;
- ❖ Ensure that construction activities are carried out in a manner that avoids, mitigates, and minimizes adverse impacts on biodiversity as given in the ESIA report and ESMP
- ❖ Identify locations for siting construction camps and other plants, machinery, vehicles, and equipment, as well as locations for storage and disposal of wastes, both from the construction camps and from the site, and obtain approval for the same from the PIC
- ❖ Detail out site-specific environmental mitigation and enhancement measures and obtain approval of the DSC.
- ❖ Ensure that the safety of the workers and other site users is not compromised.
- ❖ Preparing registers for material sources, labour, pollution monitoring results, public complaints, and as may be directed by the DSC
- ❖ Undertake enhancement measures as outlined in ESIA, including ESMP
- ❖ Preparing and submitting monthly/quarterly/semi and annual Safeguard reports as per ESMP/EMoP to DSC on the status of implementation of environmental safeguard measures.

4. World Bank

415. As a funding agency, the WB is responsible for monitoring the implementation of environmental safeguards, providing technical guidance to the EA as necessary. Specific responsibilities entail the following:

- ❖ Review the ESIA report, including ESMP and other supplementary environmental assessment reports, provide feedback, and disclose the reports on the WB website as required by the WB-ESF (ESS 1-10, except ESS-9)
- ❖ Issue approval of projects and project components based on the approval of the respective ESIA or other environmental assessment reports;
- ❖ Assist NSEZ_BEZA, if required, in carrying out its responsibilities and for building capacity for compliance;
- ❖ Monitor overall compliance of the project according to ESIA and ESMP through review missions;
- ❖ Review all environmental monitoring reports submitted by NSEZ, provide feedback, and disclose the reports on the WB website as required by the WB-ESF
- ❖ Guide the NSEZ-BEZA on issues related to changes in project design/scope, occurrence of unanticipated environmental impacts during project implementation, emergencies, and others as necessary. Organize coordination and capacity building activities on environment safeguards for NSEZ/PIU, ESU, CSC, and Contractor as and when necessary, etc.

5.Third Party Monitoring

416. A third-party monitoring (TPM) is required to track the progress of environmental and social management at the dredging sites and landfilling sites following the World Bank Environmental and Social Framework. Particularly for collecting the environmental quality parameters, e.g., air quality, noise level, surface water quality and groundwater quality, and soil quality, following the parameters mentioned in the Environmental and Social Monitoring Plan of the ESIA report and analysis in a government-accredited laboratory periodically. The TPM entity should be impartial, technically competent, and have no vested interest in the sub-project's success. The key functions of TPM include:

- **Verification of Compliance:** Assessing whether the project is adhering to the requirements of the ESMP, permits, and relevant regulations.

- **Independent Data Collection and Analysis:** Gathering data on environmental and social indicators to assess this sub-project's impacts.
- **Stakeholder Engagement:** Consulting with affected communities and other stakeholders to gather feedback and address concerns.
- **Reporting and Recommendations:** Providing regular reports to the project proponent, highlighting areas of compliance and non-compliance, and recommending corrective actions.

6. Department of Environment

417. As a Safeguards regulatory organization of the Bangladesh DOE is responsible for overseeing environmental safeguards during the construction of the sub-project. Their crucial role includes issuing environmental clearances, monitoring of construction impacts, and ensuring compliance with environmental regulations as necessary, according to the ECR 2023. Also review the quarterly environmental monitoring report with providing feedback on the implementation of environmental safeguards, and providing technical guidance to the EA.

8.6. TRAINING REQUIREMENT AND INSTITUTIONAL STRENGTHENING

418. The contractors (Implementation Agency), Monitoring and Supervision Agency (PMU of NSEZ), and others will be trained in ESMP, ESMoP, mitigation strategies, occupational and community health and safety management, waste management, emergency response, traffic management, biodiversity management, stakeholder engagement, and the use of grievance redress mechanisms, among other things**. Table 8-6** summarizes the Training modules, target participants and anticipated cost of training. The Environmental and Social Consultant Team (E&S Team) will prepare a training session plan after consulting with the PMU of NSEZ, following the WB recommendations.

Table 8-6: Training Program

Training Topics/ Modules	Training Method/	Target Participants	Training Schedule & Frequency
ESMP Implementation: Roles and Responsibilities, Monitoring, Supervision and Reporting Procedures.	▸ Speech ▸ Demonstration ▸ Presentation ▸ Pair discussion ▸ Interactive discussion ▸ Small Group Discussion and exercise ▸ Brainstorming ▸ Stimulating games ▸ Interactive Briefing ▸ Q&A ▸ Case Study ▸ Experience Sharing ▸ Open discussion ▸ BUZZ Group Debate	Contractor's representatives, PMU of NSEZ representatives,	Prior to construction (2 days) Refresher training each yr. construction phase (2 days)
Grievance Redress Mechanism: Roles and Responsibilities, Procedures, Occupational and Community Health and Safety, Emergency Preparedness and Response, Pollution Control and Environmental Monitoring, construction waste management, Inspection and Reporting, Public Consultation, Contractor Engagement and Management, including ESMP enforcement, etc.		Contractor's representatives, PMU of NSEZ representatives,	Refresher training each yr. construction phase (2 days) Refresher training in each yr. construction period (2 days phase)
Labor and Working Conditions: Terms and conditions of employment according to national working laws and regulations. Contractor and sub-contractor codes of conduct, Worker's organizations, Child labor and minimum age employment		Contractor's representatives, PMU of NSEZ representatives,	Prior to construction (1 day) Refresher training in each yr. construction phase (1 day)
GBV Risk: Raising awareness and measures to prevent and mitigate GBV risks. The topics, activities and targeted groups will be developed in the GBV Action Plan including GBV-specific GRM		Contractor's representatives, PMU of NSEZ representatives,	Prior to construction (1 day) Refresher training (1 day)

8.7. ESMP IMPLEMENTATION AND TENTATIVE COST

419. BEZA will allocate a separate budget for the implementation of the ESMP, including environmental monitoring, analysis, training, environmental monitoring, analysis, and reporting, verification monitoring and capacity building during the construction phase. It should be noted that the cost for many in-built mitigation measures, such as, acoustic enclosures for noise control, water and wastewater treatment, etc., need to be included in the contract cost estimation and/or operating cost estimation. For implementation, the tentative cost of the ESMP during the construction phase will be an amount of BDT 8.67 million for one year and 14.52 million for two years. The major components of this cost include about BDT 3.0 million and 5.24 million for Environmental Pollution Monitoring at the sites for one year and two years, respectively. The remaining costs will be for the Environmental Mitigation Measures, workers/sub-project staff training purposes, etc. In USD, the total cost will be 1,761.97. The breakdown for the ESMP implementation tentative cost is presented in **Table 8-7** for the land development of Part of Precinct F (IMD Zone and Housing Facilities of the NSEZ-BEZA.

Table 8-7 : ESMP Implementation Tentative Cost

Sl. No.	Monitoring Issues	Description	Monitoring Locations/ Sites	Monitoring Frequency / Unit	Unit Rate (BDT)	Cost / Year (BDT)	Total Cost (Considering 2 Yrs. Construction phase)
A	**Environmental Pollution Monitoring (Environmental Monitoring for Air, Noise, Water, Soil attributes and Biodiversity)**						
1	Air Quality	PM10, PM2.5, NO2, SO2, CO and O3	Samples (2) at dredging Location Landfill site, and (1) at Road surface =3	Quarterly	45,000	540,000	1,080,000
2	Noise Level	Leq	Sample (1) at dredging location, (1) at the landfill site, (2) at Road surface =4	Monthly	5,000	240,000	480,000
3	Surface water Quality *(only dredging location)	pH, DO, TDS, Turbidity, Temperature, TSS, BOD, COD, Lead, Iron, zinc, Cd, As, chloride, Oil and Grease	Samples Two (2) from dredging locations=2	Quarterly	45,000	360,000	720,000
4	Ground Water Quality and Drinking Water Quality	pH, Turbidity, TDS, Hardness as CaCO3, Cr, Cu, Fe, Mn, Mg, Na, Zn, SS, Temperature, FC Total-N, NO_3, SO_4 Nitrate, Sulphate etc.	Sample one (1) from Inside the landfilling area, sample one (1) from the BEZA office, sample three (3) from the labor camps = 5	Quarterly	45,000	900,000	1,800,000
5	Dredging Sediment Quality, pH	Heavy Metals (Cd, Cr, Cu, Hg, Pb, Zn) and As	Sample from dredging locations two (2)=2	Before and after dredging	45,000	180,000	360,000
6	Biodiversity: Terrestrial and Aquatic Flora, Fauna and marine ecology, etc.	Survey	At dredging locations and study area two (2)= 2	Before and after dredging	200,000	800000	800,000
Subtotal (A)						**3,020,000**	**5,240,000**
B	**Environmental Mitigation Measures**						
1	Dust suppressing by water sprayer	Suppressing quantity	Road surface	Monthly			Included in civil work
2	Providing sewage tank/soak well in construction camps and yards	Labor camps, administrative offices, and working sites					Included in civil work
3	Installation of Tube well and safe drinking water supply at labor camps and site	Labor camps, administrative offices, and working sites					Included in civil work
4	Providing solid waste management facilities in construction camps (Waste bins)	Labor camps, administrative offices, and working sites		Monthly	15,000	180,000	360,000

Sl. No.	Monitoring Issues	Description	Monitoring Locations/ Sites	Monitoring Frequency / Unit	Unit Rate (BDT)	Cost / Year (BDT)	Total Cost (Considering 2 Yrs. Construction phase)
5	Disposal of construction debris and other waste materials and transportation	Labor camps, administrative offices, and working sites		Monthly	10,000	120,000	240,000
6	Implementation of the Traffic Management Plan	Roads Networks in NSEZ					Included in civil work
7	Occupational safety appliances and PPE and First aid box	PPE cost (safety jacket/ life jacket, high visibility vest, helmets, hand protection gloves, protective shoes, safety helmets, eye protection goggles, Face mask/KN95, Hand Sanitizer)	Labor camp and working sites.	Monthly	15,000	180,000	360,000
8	Implementation of Environmental Enhancement Measures Greenery Plan. Compensate Tree Plantation by plantation of @ 1:5 of cut down of about trees with 3yrs maintenance	About 401 trees in Zone- 12, about 442 species in Zone - 13 Total = 843 trees	Plantation in the Roadside after land preparation will be done as 1:3= 2529.	No	600	1,517,400	1,517,400
9	Establishing buffer zones around agriculture lands, wetlands etc. where necessary						Included in civil work
10	Informatory Signage for safety near sensitive locations and built-up sections				LS	30,000	30,000
11	Erosion control measures such as silt fences and sediment traps						Included in civil work
12	Cross dam if necessary						Included in civil work
Subtotal (B)						**2,027,400**	**2,507,400**
C	**Training for Workers and Institutional Strengthening, and Implementation of SEP**						
1	Capacity Building	Training of the workers and project professionals	Working sites	LS		1,800,000	3,600,000
2	Implementation of SEP			LS		375,700	751,400
Sub Total (C)						**2,175,700**	**4,351,400**
Total Cost During Construction Phase (A+B+C)						**7,223,100**	**12,098,800**
	Contingency 20%					1,444,620	2,419,760
	Grand Total (BDT)					8,667,720	14,518,560
	Total Cost (million BDT)					**8.67**	**14.52**
	Total Cost (USD) Note: (1 USD = BDT 121.36 date 16 March 2025)					**1,051.91**	**1,761.97**

8.8. INCLUSION OF THE ENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN BOQ OR CONTRACT DOCUMENT

420. The Design Supervision Consultants of the PIU/PRIDE will be responsible for incorporating environmental management requirements in the bidding documents and the different operational manuals of the project, with the assistance of the environmental consultants. The generic guidelines to incorporate environmental and social aspects for this purpose are listed below. These are examples only and shall be further elaborated and expanded upon based on the findings and recommendations of the ESIA.

- Prepare cost estimates to be incorporated in the Bid Documents.
- Contractor version of the Environmental and Social Management Plan to be incorporated in the bid document's work requirements.
- Prepare Waste Management Plan
- Drainage Management Plan for Land Filling of IMD Zone, Part of Precinct F
- Dredging Management/Land Development Plan
- Occupational Health and Safety Plan
- Traffic Management Plan
- Emergency Response and Disaster Management Plan,
- Prepare an Environmental Enhancement Measures Greenery Plan
- Prepare the Stakeholder Engagement Plan according to the SEP of the PRIDE project
- Prepare Environmental and Social Code of Practices (ESCOP)
- Penalty clauses for not complying with ESMP requirements to be incorporated.
    - The contractor has to follow all traffic safety measures as defined in the technical specification.
    - Damage shall be levied at the rate of up to BDT 10,000 per day per location for non-conformity of traffic safety measures as per the decision of the PIU/PRIDE.
    - The contractor has to follow all environmental mitigation and management measures as defined in the technical specification, read along with the Environmental Management Plan for the specific PIU/PRIDE activities. Damage shall be levied at the rate of up to BDT 10,000 per day per location for nonconformity of ESMP measures as per the decision of the PIU/PRIDE.
    - The contractor has to ensure that prior to every monsoon season, during the construction period, all the temporary and permanent cross drainage structures are free from debris as defined in the Technical Specifications, read along with the ESMP. Damage shall be levied at the rate of BDT 3,000 per day per location for non-conformity as per the decision of the PIU/PRIDE.
    - The contractor has to ensure that a comprehensive Health and Safety program is in place for the duration of construction. Implementation of the program will include, among other aspects, ensuring that sufficient numbers and good quality Personnel Protective Equipment (PPE) are provided to staff and labour at all times as defined in the labour codes, read along with the ESMP. Damage shall be levied at the rate of up to BDT 5,000 per day for nonconformity as per the decision of the PIU/ PRIDE officials.
    - In addition, for any non-compliance causing damages or material harm to the natural environment, public or private property or resources, the contractor will be required to either remediate/rectify any such damages in a timeframe specified by and agreed with the engineer, or pay PIU/PRIDE for the cost (as assessed by PIU/PRIDE) of contracting a third party to carry out the remediation work.

421. Since many contractors do not have a clear understanding of the need for environmental management, some quote a very low price for the implementation of ESMP and eventually cannot implement ESMP as per the specific requirements of ESMP and project design. To avoid this problem, the fixed budget can be assigned for ESMP implementation. The contractors may need orientation on the requirements of the ESMP in the pre-bidding meeting. The main Environmental and Social Items to be included in the Tender Documents are presented in **Table 8-8.**

Table 8-8: Environmental and Social Items to be Included in the Tender Documents

Sl. No	Description of activity	Remarks
1.	► Recruit and appoint ESMO (Environment, Social Management Officer) and Occupational Health and Safety Officer (OHSO) for 24 months at the time of dredging (such as preparing checklist, SOP, Training manual, Operational Manual, monitoring, reviewing plans, internal auditing, receiving and renewal NOC, conduct on the job training/tool box talk etc.)	BoQ items/ technical specification

Sl. No	Description of activity	Remarks
2.	▶ Soil erosion and slope protection monitoring at every working section of the landfill site, dredging sites, and sea shoreline areas during the dredging period ▶ Special attention should be paid to the camp site also. ▶ Soil erosion and drainage congestion should be monitored using visual inspection and will be judged by the supervising environmental officer/engineer.	BoQ items/technical specification
3.	▶ Debris disposal and waste management on camp sites and working sites. ▶ Temporary camp site, construction site, and administrative site waste disposal facility improvement 3 no's (for organic waste, hazardous waste and construction-related waste disposal facility) site cleaning, removal, and disposal activities ▶ Construction spoil management, identification, and site selection for storage, fencing for construction spoil etc.	BoQ items/technical specification
4.	▶ Hazardous waste management, collection and storage of hazardous waste, safe disposal of hazardous waste (e-waste, battery, etc.), MOU with the service providers	BoQ items/technical specification
5.	▶ Traffic management during dredging, equipment for traffic management, employing two (02) workers for traffic management, traffic signs, site demarcation materials, awareness to the community members, etc.	BoQ items/technical specification
6.	▶ Medical supplies (First Aid box), other medical requirements, notes, equipment, kits, dress, etc.	BoQ items/technical specification
7.	▶ Fire safety and fire management equipment, fire protection. Organize fire drills, warning signs, emergency communication cascade, dedicated firefighters, etc.	BoQ items/technical specification
8.	▶ Emergency response and Disaster Management Plan, ▶ Arrangement to respond during an emergency, MoU with hospital, assign responsible personnel to respond to emergency situations, incidents, accident record keeping, and reporting	BoQ items/technical specification
9.	▶ Safe chemical management, spill control equipment, safe chemical storage site, chemical safety sign, leveling for chemicals, PPE for chemical handling etc.	BoQ items/technical specification
10.	▶ Health safety warning signs and log maintenance, HIV/ AIDS communicable diseases response (arrange face masks with hand sanitizer).	BoQ items/technical specification
11.	▶ Personal Protection equipment (PPE) supplies to the workers	BoQ items/technical specification
12.	▶ Safe Drinking water facilities for campsites and working areas.	BoQ items/technical specification
13.	▶ Separate male and female toilet facilities for camp and work site, sanitary facilities, Response to COVID-19 & other communicable diseases as stipulated in the ESMP	BoQ items/technical specification
14.	▶ Water spraying to control fugitive dust	BoQ items/technical specification
15.	▶ ESMP training/capacity building (including GRM focal and other relevant officials covering code of conduct, SEA, SH, OHS, and HIV/ AIDS issues, incident reporting, training on ESF and 10 ESSs, social issues, monthly/quarterly reporting	BoQ items/technical specification
16.	▶ Environmental and Social Code of Practices. Conduct a signing form for the workers	BoQ items/technical specification
17.	▶ Conduct monitoring as per ESMoP as shown in **Table 8-2**.	BoQ items/technical specification
18.	▶ Maintain a minimum buffer zone around wetlands, mangrove areas, and agricultural lands, where applicable ▶ Implementing erosion control measures, such as silt fences and sediment traps, to prevent sediment runoff into water bodies. ▶ Providing cross-dams.	BoQ items/technical specification

8.9. RELEVANT MANAGEMENT PLANS

422. During the project life cycle, the contractor should follow the different management plans. Indicative management plans have been outlined for the contractor included in the Appendices in Volume II. Waste Management Plan in Appendix 2, Drainage Management Plan for land filling of IMD Zone, and part of Precinct F (Zone 5 and 18), in Appendix 3, Dredging Management/Land Development Plan in Appendix 4, Occupational Health and Safety Plan in Appendix 5, Emergency Response and Disaster Management Plan in Appendix 6, Environmental

Enhancement Measures and Greenery Plan: Appendix 7, Traffic Management plan in Appendix 8 and Environmental and Social Code of Practices in Appendix 10 are appended in the **Volume II.**

8.10. ESMP IMPLEMENTATION SCHEDULE AND REPORTING

423. A tentative Implementation of the ESMP schedule is provided in **Table 8-9**.

8.10.1.REPORTING

424. The environmental reports will contain results of air, noise, soil, sediment and water quality data, maps, diagrams, plans, tables, etc., related to environmental concerns with the project's associated activities. The following reports will be prepared and submitted by the Contractor and Engineer.

- Monthly Environmental Monitoring Report
- Semi-annual Environmental Monitoring Report
- Final Environmental Compliance Report after completion of the sub-project

425. **Monthly Environmental Monitoring Reports:** During the construction period, monthly environmental reporting will be required monthly, which will be prepared by the contractor based on the previous month project activities and upcoming activities of the following month. The monthly report will consist of completed environmental compliance checklist developed using the ESMP and approved by the PD/DPD/Engineer such that actions necessary for each relevant mitigative action are identified and a summary of all actions are recorded. In addition, the monthly Contractor's environmental checklist shall consist record of training conducted, received complaints and how resolved, accidents during the civil works if any. Contractors will submit their report to CSC for endorsement before submission to PIU.

426. **Semi-Annual Monitoring Reports:** The CSC will lead the preparation of Semi-Annual Report Environmental Monitoring Report to include details of all environment related activities together with a summary of all tests and monitoring activities, on-compliance issues and the assessment of effectiveness of current monitoring activities, possible changes in construction methodologies and any other thing(s) which may contribute to a reduction in environmental impacts. The PIU's Environmental Specialist or Safeguard consultant will review the Semi-Annual Environmental Monitoring Report based on the monthly and quarterly reports, and observations from the site visits, and submit to NSEZ _BEZA for submission to WB and DOE (if needed).

427. **Final Environmental Compliance Report after Completion of Sub-project:** The DSC will conduct a safeguard audit to check compliance with ESMP items and all environmental clauses in the contract, as well as to confirm that implementation of the corrective measures taken during any other non-compliance issues identified in entire the construction work. Based on audits, DSC, with inputs from the contractor and PIU, will prepare the final Environmental and Social Monitoring Report. This report must provide the evidence that the Project was completed in compliance with the safeguard requirements of WB-ESF and latest national ECR.

Table 8-9 : ESMP Implementation Schedule of the Sub-Project

	Task During Construction	ESMP Implementation Schedule																							
		Year 1												Year 2											
		Months																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Mobilization of the Contractor																								
2	Engagement of a Safeguard Team to look after Environmental and Social Safety and Risk Management issues of the Sub-Project																								
3	Ensure inclusion of Environmental and Social Safeguard Clauses in Tender Document																								
4	Environmental and Social Safeguards briefing and training of Contractors, relevant officers of PIU and BEZA by Safeguard consultants of PIU and CSC																								
5	Preparation of Construction Environmental and Social Management (CESMP) by the Contractor																								
6	Approval of (C-ESMP) of the Contractors by NSEZ-BEZA																								
7	Preparation and Approval of Environmental Monitoring Form/ Checklist																								
8	Implementation of Mitigation Measures according to C-ESMP by the contractor and monitoring by PIU Safeguard Consultants, Environmental and Social Councilors, and Safeguard Consultant of the Third Party																								
9	Tree Plantation Program																								
10	Capacity building of Workers and Project Personnel on Occupational Health and Safety and C-ESMP																								
11	Monthly Environmental Compliance monitoring and reporting by the Contractor																								
12	Quarterly Environmental Compliance Monitoring by Third Party Safeguard consultants																								
13	Semi-Annual Environmental and Social Compliance Reporting																								
14	Final Environmental and Social Compliance Reporting																								

9. CONCLUSION AND RECOMMENDATIONS

9.1. CONCLUSION

428. The NSEZ is the flagship Economic Zone development project of the BEZA that has been proposed to promote the local economy and to develop a linkage with national economic development by establishing appropriate industries in an enabling environment. As part of that initiative, the NSEZ has proposed a sub-project for the land development of part of Precinct F (IMD Zone and Housing Facilities) located in Mirsharai Upazila under Chattogram district. About 15.85 MCum of dredged material needed to be excavated from the Sandwip Channel for landfilling of 1560 acres of land in IMD (Zone 12 and 13), Zone 18, and Zone. The potential environmental and social impacts are anticipated to occur during the sub-project's intervention, such as pipe installation, dredging, and landfilling activities. The Cutter suction dredger is found to be more feasible than other dredgers for dredging the channel.

429. To assess the baseline conditions of these parameters during the ESIA study, air quality, noise level and vibration, surface water quality, groundwater quality, sediment quality, and soil quality samples were analyzed in the government-accredited laboratory. The results show the testing parameters of air quality and noise levels in the study areas within the standard limits outlined in the Noise Pollution Control Rules of 2006. Four surface water samples (L-5, L-7, L-8, and L-9) were collected from the Sandwip Channel, and three samples of groundwater at a level of 550 to 700 feet were also tested. The analyzed results complied with DoE standard limits. In addition, soil and sediment samples from four (04) locations of the Sandwip channel were analyzed, which exhibited the clay texture percentage varies from 22.87% to 43.64% silt texture varies from 38.32% to 53.91%, while sand texture varies from 2.46% to 33.94% etc. Analytical testing shown that all sediments were free from the toxicity of heavy metals Zn, Cd, Hg, Cu, Pd, which indicates the dredged material from these locations would have no adverse impacts on the landfilled area.

430. For selecting suitable dredging locations, an alternative analysis of 12 probable locations alongside the Sandwip channel was carried out to identify suitable dredging sources, where adverse impacts on the marine ecology will not be significantly a concern, and also other physical environmental factors. Analysis shows four (4) sites (L-05, L-07, L-08, and L-09) will be more suitable locations than the other eight (08) locations. Out of four (04) suitable locations, the location L-05 is observed as more viable than the other three locations.

431. The landfilling of the sub-project will affect the environmental features of the area. Lifting dredging materials from the channel bed and transporting them to the targeted area might hamper physical and ecological balance. The potential environmental and social impacts are anticipated to occur during different kinds of sub-project activities, such as pipe installation, dredging, and landfilling activities. During pipeline installation, dredging operation and landfilling activities, the most anticipated impacts are mainly noise generation from noisy equipment and dredger engines and other vehicles; air pollution due to exhaust gas emission from vehicles and dredgers; removal of vegetation due to landfill activities; impurities of surface water due to increased turbidity; oil spillage may find in the dredging and landfilling areas will lead to surface water pollution, groundwater contamination occurs by leachate generation, improper liquid waste management from labor camps, & working areas.

432. In addition, water logging and drainage congestion, climate change vulnerability, sedimentation, terrestrial flora and fauna (phytoplankton, zooplankton, benthic community, marine fish resources), labor influx, creating of job opportunity, traffic congestion by movement of equipment, vehicles, water vessels, waste generation from labor camps, landfilling sites and dredging operation sites, social conflict caused by labor influx, & lacks of proper consultation with the local people, GBV and SEA/SH risks etc.

433. Despite these impacts, the sub-project intervention will cause cumulative impacts such as deteriorating air quality, an increase in noise level, alteration of land use and landfilling, water and sedimentation, labor influx, occupational and community health, and safety, which will cause minor to substantial risk. However, it is likely that all these impacts are insignificant in the context of the implementation of the land development through adopting the mitigation and monitoring measures as highlighted in the ESMP and ESMoP of this ESIA study.

434. An ESMP for the sub-project was prepared as a comprehensive measure to offset the sub-project's adverse environmental and social impacts during construction activities like dredging operation, landfilling, dewatering, and compaction during the land development. This plan closely adheres to several Environmental and Social Standards (ESS) of the World Bank. The ESMP seeks to preserve environmental integrity, advance social well-being, and guarantee complete compliance with national laws and World Bank standards.

435. To address these risks, a set of mitigation measures are suggested through the ESMP. The probable sources of various types of waste throughout the dredging activities due to the land development will be from the labor camps, the generation of a variety of trash, including food waste, lubricating oil, waste oil, and others. During the dewatering and compaction processes, water logging may occur in and around the sites and endanger the local environmental

settings. So, it is important to control existing drainage, soil erosion, and water quality to protect natural water bodies and avoid drainage congestion, and providing cross dam, where necessary. The implementation of a comprehensive drainage management plan is crucial for dredging drain-out water and effective storm water and wastewater management, while also safeguarding the surrounding environment. Separate plans on the Waste Management Plan, Drainage Management Plan, and Dredging Management/ Land Development Plan have been prepared to focus on this sub-project and are documented in Appendices 2, 3, and 4, respectively, under **Volume II.**

436. To control soil erosion, silt fences, sediment basins/ traps to prevent sediment runoff into water bodies, and vegetation covers, and monitoring of the effectiveness of the control measures will be taken. Developing management plan for oil spills, to quickly address and mitigate impacts and regular checking of soil quality to detect any adverse effects from dewatering and compaction activities will also be applied. To reduce soil erosion while installing pipes, the proposal recommends placing supporting structures underneath pipelines, like bamboo sticks. Additionally, the plan places a strong emphasis on community involvement, cautious pipeline routing, and avoiding congested regions to prevent social disputes and traffic interruptions.

437. To safeguard marine and terrestrial biodiversity, the dredging operations need to avoid the adverse impacts on sensitive ecosystems, particularly the Hilsa breeding ground, and restrict the dredging operation during breeding seasons. Furthermore, dredging needs to be limited to reduce habitat loss. Nevertheless, no mitigation is required as the operation will for short period, and due to the dynamic nature of the channel-bed, the system will soon regain. Strict regulations are to be applied during landfilling and excavation to protect terrestrial and marine biodiversity, soil quality, and land stability. Establishing a minimum buffer zone around wetlands, mangrove and agricultural land at the outer edge of the ecosystem boundary where applicable to reduce disturbances and protect these ecosystems.

438. Disseminating information to the local population, limiting access to dredging sites, and hiring flagmen to oversee interactions between the sub-project and the community are ways to handle community safety, traffic management, etc. To lower health hazards and guarantee safety on the job, workers must wear PPE and closely follow an occupational health and safety plan. An OHSP in **Appendix 5** and ERDMP in **Appendix 6** and EEMGP in **Appendix 7** are documented in the **Volume II**.

439. With distinct indicators and techniques for evaluating adherence to social and environmental criteria, the monitoring component of the ESMP is extremely comprehensive. Site clearing, stakeholder involvement, air and noise pollution, water quality, waste management, and biodiversity preservation are some of these indicators. Periodic assessments are part of the monitoring process, and they include gathering information on the quality of the air and water, estimating noise levels, and keeping tabs on the production and disposal of waste. Along with emergency preparedness measures to guarantee prompt and efficient reactions to any disasters, the ESMP also includes extensive training programs to improve project workers' and local community members' comprehension and awareness of environmental and social issues. It is expected that the proper execution of the ESMP, including the ESMoP would lead to the project's successful conclusion with the least negative effects on the surrounding environment and communities. Furthermore, it is anticipated that the stringent monitoring and stakeholder engagement procedures would foster confidence in the local community, guaranteeing their active involvement and support for the sub-project. The ESMP will promote sustainable development by striking a balance between social responsibility, environmental preservation, and economic progress.

440. Before construction works begin, the Contractor will prepare the site-specific Construction Environmental and Social Management Plan (C-ESMP) according to the ESMP and ESMoP. The C-ESMP will include all management plans following ESMP in consistent with the site-specific identified impacts. For effective implementation of C-ESMP, it is essential to evaluate the contractor's overall performance independently in complying with the provisions of the ESMP, as well as for satisfactory compliance with the World Bank's E&S framework and DoE requirements. For capacity building, the contractors, workers, DSC, and Monitoring and Supervision Agency (PIU/PMC of PRIDE, NSEZ), will be trained in the implementation of ESMP, ESMoP.

441. Specifications on environmental and social issues shall be included in the BOQ/contract documents based on this ESIA. The tentative cost for implementing the ESMP of the sub-project during the construction phase will be about BDT 8.67 million for one year and BDT 14.52 million for second year. The major costs include about BDT 3.02 million and 5.24 million for managing environmental pollution for first and second year, respectively. The rest of the budget is for mitigation measures and training purposes for the workers/project staff at the site, etc.

442. The implementation of Land Development is expected to have some significant technical, economic, social, and environmental benefits as well as some negative effects. The negative effects can be reduced or managed after the implementation of mitigation and enhancement measures. To ensure minimum environmental and social impacts for the land development, sufficient effective measures during the construction period of dredging activities are recommended in the ESMP of this ESIA report in **Table 8-1,** and the ESMP in **Table 8-2**. It can be concluded that the sub-project will play a significant role in land development, which will bring national revenue from the diversified

industries, creating job opportunities by setting up state-of-the-art green resilience industries as sustainable in the long run.

9.2. RECOMMENDATIONS

443. A comprehensive Environmental and Social Management Plan (ESMP) has been recommended, along with mitigation measures, a monitoring plan, institutional responsibility, and associated monitoring budget and institutional responsibilities. Ensure that ESMP implementations by following suggestions.

- Ensuring ESMP for the land development activities is included in the contract document. Monitoring of the key environmental and social parameters as per ESMoP, including potential cumulative impacts, should be ensured. Ensuring ESMP shall be the supplementary bid/contract document with a sufficient budget for ESMP implementation
- The proposed landfilling of part of Precinct F (IMD Zone and Housing Facilities) of 1560 acres lands in the NSEZ by dredged material from the Sandwip Channel will cause adverse impacts on the surrounding drainage and flooding situation if the present natural canals/waterbodies of the sub-project area cannot remain unchanged or uninterrupted. In this regard, the drainage management plan, dredging management /land development plan during the construction phases should be followed as per the guidelines provided in the ESMP.
- Cross dam /sediment traps have also been suggested in the landfilling areas to protect canals from dredging spoils, erosion, flooding, and storm water discharge within the project area.
- It is recommended that the dredged material not to be excavated from two side-by-side locations at the same time. The Contractor should do dredging sequentially by one interval location. As a result, the immediate or short-term impact of this sequence of excavation of filling material would be minimum. The long-term impact is also not expected due to the channel being accretion-prone alongside the NSEZ, and the construction of the Super Dyke also protected the embankment of the Sandwip channel.
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Annexure- 1: Environmental and Social Screening Checklist

Land Development of Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ-BEZA

A risk rating screening checklist is used by the consultant to determine whether the sub-project will trigger the potential environmental and social impacts relevant to safeguarding ESSs of the World Bank ESF. The World Bank classifies any proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project as Low, Moderate, Substantial, and High impacts and risks. The magnitudes of different parameters of impacts have been determined by the WB's potential risk categories (High, Substantial, Moderate, and Low), considering the significance of the impacts having anticipated scores 0-25 Low, 26-50 Moderate, 51-75 Substantial and 76-100 High. The screening is carried out as follows

Name of sub-project	Land Development of Part of Precinct F (IMD Zone and Housing Facilities) of the NSEZ-BEZA
Location of sub-project	Mirsharai Upazila, Chattogram District
Owner of sub-project	NSEZ, BEZA
Department of sub-project	**Chief Advisor's Office, Dhaka**
Start and completion dates	

Environmental and Social Screening Checklist

Sl No	Screening Questions	Answers		Impact Scale: 1 -10) 1=Lowest Impact; 10=Highest Impact, 0=No Impact;	If yes, it will trigger the ESF of the World Bank	Remark. If yes, relevant documents shall be provided
		Yes	No			
A.	**Sub-project Sitting**					
1	Is the project impact area densely populated?		☐	0	ESS-1 Assessment and Management of Environmental and Social Risks and Impacts	Excluded from the sub-project scope.
2	Any development activities within the sub-project site?		☐	0		No need for a relevant study
3	Will there be any potential for transboundary, like river (frontier) impact?		☐	0		There are no potential transboundary rivers/channels, no need for a relevant study
4	Impact of the Sandwip channel connected to the Bay of Bengal on the sub-project area?		☐☐			The sub-project area is far away from the Bay of Bengal
5	Is the impact beyond the project area? Is the impact of project implementation beyond the scope of planning? Are these major negative environmental impacts irreversible?		☐	0		No impact anticipated
6	Disfiguration of the landscape by dredging and land development, such as sand fills and water draining out from dredging, fixing the dredging pipelines from the dredging sources to the land filling sites?	☐		9		Proper mitigation measures should be implemented as per ESMP
7	Alteration of surface water hydrology of waterways, resulting in increased dredging activities and soil erosion?		☐	0		

Sl No	Screening Questions	Answers		Impact Scale: 1 -10) 1=Lowest Impact; 10=Highest Impact, 0=No Impact;	If yes, it will trigger the ESF of the World Bank	Remark. If yes, relevant documents shall be provided
		Yes	No			
8	Critically Vulnerable Coastal Area. Sub-project area is located in the coastal plain land at Mirsharai Upazila in Chattogram district alongside the Sandwip channel and the eastern part of Feni district		☐			It is tidal and estuarine floodplain landscapes, but due to the construction of the Super Dyke embankment the sub-project areas is free from tidal flooding and coastal surge
9	Is the project site located on or adjacent to any of the following				☐	
9.1	Ecologically critical area		☐	0	ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	
9.2	Protected Area		☐	0		
9.3	Wetland		☐	0		
9.4	Mangrove		☐	0		
9,5	Estuarine		☐	0		
9.6	Buffer zone of the protected area		☐	0		
9.7	Area for protecting marine biodiversity due to the Dredging source in the Sandwip Channel	☐	☐	4		A detailed Marine Biodiversity baseline study is required at the dredging source locations
9.8	Critically Vulnerable to the marine ecosystem	☐		8		Dredging source in the Sandwip Channel, so an additional study on the marine ecosystem is required
9.9	Does the project involve changes or degradation of non-critical natural habitats?	☐		3		Minimum on the terrestrial flora and fauna, but no need for additional study
B	**Potential Social Impact**					
1	Does the proposed project have a Social impact? Please provide a brief description:	☐		6	ESS 2: Labor and Working Conditions•	Involvement of local workers and the influx of labor, occupational health, and safety hazards
2	Will the sub-project have a serious negative social impact? Are these impacts sensitive, diverse, or unprecedented?	☐	☐	6	ESS 4: Community Health and Safety;	Accidents due to the movement of vehicles, damage to local roads for dredging pipeline installation, Gender-based violence, etc.
3	Land Acquisition, Restrictions on Land Use?		☐	0	ESS 5: Land Acquisition, Restrictions on Land Use and	
4	Dislocation or involuntary resettlement of people		☐	0		

Sl No	Screening Questions	Answers		Impact Scale: 1 -10) 1=Lowest Impact; 10=Highest Impact, 0=No Impact;	If yes, it will trigger the ESF of the World Bank	Remark. If yes, relevant documents shall be provided
		Yes	No			
					Involuntary Resettlement;	
6	Will the project endanger cultural resources that are meaningful to the local community or town (such as the mosque, temple, church etc.)		☐	0	ESS 8: Cultural Heritage;	
12	Interference of construction due to traffic, increasing danger of accident or spill	☐		5	ESS 4: Community Health and Safety;	The contractor should follow the Traffic Management Plan, and spill control plan
C.	**Construction Phase/ Dredging activities impacts**					
1	Will the sub-project during the Construction Period lead to					
1.2	Alteration of surface water hydrology of waterways, resulting in increased dredging activities and soil erosion?		☐	0	☐	
1.3	Increased pollutant discharges into canals/streams, including oil and fuel wastes, and construction materials spilled into the waterway during dredging activities?	☐		8	ESS-3: Resource efficiency and pollution prevention and management	Construction Waste Material Spilled Preventive Plan should be implemented as per EMP
1.4	Deterioration of surface water quality due to silt runoff from dredging sand and sanitary wastes from worker-based camps, and chemicals used in construction?	☐		3		Proper Sanitation facilities should be considered at all workers' camps.
1.5	Sewage runoff from labor camps and the site project office due to direct discharge of sewage waste into surface water	☐		3		Insignificant impact, since direct discharge of sewage waste from the dredger into surface water
1.6	Increased local air pollution due to dust from dredging construction activities, including movement of construction vehicles and access roads?	☐		5		Temporary air pollution during the construction of rail embankments can be mitigated by sprinkling water in the dry season
1.7	Noise and vibration due to dredging activities and other civil works?	☐	☐	4		Noise attenuation measures should be considered during civil works as per ESMP
1.8	Impacts due to traffic, increasing danger of accident or spill	☐		5		The Traffic Management Plan and spill control plan should be followed by the contractor
1.9	Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?	☐		5		A Health Safety Plan should be implemented. Provision of solid waste disposal facilities, and communicable

Sl No	Screening Questions	Answers		Impact Scale: 1 -10) 1=Lowest Impact; 10=Highest Impact, 0=No Impact;	If yes, it will trigger the ESF of the World Bank	Remark. If yes, relevant documents shall be provided
		Yes	No			
						diseases (HIV) from workers to local people should be considered by adapting control measures at the site
	Total Score			**76**		
	Additional Comments: Most of the questions answered are 'Yes' with a weightage of 76 for the sub-project					
	According to the screening based on the WB-ESF, the sub-projects are deemed as Substantial Risk, and appropriate safeguard guarantee measures are required. An Environmental and Social Assessment (ESIA) is warranted to be undertaken					

https://documents1.worldbank.org/curated/en/471791594632799255/pdf/Appendix-1-Environmental-and-Social-Screening-Checklist.pd

Notes: Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts.